# Study on the Market Value of Fixed and Broadcasting Satellite Spectrum in Canada

## Final Report

**Nordicity**

Prepared for
**Industry Canada**

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# Executive Summary

The purpose of this assignment is to establish market-based valuation and fee-structure for Canadian satellite spectrum. Industry Canada (the “Department”) recognizes that the existing apparatus-based fee regime for satellite spectrum licensees is no longer adequate. The status quo, (i.e. continuing with the current fee structure) is not a realistic option for various reasons. The structure – originating in the 1970s and codified in 1978 – is based on the implicit value of a terrestrial voice telephony circuits. The last update to the fees was completed in 1994 and the fee levels are neither the equivalent of existing administrative costs nor the market value of the satellite spectrum governed by these licences. The basis for setting the licence fees was raised as an issue during the Department’s recent consultation on the revisions to the Framework for Spectrum Auctions.

The Department thus would like to move towards a transparent, equitable, market-based spectrum licensing regime and determine the applicability of corresponding revised fee structure going forward.

**Market valuation approaches**

In this study, the Consultant team estimate the value of satellite spectrum based on three different methodological approaches: (i) Income or Net Present Value, (ii) Market Comparables, and (iii) Optimal Deprival Value (ODV). The results of three approaches are compared against each other on the basis of data availability and integrity, the requirements and conditions of application of the financial models created for this valuation, and applicability to the satellite industry. We conclude that the Income Approach with support from the Market Comparables Approach offers the best way forward for establishing a new satellite spectrum fee structure for Canada.

We find that the ODV approach could not be applied to the satellite sector. The particular economic conditions of the satellite sector mean that the ODV model’s stringent conditions of application – identical price levels and service conditions - could not be met. While instructive in illustrating an alternative economic approach, its application is impractical. This impracticality is largely due to the absence of typical deprival events (contrary to the situation with terrestrial spectrum where this approach can be applied), and the complexity of the wholesaler–distributor relationship in the satellite value chain.

The fee levels generated by the three approaches are tested against current fee levels applied in eight other jurisdictions fee regimes (as mandated in the User Fees Act). We find that the fee levels applied in the eight countries to be lower than the values which would be generated by the application of the Income Approach and the Market Comparables Approach. This outcome is not surprising given the lack of market-based approaches in these jurisdictions. Finally, we find that by applying 50% of the calculated economic rent, the proposed fee levels would still be higher than current levels when standardized on a $/MHz basis.

**Fee structure recommendations**

In developing recommendations for the application of the proposed fee structure, we consider the following:

- data validity issues;
- sensitivity analysis based on the key variables and assumptions;
- Industry Canada and Government of Canada policy objectives – including national social and economic goals;
- industry issues and finally;
- financial impacts on individual operators.

We note the contribution of the satellite operators to national social and economic in particular, as the sole or secondary provider of broadband communications and broadcasting services in regional and remote areas. We note the contribution in employment arising from the roll out of new technology and services. We also note the inherent uncertainties in the calculation of economic value due to data availability and validation, in the development of assumptions and the selection of scenarios.

In setting the fee methodology and levels, the policy makers must also take into account both the contribution of operators to satellite coverage and availability of services goals and the uncertainties inherent in the development of the models. One way of recognizing this contribution would be to calculate satellite spectrum fees based on a portion of the economic rent rather than on the full economic rent associated with the spectrum. We believe a reasonable approach – to adjust for both contribution and uncertainties, would be to base the satellite fee structure on 40-70% of the economic value of the satellite spectrum, depending on the weight the Department puts on these factors. As an example, if one were to place the percentage of economic rent at 50% of the value generated by the Income Approach, the Department could set fees as follows:

- C-band spectrum: **$1,400 per MHz** per annum
- Ku-band spectrum: **$1,900 per MHz** per annum
- Ka-band spectrum: **$2,200 per MHz** per annum

Alternately one could make a case for C/Ku band spectrum, which carries the preponderance of broadcasting application spectrum, having a value in the range of **$1,650 per MHz per annum** and Ka set at **$2,200 per MHz per annum**.

We consider a band specific fee because of the impact of the technologies that drive new efficiencies across bands. However, because of typical multi-band configurations of new satellites, we recommend the same fee for all three bands. This single cross-band fee rate would be set between $1,400 per MHz and $2,200 per MHz. For example, the Department could use the midpoint, $1,800 per MHz. Alternatively, the Department could use a weighted average (weighted by the current amount of assigned spectrum). Based on the current assignments, the weighted average would be $1,900 per MHz**.** As well, this approach offers more administrative efficiencies than separate fees for separate bands. As well, for purposes of administrative efficiency and simplicity, we conclude that the fees should be applied on a $/MHz basis.

In the Income Approach fee analysis, we consider whether to recommend the setting of fees based on Canadian only coverage or North American coverage. We came to the conclusion that generally the true value of the spectrum in any particular orbital slot is based on North American coverage. Therefore, we recommend that the calculation of fees continue to be based on the full geographic market coverage. We recommend that Industry Canada pro-actively file only for services which include the Canadian market.

We would recommend that the question of fairness and equity in treatment of licensees across all terrestrial and satellite bands should be addressed by Industry Canada as it moves forward in its reviews all of its licence fees.

Given the magnitude of increase in fees under the recommended fee regime, we recommend that the new regime be implemented over a seven-year period with a graduated ramp up over that period. This approach would correspond with the similar period afforded to PCS operators.

Overall, the proposed fee structure meets the criteria for global best practices in fee design: it is based on a rigorous examination of the evidence, consideration of alternative methodologies, testing against fee levels in other jurisdictions and relative simplicity and efficiency in its application.

We also consider the arguments for and against IC pursuing orbital slots that are entirely outside the Canadian arc (section 8.2.4). We conclude the potential benefits to Canada in employment, technology development as well as potential lower costs of doing business which would be generated by satellite operators having these additional orbital slots would likely be highest for mid-Atlantic and mid-Pacific slots which have significant Canadian traffic. These slots are critical for operators to service international business (data, voice, video) of Canadian and international clients. The potential benefits are likely much less when orbital slots which have minimal Canadian as a percentage of total traffic (i.e., over Europe, Africa, and Asia). In both cases, there are potential spectrum management and coordination issues in partial and catastrophic failure scenarios which must be addressed. In the eventuality that the Department decides to proactively pursue new orbital slots outside the Canadian arc, we recommend that fees be based on full cost-recovery.

**Impact of potential new fee schedule**

We assess the impact of a scenario in which the Department sets satellite spectrum licence fees at a rate equal to 50% of the estimated economic rent associated with the spectrum. In particular, as part of our assessment, we calculate how the implementation of this licence fee scenario would affect the EBITDA of Telesat Canada.

According to Industry Canada, Telesat Canada currently remits $5.97 million, annually, in satellite licence fees, including spectrum licence fees and radio licence fees. We use this amount as the baseline amount in our impact analysis. Telesat Canada's current licence fees represent 0.8% of its total 2009 revenues of $727.8 million and 1.1% of its 2009 EBITDA of $559.8 million.

Under a scenario where the Department sets licence fees equal to 50% of the estimated economic rent, we estimate that the higher licence fee rates would increase Telesat Canada's annual licence fee remittances by $12.78 million to a total of $18.75 million. Telesat Canada's licence fees as a percentage of EBITDA would increase from 1.1% to 2.3%. Its EBITDA would drop to $546.7 million, and its EBITDA margin would drop from 71.1% to 69.5%. Overall, therefore, this licence fee scenario would cause Telesat Canada's annual satellite licence fee payments to the Department to more than triple, while causing its EBITDA margin to drop by nearly two percentage points.

Implementing the 50% of economic rent scenario would result in Canadian fee levels rising above those of all the countries benchmarked for this study. Most importantly the 50% economic rent fee scenario would be higher than Canada's major NAFTA commercial partners – both the US and Mexico (which currently has the highest fee levels see Table 53). It could be argued that the 50% economic rent fee scenario would have a relatively modest impact on satellite operators' EBITDA, and would not put Canadian operators at a competitive disadvantage vis-à-vis foreign operators. Thus, there would be little incentive for Canadian operators to register in another jurisdiction with lower fees.

However, satellite operators are increasing mobile and apatride – mirroring the global structure of the satellite market. We note that in July 2010, the Canadian government announced the elimination of ownership and control (O&C) restrictions on Canadian satellite services. This change effectively ends any remaining vestiges of Telesat's traditional role as a 'national operator'. While eligible foreign or domestic satellite operators would still be subject to licence conditions (in keeping with Canadian satellite use policy on coverage) in the Canadian assigned slots, the change might also effectively reduce the regulatory leverage to require access and encourage provision of modern satellite services (other than broadcasting) to Canadians. Thus, while the O&C lever has been eliminated, the challenge of ensuring access to satellite services remains.

Canadian satellite operators have underlined the importance of having a fee schedule in line with that of the US. Thus, the possibility that satellite operators might use the higher fee levels as the occasion to move functions and jobs out of the country and register in another jurisdiction – especially for the launch of future satellite services – cannot be discounted.

# 1 Background and Introduction

## 1.1 Context

Industry Canada hired Nordicity to analyze market values of satellite spectrum and to propose a potential new fee structure and levels in preparation and input to a consultative process on the fee structure and fee levels – expected for late 2010 or early 2011.

Continuation of the current fee structure is not a realistic option it is both out of date and not based on satellite value. The fee structure has it's origin in the 1970s and was codified in 1978. It is based on the implicit value of a terrestrial voice telephony circuits. The last update to the fees was completed in 1994 and the fee levels cannot be matched to existing administrative costs or spectrum market value.

## 1.2 Overview of research methodology

In undertaking this project, the Consulting team undertook primary and secondary research processes to capture and analyze key data sets and information on the satellite industry (see figure below).

Three different analytical approaches: Income Analysis, Optimal Deprival Valuation and Market Comparables were examined and the results were compared to each other with regards to data integrity, sensitivity of key assumptions, applicability in the Canadian and global context. The results of the three approaches were also tested against the results of an International Fee Benchmarking exercise – as mandated by the User Fees Act, for this study comparing the fee regimes and levels in eight countries. In developing recommendations for the Ministry, we considered Industry Canada and Government of Canada policy objectives – including social and economic contributions by the operators, industry issues and finally financial impacts on individual operators.

# 2 The Satellite Communications Market in Canada

## 2.1 Summary

Canada was one of the pioneers in developing and applying innovative satellite technology solutions as part of its overall communications strategy: this is largely a response to the challenges posed by vast distances, sparse population and extreme climatic events. In many regional and remote areas, satellite is the only means of providing communications and entertainment services and in many others, satellite provides a second or third service delivery platform thus ensuring choice and competitive pricing for consumers. With the advent of new compression technology (MPEG4 being the most recent) and spot beam technologies, satellite has become a viable alternative for broadband communications and media services for consumers in urban as well as rural areas across the country.

Canada has significant national satellite players, led by Telesat (and previous corporate incarnations) for 50 plus years.

The market has become highly concentrated with the top player Telesat (Loral Space and Communications Inc.) controlling 97% of the market, the next largest player CIEL (SES) 2% and the rest less than 1%. In the global market, a handful of large players: SES, Intelsat, Eutelsat, and Loral dominate the market. Interestingly, Loral is a relatively small player in the global market but dominant in the Canadian market. With such a highly concentrated market, some concern has been raised by satellite users regarding dominant market power.

Canadian satellite companies always take into account the North American potential market prior to building and launching any satellite into a Canadian orbital slot and generally design their satellites with North American coverage patterns. The Canadian Government (through Industry Canada) has given special attention to ensuring that these satellite operators provide anticipated services to Canadians; i.e. requiring Canadian satellite operators to canvas potential satellite users to determine Canadian needs before allowing the operators to provide capacity to foreign entities.

As indicated above, the previous independent national players have been purchased by the larger global players over the last decade, with consolidation driven by the economics of a global satellite market. The Canadian satellite market is relatively small in the global context and even for satellite licensed in Canada, a significant portion of revenues are generated outside its boundaries – mainly in the US.

# 3 International Benchmarking of Spectrum Licence Fees

## 3.1 International comparison

Benchmarking international jurisdictions provides insight into satellite spectrum licensing fees, as well as the regimes through which the fees are set. As well, Canadian regulatory authorities are required to examine the licensing processes and fees in other jurisdictions. Specifically, the 2004 User Fees Act[1] states:

> *Before a regulating authority fixes, increases, expands the application of or increases the duration of a user fee, it must…*
>
> *(f) establish standards which are comparable to those established by other countries with which a comparison is relevant and against which the performance of the regulating authority can be measured."*

The 2008 May Report of the Auditor General[2] provides additional direction regarding licence fees. It states (emphasis added):

> *1.2 There are two categories of fees. The first category includes fees for goods, services, or the use of a facility; examples include the amount charged for a government publication (good), the charge for inspection services (service), and the cost to enter a federal park (use of a facility). For these fees, the amount charged is normally intended to recover all or part of the cost to the government (not only the organization concerned) of providing that good, service, or use of a facility.*
>
> *1.3 The second category of fees includes those for rights or privileges, which mainly include authorization to use publicly owned or managed resources. Examples include a licence to fish commercially or to operate a business on federal property. The amount charged for these fees has normally not been related to costs but rather to the* ***market value*** *of the right or privilege, which can be* ***determined by looking at equivalent fees or proxies*** *(domestic or international) or by assessing a fee's potential value. The objective for these fees is to earn a fair return for Canadians from the rights or privileges granted by the government on behalf of all Canadians.*

This chapter presents the findings, analysis and comparison of the satellite spectrum fees charged in the following eight jurisdictions: **Australia**; **New Zealand**; **United Kingdom**; **United States**; **Mexico**; **Brazil**; **Luxembourg**; and **France**.

In terrestrial wireless spectrum, there tends to be several current and/or potential service providers and spectrum licenses are often contested (i.e. demand exceeds supply); the spectrum is typically licensed using a market value process (i.e. spectrum auctions).[3] In contrast, in satellite, the number of current/potential operators in any one jurisdiction tends to be much lower as the capital requirements are greater than for terrestrial wireless and historically, satellite spectrum has been licensed via administrative process – comparative review or first come, first serve.

Satellite spectrum fees are generally calculated to recover the regulator's costs of administration or to provide incentives for efficient use. The regimes used to set these satellite services fees tend to be constant through time, sometimes remaining the same – except for slight rate increases to account for inflation – for decades. Therefore benchmarking satellite fees generally requires only examining the fee

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[1] *User Fees Act*, paragraph 4(f).

[2] *2008 May Report of the Auditor General of Canada, Chapter 1 – Management of Fees in Selected Departments and Agencies*, Government Fees, paragraphs 1.1 and 1.2.

[3] We note however, that a significant amount of the spectrum used for commercial purposes (VHF, UHF bands land mobile spectrum etc) is still licensed first-come-first-serve.

regime and fee calculation formula of each jurisdiction. Benchmarking terrestrial wireless spectrum fees, on the other hand, often involves profiling specific licences within the broad context of how and when they were acquired – to account for external market conditions that would impact prices.

Although examining satellite fees is a more straight forward process because the fees within a jurisdiction are often the same for all licensees, the variance in fee regimes used globally makes direct comparisons between jurisdictions difficult. In fact, no two of the studied jurisdictions use the same satellite spectrum licensing and fee-setting regime. Depending on the jurisdiction, principal fees are applied to space stations, earth stations, orbital slots, or transmission and reception. Also, only three jurisdictions (Australia, the UK and Brazil[4]) factor the amount (bandwidth) and type (frequency) of spectrum used into their fee-setting calculation. Identifying the annual per-MHz satellite spectrum fee for these jurisdictions is thus more straight forward and accurate, but estimating an average annual licence fee is very subjective due to the differences in the fee-driving variables that exist from one licensee to another. Converting per-satellite or per-orbital slot annual licence fees from other jurisdictions to per-MHz fees is similarly arbitrary.

Therefore, due to the variety of global licence fee regimes, jurisdictional fees can only be compared indirectly. The variety of the global satellite services fee regimes also reduces applicability to Canada. This chapter compares satellite spectrum licence fees on an average annual basis as well as on a per-MHz basis, but some figures within both comparisons are subject to assumptions and averages necessary to display some level of comparability. The chapter begins with a comparison of the fee regimes and fees across all of the examined jurisdictions, followed by a profile of the regime and fees for each individual jurisdiction.

## 3.2 Policy and process

### 3.2.1 Policies

Satellite licence fees are largely dictated by the fee policy of the licensing jurisdiction. There are three common fee policies:

1. **Cost recovery –** fees are used to recover any number of regulators' costs, ranging from the direct expenses of processing and reviewing licence applications to indirect costs of spectrum management and other regulatory activities.
2. **Incentive pricing –** fees are set higher than what is necessary to recover regulatory costs with the aim of promoting efficient spectrum use by licensees.
3. **Market pricing –** fees are directly related to the market value of spectrum, apparatus or orbital slot being licensed.

As the fourth column in the table below illustrates, all three of these fee policies are used by national regulators. However, each of the policy positions are employed to varying degrees, resulting in different fee schedules. For instance, the cost recovery portion of satellite services licences in Australia and New Zealand cover only the direct administrative costs of processing and certifying licence applications. On the other hand, the Federal Communications Commission in the US uses all regulatory fees, including satellite service licences, to recover the FCC operational costs that are not covered by the commission's annual government funding.

Incentive pricing schemes also differ depending on their purpose. Australia's regime blends cost recovery and incentive pricing by applying "annual taxes that aim to recover the indirect costs of spectrum

[4] Bandwidth used to provide capacity in Brazil is one variable in Brazilian regulator Anatel's calculation of fees for foreign satellites.

management and provide incentives for efficient spectrum use."[5] Ofcom's earth station fees were adjusted in 2009 to reflect full incentive pricing, but the adjustment was based on altering part of the existing fee-setting algorithm. Generally, incentive pricing is somewhat of an arbitrary process in that it is not based solely on the cost of regulation or on market value, and is set to "promote particular aspects of efficient use."[6]

To date, only two jurisdictions – Brazil and Mexico – have used a market pricing regime to set satellite service licence fees (other than BSS[7]), and in both instances the licences were issued via auction. Brazil is also the only jurisdiction charging licence fees on space stations serving the Brazilian territory that are already licensed by another jurisdiction (see column 6 in Table 1 below.) Finally, no jurisdiction has set market-based prices for satellite service licences using an administrative process.

**Table 1 Satellite services licensing: policies and processes**

| Country | Licensing Body | Type | Fee Policy | Process | Foreign Satellites?* | Spectrum Based?** |
|---|---|---|---|---|---|---|
| **Canada** | Industry Canada | Satellite, earth stations | Ministerial authority /Regulations | Comparative review | No | Yes |
| **Australia** | ACMA | Apparatus licence | Cost recovery/ Incentive pricing | FCFS† | Yes†† | Yes |
| **New Zealand** | Ministry of Economic Development | Earth station transmission & receive protection | Cost recovery | FCFS | No | No |
| **UK** | Ofcom | Earth station transmission | Incentive pricing | FCFS | Yes††† | Yes |
| | UK Space Agency | Space station | None | FCFS | No | No |
| **US** | Federal Communications Commission | Space stations, earth stations | Cost recovery | FCFS | No | No |
| **Mexico** | Cofetel | Orbital slot | Market pricing | Auction | No | No |
| **Brazil** | Anatel | Satellite exploitation rights | Market pricing | Auction/ FCFS | Yes | Yes |
| **Luxembourg** | ILR - Institut Luxembourgeois de Régulation | Satellite | Incentive pricing: co-investment/co-risk with single licensee. Some cost recovery | FCFS | No | No |
| **France** | ANFR Agence nationale des frequences | Satellite, earth stations | Cost recovery | FCFS & Comparative Review | Yes | Yes |

Source: Nordicity research
Notes:
* Does the jurisdiction charge fees on satellite spectrum – directly or de facto – licensed by other jurisdictions?
** Is the amount of and type of spectrum used part of a fee-setting equation?
† FCFS – First-come, first-serve
†† Australia only charges fees on earth stations operated by operators that do not have an Australian satellite licence. Therefore, 'earth' and 'earth receive' licensees that transmit to or receive from a foreign-licensed satellite are subject to fees.
††† UK earth station licence fees are based on transmission, not reception, but the same licence fees do apply to earth stations that transmit to a foreign-licensed satellite.

[5] Australian Communications and Media Authority (2010) Apparatus licence fee schedule, 5 April 2010.
[6] Ofcom, Wireless Telegraphy Act Licensing Policy Manual: A practical user guide to licensing policy, January 2007.
[7] In 1996 the FCC auctioned BSS licences to MCI Telecommunications Corp. and Echostar. See Table 25.

### 3.2.2 Processes

Global satellite services regulators employ a variety of licensing processes, including what is actually being licensed, how a licence is obtained and how the fee is set. To begin, as the third column in the table above illustrates, virtually every jurisdiction licenses a different aspect of satellite services. Licences include earth stations and space stations, earth station transmission, earth station transmission protection, orbital slots and satellite exploitation rights. In the unique case of the UK, one regulatory agency, Ofcom, issues licences for earth station transmission, while another, the UK Space Agency, issues licences for space stations.

Virtually no jurisdiction directly licences satellite spectrum. Rather, spectrum is considered a part of the service being licensed (i.e. space station and orbital slot licences include the spectrum available within the orbital slot). While some jurisdictions include the amount and/or type of spectrum being used within their fee calculation formula (column seven above), the licence is still not directly considered a ‘spectrum licence.’ As well, the jurisdictions that include the spectrum as part of their fee calculation tend to charge ‘per-use’ fees – that is they calculate fees for an activity like earth station transmission or reception and only include the spectrum being used within the fee calculation. Therefore, satellite services licences and fees differ greatly from those for terrestrial wireless, which are almost exclusively based on available spectrum.

With the exception of Brazil and Mexico, regulators proffer satellite services licences on a first-come-first-serve basis (column five). As well, only Brazil directly licenses foreign satellite services; foreign satellite licensees must obtain a local representative in Brazil and their fee for operating in the country is calculated based on variables including the licence period and spectrum bandwidth. The UK and Australia also, de facto, charge fees on foreign satellites through their earth station regimes. The UK’s principal satellite services fee is based on earth station transmission, and includes transmission to UK- and foreign-licensed satellites. Australia charges for earth station reception, and therefore would include the reception of signals from foreign satellites.

In the US, the FCC auctioned DBS spectrum in 1996, but has refrained from doing so since.

Overall, there is no clear pattern established globally regarding the satellite services licence fee policies and processes. Generally, jurisdictions that charge a substantial fee for space stations do not charge a fee of any significance for earth stations, and vice versa. Beyond that, fee regimes and fee calculations vary greatly.

Presently, only two jurisdictions (Mexico and Brazil) use market pricing to set satellite services licence fees, and in both cases fees are set through auctions. No jurisdiction has undertaken to set market-based fees using a non-auction, or administrative, process.

## 3.3 Application fees and direct administrative charges

In addition to their licence fees, some regulators charge application fees and other administrative-specific charges to directly cover administrative costs such as filing and engineering certifications. The application and administrative fees charged by the various jurisdictions range from per hour issue charge rates to substantial one-time application fees. The US for instance, charges as much or more to apply for a space station licence than it does for the annual licence itself.

Direct administrative charges and application fees, where applicable, are described below, per jurisdiction. [Fees in Canadian dollars are provided in square brackets; see Appendix A for currency exchange rates used throughout this report].[8]

[8] All dollar amounts presented in this report (denoted by $) are in Canadian currency unless indicated otherwise.

### *Australia*[9]

The Australia Communications and Media Authority's administrative charge consists of an hourly issue charge, which covers the direct cost of issuing the licence, the major component of which is the frequency assignment task. For assigned licences there is a renewal charge payable for each spectrum access. If the licensee has a multi-year licence and chooses to pay by annual instalment, there is an instalment charge for each chargeable spectrum access.

- Current administrative charges (as at April 2010 ) are:
- issue charge – A$164 [$147] per hour, with a minimum charge of A$82 [$74].
- renewal/instalment charge – A$3 [$2.70].

### *New Zealand*

New Zealand's Ministry of Economic Development's Radio Spectrum Management Group (RSM) administers satellite licensing arrangements. New licences, or modifications to existing licences, incur an Engineering Certification Fee. The certification can be performed by either the RSM or by an Approved Radio Engineer or Approved Radio Certifier. The Engineering Certification Fees charged by the RSM are:

- Fixed satellite service – NZ$600 [$432] per transponder accessed.
- Other satellite services (non-shared with fixed services) – NZ$300 [$216] per transponder accessed.
- Other satellite services (shared with fixed services) – NZ$600 [$432] per transponder accessed.

### *United Kingdom*

Of the two UK regulatory agencies that issue satellite services licences, only the UK Space Agency charges an application fee. Currently:

- The only required fee to obtain a licence from the UK space agency is a one-time, non-refundable fee of £6,500 [$11,573] to cover application costs.

### *United States*

In addition to its annual licence fees, the FCC, by comparison to other jurisdictions, charges relatively high one-time application fees:

- GSO, Launch & Operate Application, US$115,990 [$132,461]
- NGSO, Launch & Operate Application, US$399,455 [$456,178]
- Earth Station, Authorization Application, US$9,330 [$10,655]

### *Brazil*

In addition to auction fees, Anatel charges all transmitting stations an annual fee called TFF. In Anatel's regulations, a space station in the FSS or in the MSS services is considered to be a transmitting station.

- For the first year the annual payment is R$26,816 [$15,387].
- In years following the first year the annual payment is R$13,408.00 [$7,694].

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[9] Australian Communications and Media Authority (2010) Apparatus licence fee schedule, 5 April 2010.

#### *France*

ARCEP charges a one-time space station application fee charge of €20,000 [$31,710].

## 3.4 Apparatus fees

Due to the variety of satellite services licence fee regimes employed globally, licence fees are best compared two different ways: comparison of apparatus (earth station) fees; and satellite fees. Apparatus fees per jurisdiction, where applicable, are described below (full profiles of licence fee regimes in all profiled jurisdictions are in Section 3.7). The descriptions are followed by a comparison table based on some necessary assumptions and adjustments, including conversion to Canadian dollar values.

#### *Australia*

The AMCA charges annual taxes on apparatus licences that are calculated based on normalization, bandwidth parameters, power parameters, location weighting and adjustment factors. At the highest level, which assumes nationwide coverage, per-MHz satellite spectrum fees are:

- C-band: A$1944.20
- Ku-band: A$856.70
- Ka-band: A$233.60

#### *New Zealand*

New Zealand earth station licensees are charged NZ$300 annually per earth station for a transmission licence and to receive protection rights.

#### *United Kingdom*

In the UK, Ofcom uses a fee-setting algorithm to calculate the licence fees for each earth station site, which includes “the area contained within a circle of radius of 500m centred on a point defined by the licensee.” Permanent Earth Station fees are the principal satellite-based licence fees in the UK. Because the algorithm is based on four variables – band factor, number of transmit paths, bandwidth, and transmit power – the fees vary greatly, from less than £500 to more than £15,000.

#### *United States*

The FCC in the US charges US$230 annually for earth station licences.

#### *France*

In France, ARCEP sets the licence fees for ground stations based on cost recovery of its administrative costs.

- a €20,000 licence fee for ground station(s) operated by telecommunications operators.[10]
- A management fee for costs related to spectrum management which varies according to the number of ground station assignments and whether fixed or mobile satellite service.
- A frequency availability fee which varies according to the number of assignments and whether fixed or mobile satellite service.

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[10] ‘Frais applicables au spectre par satellite en France’ ARCEP Document received July 28, 2010

*Luxembourg*

In Luxembourg, the Institut luxembourgoeois de Regulation (ILR) applies an annual administrative fee of €305 per ground station site. According to the ILR, all administrative fees are set according to cost recovery.[11] In the case of SES, administrative fees are superseded by fees calculated on overall corporate profitability.

### 3.4.1 Apparatus fees comparison

In the table below, apparatus licence fees from the studied jurisdictions are compared against each other on both an average annual basis, and indicating a cost per-MHz where possible.

In order to establish some level of comparability, the following assumptions/adjustments were made:

- For the UK, annual licence fees were calculated using the actual bandwidth and transmit power parameters from Canadian earth stations transmitting within the appropriate frequency bands. Canadian earth stations utilizing similar bandwidth and transmit power were selected for comparability.[12]
- For Australia, which commonly charges licence fees for earth station transmission or reception based on spectrum type and bandwidth only, an average of 25 MHz was used across the three relevant frequency bands. Australian rates below are additionally based on nation-wide coverage as rates are scaled based on operational parameters.
- For Canada, the earth station fee is based on the mean of the earth station licence fee range of $122 per year to approximately $1,000 per year, based on Industry Canada's Fee Schedule Applicable to Radiocommunication Users for Fixed Stations that Communicate with other Fixed Stations or Space Stations.

All fees below have been converted to Canadian dollars. All fixed fees in the table below are represented in black font, while all fees calculated using one of the above assumptions are displayed in red font.

**Table 2 Apparatus licence fees**

| Country | Licence | Band | Bandwidth | Annual Fee | $/MHz/Year |
|---|---|---|---|---|---|
| **Canada** | Earth station | n/a | n/a | ***$561*** | n/a |
| **Australia** | Apparatus* | C | 25 MHz | ***$43,594*** | $1,744 |
| | | Ku | 25 MHz | ***$19,209*** | $768 |
| | | Ka | 25 MHz | ***$5,238*** | $210 |
| **New Zealand** | Earth station | n/a | n/a | $216 | n/a |
| **UK** | Earth station | C (<5 GHz) | 27 MHz | ***$28,819*** | ***$961*** |
| | | C (5-10 GHz) | 23.8 MHz | ***$21,869*** | ***$737*** |
| | | Ku (10-16 GHz) | 23.5 MHz | ***$10,284*** | ***$438*** |
| | | Ku (16-24 GHz) | 29.65 MHz | ***$7,244*** | ***$304*** |
| | | Ka (>24 GHz) | 30 MHz | ***$6,614*** | ***$246*** |
| **US** | Earth station | n/a | n/a | $274 | n/a |
| **France** | Earth Station | n/a | n/a | $31,710 | n/a |
| **Luxembourg** | | n/a | n/a | $484 | n/a |

Source: Nordicity research
* Fees cover: Space, space receive, earth and earth receive.
See Appendix A for currency exchange rates
Note: Figures in bold italic are estimates based on the assumptions discussed above the table.

[11] Decision 06/103/ILR du 15 decembre, 2006 "les taxes administrative auxquelles les enterprises notifies sont asujetties en vertu de l'article 10 de la loi du 30 mai 2005 sur les reseaux et les services de communications electroniques, couvrent exclusivement les couts admisitratifs globaux, qui sont occassiones annuellement par la gestion, le control et l'application du regime d'autorisation generale, des droits d'utilisation et des obligations spécifiques des enterprises.

[12] Technical details of the Canadian earth stations sampled is provided in Section 3.7.3.

It is clear that earth station licence fees vary greatly – from a low of $216 in New Zealand to as much as $43,000 in Australia – depending on the intent of the fee. However, when examining only the two jurisdictions that apply incentive pricing for spectrum use in earth station transmission as their principal satellite services licence fee – the UK and Australia – the fees are not that different when using some common earth station parameters. Knowing that, the fees charged by Ofcom in the UK and the ACMA in Australia are based on the amount of spectrum being transmitted by an apparatus, thus these fees themselves can vary greatly. In fact, Ofcom sets a minimum limit of £500 for earth stations whose fees calculated using the fee algorithm are less than that, indicating that it is possible for earth station fees to be much lower than presented above.

The UK and Australia results, however, do suggest that C-band spectrum fees are, on average, the highest, followed by Ku-band spectrum and, finally, Ka-band spectrum. In the case of Australia, which publishes direct per-kHz spectrum taxes, C-band spectrum fees are more than twice as high as Ku-band fees, and more than eight times as high as Ka-band fees. In the UK, when using similar bandwidth and transmit power parameters across all the bands, the highest-valued C-band spectrum fees are nearly four times higher than Ka-band fees.

As well, the UK fees were calculated using the bandwidth and transmit power parameters from actual Canadian earth stations, to provide real world examples. The actual earth stations are located in Summer Beaver Ontario, Bellevue Ontario, Montreal, Toronto and Vancouver, and are licensed to Bell Aliant, MTS Allstream, Bell ExpressVu and two to Telesat. Although these are Canadian earth stations, the situation in the UK would be similar in that the fees paid for spectrum use would be borne directly by a variety of users, including telecommunications companies and satellite television providers. In jurisdictions that de facto charge for spectrum through space station fees, such as the US, ground station fees are minimal – US$230 per year. In terms of earth station fees, Canada's regime is more similar to that of the US. In Canada, earth station licence fees can range from roughly $122 per year to approximately $1,000 per year.[13]

## 3.5 Satellite fees

Satellite licence (space station or orbital slot) fees per jurisdiction, where applicable, are described below. The descriptions are followed by a comparison table based on some necessary assumptions and adjustments, including conversion to Canadian dollar values.

***United Kingdom***

Space station fees in the UK are issued by the UK Space Agency. Although the Agency doesn't charge a licence fee, current requirements mandate licensees must carry a £100 million third-party liability insurance policy. The annual premiums to carry such a policy are approximately £100,000,[14] resulting in a de facto annual licence fee for space stations.

***United States***

The FCC charged the following annual space station fees in 2010:

- Geostationary Space Stations: US$127,925
- Non-geostationary Space Stations: US$138,050

[13] Industry Canada, RIC-42, *Guide for Calculating Radio Licence Fees*, http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf01027.html
[14] Source: Atrium Space Insurance Consortium.

Unlike Canadian satellite licence fees, which are only charged on operational satellites, US fees are collected annually as soon as a licence has been issued.

To incent satellite licensees to build and launch satellites within an appropriate time frame, the FCC mandates licences post $3-$5 million performance bonds within 30 days of licence grant ($3 million for GSO space stations and $5 million for NGSO space stations). The bonds are posted for 3 to 5 year terms as appropriate, and the cost of capital associated with posting the bonds is therefore a de facto licence fee. Using the weighted average cost of capital (WACC) of 9% calculated in Section 4.3.4, the cost of posting a US$3 million bond for three years is approximately US$885,087.

***Brazil***

Brazilian regulator, Anatel, issues both Brazilian and Foreign satellite exploration rights. Brazilian rights are issued though auctions, usually providing licence terms of 15 years. Fees for foreign-licensed satellites operating in Brazil are calculated based on bandwidth, term and other variables. A recent eight-year foreign licence was granted by Anatel for R$952,932.69, As well, foreign licensees pay an annual fee of R$13,408.

***Mexico***

In Mexico, Cofetel (Comisión Federal de Telecomunicaciones) and SCT (Secretaría de Comunicaciones y Transportes) cooperate to issue satellite licences through auctions.

***Luxembourg***

In Luxembourg, the Institut luxembourgoeois de Regulation (ILR) sets administrative fees according to cost recovery.[15] In the case of SES the national communications enterprise, administrative fees are superseded by fees calculated on overall corporate profitability.

### 3.5.1 Satellite fees comparison

As with comparing apparatus fees, a satellite fee – space stations or orbital slots – comparison also requires assumptions and adjustments, particularly to put the fees on a per-MHz basis.

Therefore, in order to establish some level of comparability, the following assumptions and/or adjustments were made:

- For Brazil, annual licence fees were calculated by dividing the average auction amount for the three orbital slots acquired in 2007 by the number of years in the licence term and the average amount of a spectrum available to the auction winners.
- For Canada, the average annual satellite fee is based on the fee for a common hybrid C/Ku configuration with a Radio licence – variable fee. Canadian band rates are based on average fees of $350,000 and $450,000[16] for licensees that have access to 1000 MHz of C-band and Ku-band spectrum respectively[17]– based on radio fees for 24 C-band channels and 32 Ku-band channels.

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[15]Source: Decision 06/103/ILR du 15 decembre, 2006 “les taxes administrative auxquelles les enterprises notifies sont asujetties en vertu de l’article 10 de la loi du 30 mai 2005 sur les reseaux et les services de communications electroniques, couvrent exclusivement les couts admisitratifs globaux, qui sont occassiones annuellement par la gestion, le control et l’application du regime d’autorisation generale, des droits d’utilisation et des obligations spécifiques des enterprises.

[16] Source: Industry Canada.

[17] Throughout the report, we calculate the total amount of licensed satellite spectrum as the sum of the uplink and downlink spectrum, inclusive of any guard-band spectrum. In the case of Canada’s C and Ku-band spectrum, this typically entails 500 MHz uplink plus 500 MHz downlink for a total of 1,000 MHz of licensed spectrum each.

- Annual space station/orbital slot/satellite regulatory and/or insurance fees for the US and UK were divided by an average of 2000 MHz of available spectrum, which represents a common hybrid C-band/ Ku-band satellite configuration. Brazilian auction results were divided by the amount of spectrum available in the licences auctioned.
- US fees include WACC of posting performance bonds (US$3 million for GSO satellites, US$5 million for NGSO satellites) for three years.
- Annual orbital slot fee for Mexico was divided by the 1,000 MHz capacity of the satellite licensed in 2005.
- Annual fees for non-auctioned licences (auctioned licences include a licence term) are calculated based on an 18-year life cycle to provide comparability between jurisdictions that charge fees immediately following licence grant and those that only charge operational satellites.

All fees below have been converted to Canadian dollars. All fixed fees in the table below are represented in black font, while all fees calculated using one of the above assumptions are displayed in red font.

**Table 3 Satellite licence fees**

| Country | Licence | Band | Bandwidth | Annual Fee (Canadian $) | $/MHz/Year (Canadian $) |
|---|---|---|---|---|---|
| **Canada** | Satellite | C/Ku | 2,000 MHz | $666,667 | $333 |
| | | C | 1,000 MHz | $291,667 | $292 |
| | | Ku | 1,000 MHz | $375,000 | $375 |
| **UK** | Space station | n/a | **2,000 MHz** | $148,367* | **$74** |
| **US** | GSO space station | n/a | **2,000 MHz** | **$242,693** | **$121** |
| | NGSO space station | n/a | **2,000 MHz** | **$301,491** | **$151** |
| **Mexico** | Orbital Slot | n/a | 1,000 MHz | $850,680 | $850 |
| **Brazil** | Brazil Satellite | n/a | **1,820 MHz** | **$135,228** | **$74** |
| | Foreign Satellite | n/a | **2,000 MHz** | **$73,061** | **$37** |

Source: Nordicity research
See Appendix A for currency exchange rates
* Based on approximate annual premium on mandatory £100 million liability insurance policy.

Although international satellite fees are based on a variety of policy regimes, annual satellite licence fees are surprisingly similar. For instance, the only fee paid by UK space station licensees is a mandated insurance premium, while US licensees contribute to the recovery of FCC costs and Brazilian licences were awarded through an auction, yet the annual fees for these three jurisdictions all fall in the $130,000 to $300,000 range.

It is a general rule globally that jurisdictions charging a substantial fee for space stations do not charge a fee of any significance for earth stations, and vice versa. The only anomaly on this front is the UK, which levies fees on earth stations and also requires space station licensees to "insure themselves (currently to £100million) against third party liabilities arising from each licensed activity (i.e. the launch and in-orbit phases of the mission)." The annual premiums to carry such a policy are approximately £100,000,[18] resulting in a de facto annual licence fee for space stations in addition to Ofcom's earth station transmission fees.

Unfortunately, comparing global satellite services fees on a per-MHz basis is a somewhat arbitrary process in that it requires multiple assumptions to generate comparable figures. That such assumptions and adjustments are necessary only serves to underscore the fact that global regulators do not generally license satellite services based on the spectrum being used, and do not charge based on the economic value of the spectrum. That the majority of regulators do not charge fees based on spectrum also makes it more difficult to establish common price differentiation between the various bands.

[18] Source: Atrium Space Insurance Consortium.

Overall, the fact that the majority of satellite services licence fees are cost recovery or incentive based is evident from the table above. With the exception of the Mexican auction results, all fees are less than $300,000 per year, which is a minimal in the context of satellite services costs and revenues. By comparison, Rogers Communications spent nearly $1 billion airing terrestrial wireless spectrum in Industry Canada's 2008 AWS auction. Divided over a ten-year term, the spectrum fee amounts to roughly $100 million per year.

## 3.6 Total annual fees

A third method of benchmarking national satellite regimes is by comparing the total quantum of fees from all sources (satellite, apparatus and administrative) fees they collect in an average year. Total annual fees provide some indication of the scope of a jurisdiction's licensing regime. However, the comparability of total fees collected is limited. Due to the varying nature of fee regimes (cost recovery or incentive pricing) and even the differences between the fee amounts charged by two agencies using the same fee policy – such as cost recovery – it is difficult to infer much from the comparisons. The table below provides the full quantum of direct satellite licence fees[19] in the most recently reported year, by jurisdiction where available.

**Table 4 Total annual satellite fees collected by national regulatory agencies**

| Jurisdiction/NRA | Year | Total Fees ($ Canadian) |
|---|---|---|
| Canada/Industry Canada | 2009 | $7,400,000 |
| Australia/ACMA | 2009 | $4,036,050 |
| New Zealand/ Ministry of Economic Development | 2009 | $85,669 |
| US/FCC | 2010 | $14,642,467 |
| UK/Ofcom | 2009-10 | $2,338,581 |

The great variety of fee regimes and policies results in equally varied values of total annual licence fees collected. At one end, New Zealand's Ministry of Economic Development collects roughly $85,000 per year, more than 170 times less than the total annual fees collected by the FCC. Through its earth station and radio/spectrum licensing, Industry Canada collects a relatively high $7.4 million per year, roughly half of that collected by the FCC.

## 3.7 Benchmarking assessment

For consistency across the entire scope of this fee valuation study, the various methodologies employed are assessed across the same evaluation criteria, which are:

- Data availability;
- Simplicity;
- Transparency; and
- Applicability.

This section assesses the benchmarking process under each of these evaluation criteria.

### 3.7.1 Data availability

[19] Including all earth station, space station and direct administrative fees, but not application fees.

By and large, data on international satellite services licence fees is widely available from the applicable national regulatory agencies. Where apparatus-based licence fees are used and are common for all licensees, as with the case of the United States, identifying fees charged for space and earth stations is very straightforward. Similarly, in the case of Australia where a spectrum-based fee schedule is used, the per-MHz fees for the various spectrum bands are evident.

UK data was available only to the extent that Ofcom publishes its Permanent Earth Station fee calculation algorithm. However, Ofcom was unable to provide a complete list of all licensees and their operating parameters, which could have been used to calculate the average fees paid per-MHz spectrum type. In the absence of this data, Canadian earth station parameters were applied to the Ofcom algorithm to develop real life examples of UK earth station fees.

Similar to the UK, complete spectrum availability and spectrum use figures, by spectrum type, for space stations licensed by the FCC in the US, and the orbital slots acquired through auction in Brazil and Mexico, were not available. Full spectrum availability figures would have provided the ability to calculate more accurate per-MHz values. For example, because the FCC uses apparatus fees, instances of two satellites co-locating in the same orbital slot would result in a de facto higher licence fee per-MHz Therefore, full spectrum availability and use numbers for the 87 geostationary satellites licensed by the FCC could have been used to more accurately determine per-MHz fee equivalents, particularly by band. However, that the FCC charges apparatus fees on a cost-recovery basis only means any per-MHz equivalent, no matter how accurately estimated, would still have very limited applicability in a market value study.

### 3.7.2 Simplicity and transparency

Benchmarking satellite services licence fees from global jurisdictions is both simple and transparent. All assumptions and adjustments necessary for the sake of comparability are fully disclosed and their rationale explained. While global regulators may update or alter their satellite services licence fees on an annual or semi-annual basis, accessing the updated fee schedules is a simple process that can be applied to future valuation processes. Similarly, any interested parties could undertake to access the currently available data from the national regulators to duplicate the results of this section.

### 3.7.3 Applicability

Benchmarking global satellite services licence fees has limited applicability in the context of informing a market valuation of satellite spectrum in Canada. To begin, no jurisdiction has yet set market-value satellite apparatus or spectrum fees using an administrative process. Those jurisdictions that have attempted to extract the market value of satellite spectrum have thus far only done so via auctions.

Most jurisdictions currently seek only to recover their administrative costs through licence fees, but cost-recovery fees are very jurisdictionally specific and dependent on what costs are to be recovered and to which licences will the majority of costs be applied. Cost recovery fees do not differentiate between the various spectrum bands.

The two jurisdictions that do consider spectrum types and use in setting fees – UK and Australia – do so to establish fees that provide an incentive for efficient spectrum use, but do not attempt to extract the full market value of the spectrum. Examining fees from the UK and Australia reveals that C-band spectrum is subject to the highest fees, followed by Ku and then Ka. The Australia spectrum fee table and calculations using the UK earth station fee algorithm results in the following incentive pricing values:

- C-band: $700-$1,700 per-MHz;
- Ku-band: $300-$750 per-MHz;
- Ka-band: $210-$250 per-MHz.

Finally, while the applicability of satellite services licence fee benchmarking is limited, it does establish the lack of consistency among all regulators worldwide. In terms of fee application (apparatus, orbital slot, space station, earth station, spectrum) and policy (cost-recovery, incentive pricing, and market pricing), no two jurisdictions are identical. However, within the variety of licence fee regimes some patterns emerge, namely the spectrum band pricing identified in the bullets above, and the general $100,000 to $300,000 per year fees applied to space stations and/or orbital slot licences.

## 3.8 Jurisdictional profiles

This section presents detailed profiles of the satellite services licence fees and regimes currently in place in the eight profiled jurisdictions.

### 3.8.1 Australia

The **Australian Communications and Media Authority** (ACMA) issues licences for satellite services under four apparatus licence categories:

- space
- space receive
- earth
- earth receive.

If the satellite operator has a space or space receive apparatus licence, terrestrial receivers or transmitters are then covered by class licences. There are no fees associated with class licences. Apparatus licences may be issued for a period of up to five years.

There are two types of fees applicable to apparatus licences: administrative charges to recover the direct costs of spectrum management, and annual taxes that aim to recover the indirect costs of spectrum management and provide incentives for efficient spectrum use. Indirect costs are those that cannot be directly attributed to individual licensees. These activities include international coordination and domestic planning and interference management.

The administrative charge consists of an hourly issue charge, which covers the direct cost of issuing the licence, the major component of which is the frequency assignment task. For assigned licences there is a renewal charge payable for each spectrum access. If the licensee has a multi-year licence and chooses to pay by annual instalment, there is an instalment charge for each chargeable spectrum access.

Current administrative charges (as at April 2010[20]) are:

- issue charge – A$164 per hour, with a minimum charge of A$82
- renewal/instalment charge – A$3.

The annual taxes for apparatus licences are calculated as the product of the following parameters:[21]

- normalization – conversion factor to express the result of the tax formula into a dollar figure, and updated every year with the Consumer Price Index (CPI) to keep taxes constant in real terms.
- bandwidth parameter – taxes vary according to the bandwidth within which a service operates
- power parameter – there is a reduced tax for low power spectrum accesses

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[20] Australian Communications and Media Authority (2010) Apparatus licence fee schedule, 5 April 2010. Note that all fees quoted exclude value-added tax.
[21] *Ibid*.

- location weighting – reflects the density of services and demand for spectrum at different frequencies and geographic areas, with higher taxes in areas with greater density and demand
- adjustment factor – this allows for other parameters not elsewhere included within the tax formula.

The ACMA publishes a reference table which combines most of these factors – licensees need only look up the relevant price per kHz and multiply it by the spectrum bandwidth and the low power factor (if applicable). Co-ordinates of the various geographic areas across Australia are provided to determine the appropriate location weighting to be used. There is a minimum tax of A$33.86. As a reference point, the C-, Ku- and Ka-bands are commonly classified under the following frequencies:

- C: 4-8 GHz
- Ku: 12-18 GHz
- Ka: 27-40 GHz

The relevant bands are highlighted in the table below.

**Table 5 Annual licence tax, April 2010 (A$ per kHz)**

| Spectrum Location | Australia Wide | High Density | Medium Density | Low Density | Remote Density |
|---|---|---|---|---|---|
| 0 to 30MHz | 0.9962 | 0.9962 | 0.9962 | 0.9962 | 0.9962 |
| >30 to 70MHz | 2.2504 | 0.8789 | 0.4675 | 0.1009 | 0.0504 |
| >70 to 399.9MHz | 2.3087 | 0.9475 | 0.4336 | 0.0972 | 0.0485 |
| >399.9 to 960MHz | 2.3087 | 1.2929 | 0.5915 | 0.1009 | 0.0504 |
| >960 to 2690MHz | 2.3053 | 0.5174 | 0.2392 | 0.1203 | 0.0600 |
| >2.69 to 5.0GHz | 2.3028 | 0.4278 | 0.1734 | 0.1436 | 0.0718 |
| >5.0 to 8.5GHz | 1.9442 | 0.3594 | 0.1674 | 0.0762 | 0.0369 |
| >8.5 to 14.5GHz | 0.8567 | 0.3084 | 0.0730 | 0.0053 | 0.0025 |
| >14.5 to 31.3GHz | 0.8567 | 0.2281 | 0.0501 | 0.0053 | 0.0025 |
| >31.3 to 51.4GHz | 0.2336 | 0.1244 | 0.0270 | 0.0010 | 0.0004 |
| >51.4GHz | 0.0231 | 0.0023 | 0.0023 | 0.0002 | 0.0002 |

Source: ACMA

The annual tax is reduced by 75% where CDMA technology is used for a space licence in the 2483.5–2500 MHz band or a space receive licence in the 1610–1626.5 MHz band.

There is an exception to the above: the space and space receive licence for a non-geostationary orbit (NGSO) satellite operating in a frequency band above 8.5GHz. In this instance, the fees are:

- issue charge – A$164 per hour with a minimum charge of A$82
- renewal/instalment charge – A$3 for each spectrum access
- annual licence tax – A$242 per MHz.

***Other fee experience***

In October 2001 FOXTEL (an Australian pay-TV company) was the only applicant for an auction of two five-year space apparatus licences, one located at 152°E and the other at 164°E. Each licence was for 21 downlink channels (each of 27 MHz) in the 11.7–12.2 GHz frequency band, in accordance with the BSS Plan. The uplink channels were not included. As there was only a single applicant, the auction was not held. The spectrum authority offered one licence (at 152°E) to FOXTEL at the reserve price of one million Australian dollars. Renewal of the licence after five years was conditional upon bringing a satellite into operation within the first five years; however the licence expired in May 2007 and was not renewed.

### 3.8.2 New Zealand

In New Zealand, the **Ministry of Economic Development** (MED) is responsible for policy advice on spectrum issues and licensing arrangements, the latter being administered by the **Radio Spectrum Management** (RSM) group within the MED.

Satellite operators are not charged for coverage of New Zealand territory. In the case of spectrum managed by the Crown (that is, not sold to private owners), licences are issued for earth station transmission and receive protection rights. These licences incur an annual fee (NZD300) to cover only administrative costs.

Licensees also have the option of managing their own interference investigation – this requires the licensee to accept full responsibility (including costs) for investigating any interference during the licence period. This option will provide a discount of 10% on the annual fee.

New licences, or modifications to existing licences, will incur an Engineering Certification Fee. The certification can be performed by either by RSM or by an Approved Radio Engineer or Approved Radio Certifier. The Engineering Certification Fees charged by RSM are:

- fixed satellite service – NZ$600 per transponder accessed
- other satellite services (non-shared with fixed services) – NZ$300 per transponder accessed
- other satellite services (shared with fixed services) – NZ$600 per transponder accessed.

The current spectrum licence fees were set in 2008, and are based on the costs of providing services. There are currently no plans to change to a market-based approach for pricing in the short- to medium-term.

### 3.8.3 United Kingdom

Licences for satellite services in the UK are issued by two bodies:

1. **Ofcom** issues licences for satellite (permanent earth stations); and
2. The **UK Space Agency** issues licences for space activities.

***Satellite (Permanent Earth Stations) – Ofcom***

Ofcom is authorized to distribute Radio Spectrum licences at a fee under the directive of the Wireless Telegraphy Act 2006. The fixed satellite service frequency band permits space radio communication services and links to geostationary and non-geostationary satellite networks. Ofcom licenses Satellite Permanent Earth Stations operating in the UK in frequency bands designated for the Fixed Satellite Service and assigned for Earth-to-Space transmission.[22] A Permanent Earth Station can only operate from the one known, fixed, terrestrial UK location that has been specified in the application or previously supplied to Ofcom. Specifically, Permanent Earth Station licences are granted for each specific site, which is the area contained within a circle of a radius of 500 metres centred on a point defined by the licensee.

Fees for Satellite (Permanent Earth Station) licences are calculated according to the spectrum and bandwidth being accessed, and the aggregate power supplied to the antenna. Under this Licensing arrangement, earth stations that are closely located can benefit from a reduction in fees as a result of the

[22] Ofcom, *Licensing Procedures Manual For Satellite (Permanent Earth Station) Applications*, Nov. 2009.

reduction in total coordination area. For each site (the area contained within a circle of radius of 500m centred on a point defined by the licensee), the appropriate sum is calculated in accordance with the algorithm below.[23]

$$AS = \sum_{bands}\left[28 \times BF_{band} \times \sqrt{\sum_{paths_{band}}\left(P_{path} \times BW_{path}\right)}\right]$$

Where:

- *AS*: means the appropriate annual sum in pounds sterling;
- *Bands*: mean the numbers listed in Column 1 of the table below, corresponding to the range of frequency band listed in Column 2 of that table which are authorized by the licence;
- $BF_{band}$: means the band factor applying to each band, being the number in Column 4 of the table below corresponding to the band listed in Column 1 of the same table;
- $Paths_{band}$: means the set of those transmission paths authorized by the licence for which the authorized transmission frequency lies within the frequency range of each band as set out in Column 2 of the table below;
- $P_{path}$: means the authorized peak transmit power (in Watts) at the flange of the antenna of the earth station for each transmission path (which shall not exceed those limits specified in Radio Regulations RR 22.26-22.39 in bands where these limits are applied);
- $BW_{path}$: means the authorized transmit bandwidth (in MHz) for each transmission path; and
- Transmission path: means a combination of a satellite earth station transmitter, a satellite receiver, a transmission frequency, and polarisation for which transmissions are authorised by the licence.

The following table provides the current band factors (column 4) for input into the algorithm above. Column 3 has been added to indicate the most relevant bands (Ka, Ku, C) for the purposes of this project for each of the frequency bands covered in the UK pricing formula.

**Table 6 Ofcom Permanent Earth Station Licence Fee Band Factors**

| Band | Range of frequency band (GHz) | Band Name | Band Factor |
|---|---|---|---|
| 1 | < 5 | C | 2.33 |
| 2 | 5 – 10 | C | 1.72 |
| 3 | 10 – 16 | Ku | 1.00 |
| 4 | 16 – 24 | Ku | 0.70 |
| 5 | > 24 | Ka | 0.60 |

Source: Ofcom

Ofcom amended these band factors in 2007 to produce licence fees that would reflect full administrative incentive pricing. This new fee regime was phased in over a two year period. In 2008, Permanent Earth Station Licensees were charged 50% of the new fee value, and in 2009 they were charged the full 100%.[24] The band factor increases are illustrated in the table below, showing the previous band factors and the current band factors, which are also expressed above.

[23] *Ibid*.
[24] Source: Ofcom, *Modifications to Spectrum Pricing*, January 2007.

**Table 7 Ofcom Permanent Earth Station Band Factor increase**

| Band | Previous (2007) Band Factors | Current (2009) Band Factors |
|---|---|---|
| 1 | 1.54 | 2.33 |
| 2 | 1.23 | 1.72 |
| 3 | 0.87 | 1.00 |
| 4 | 0.70 | 0.70 |
| 5 | 0.60 | 0.60 |

Source: Ofcom

UK earth station licence fees vary greatly because of the variable nature of the fee algorithm. The authorized peak transmit power is supplied to Ofcom by the Permanent Earth Station licence applicant. The actual value is dependent on the applicant's requirements. Providing it passes Ofcom's coordination process (i.e. doesn't interfere with other users of spectrum), typical values could be anywhere between about 10 watts and 3,000 watts – depending on the service quality or data rate required by the applicant.

The same principle is applied to the authorized transmit bandwidth value, which, therefore, also varies greatly. Typical values could be anywhere from a few kHz to several hundred MHz. In addition to this, a single permanent earth station could have several transmit paths, each of which would be factored into the calculation of its fee.

Because of the potential fee range due to the variables that could be inputted into Ofcom's algorithm, annual licence fees below were calculated using the actual bandwidth and transmit power parameters from Canadian earth stations transmitting within each of Ofcom's five defined Bands. The five Canadian earth stations listed below utilize similar bandwidth and transmit power and were thus selected for comparability.

**Table 8 Canadian fixed earth station parameters**

| Band | Frequency | Bandwidth | Power (dbW) | Location | Company |
|---|---|---|---|---|---|
| C | 4180 | 30 MHz | 2052 | Summer Beaver ON | Bell Aliant |
| C | 5945 | 29.65 MHz | 2194 | Bellevue ON | MTS Allstream |
| Ku | 14411 | 23.5 MHz | 1811 | Montreal | Telesat |
| Ku | 17411 | 23.8 MHz | 1811 | Toronto | Bell ExpressVu |
| Ka | 28382 | 27 MHz | 1811 | Vancouver | Telesat |

Source: *Industry Canada, Spectrum Direct*

The table below applies the parameters of the above-listed Canadian earth stations to Ofcom's fee algorithm, providing high-level estimates of annual licence fees for permanent earth stations in the UK by band. The fee is displayed in Pounds Sterling (£).

**Table 9 Ofcom Permanent Earth Station fee calculation using Canadian earth station parameters**

| Band | Spectrum | Frequency (GHz) | Band Factor | Power (dbW) | MHz | Cost/Year (£) | Cost/MHz/Year (£) |
|---|---|---|---|---|---|---|---|
| 1 | C | 4.18 | 2.33 | 2052 | 30 | 16,187 | 540 |
| 2 | C | 5.945 | 1.72 | 2194 | 29.65 | 12,283 | 414 |
| 3 | Ku | 14.411 | 1.00 | 1811 | 23.5 | 5,776 | 246 |
| 4 | Ku | 17.411 | 0.70 | 1811 | 23.8 | 4,069 | 171 |
| 5 | Ka | 28.382 | 0.60 | 1811 | 27 | 3,715 | 138 |

Source: Ofcom

Inputting common transmit power and bandwidth parameters for all spectrum types into the Ofcom algorithm reveals that licence fees for transmitting over C-band spectrum in the range of less than 5 GHz are nearly four times greater than those for Ka spectrum.

#### *Space Activities - UK Space Agency*[25]

Satellite licensees in the UK need to acquire a licence from the UK Space Agency to launch a space object.

The Outer Space Act 1986 (the Act) is the legal basis for the regulation of activities in outer space carried out by organisations or individuals established in the United Kingdom or one of its Overseas Territories (OTs) or Crown Dependencies (CDs).

The Act confers licensing and other powers on the Secretary of State for Business, Innovation and Skills, who carries these powers out through the UK Space Agency. The Act seeks to ensure compliance with the UK's obligations under international treaties and principles covering the use of outer space, including liability for damage caused by space objects, the registration of objects launched into outer space and the principles for the remote sensing of the Earth.

The Outer Space Act 1986 applies to United Kingdom nationals (as defined in the Act), Scottish firms, and bodies incorporated under the law of any part of the United Kingdom, the Bailiwick of Guernsey, the Bailiwick of Jersey, or the Isle of Man carrying out the following activities in the United Kingdom or elsewhere:

- launching or procuring the launch of a space object;
- operating a space object;
- any activity in outer space.

The following activities do not require a licence:

- the leasing of space segment satellite capacity (transponders) from international inter-governmental satellite organizations or privately owned entities for use by the lessee or by a person sub-letting the capacity;
- the utilization of space segment capacity (transponders) using earth stations for either transmission or reception purposes.

Obligations for UK Satellite Permanent Earth Station licensees are listed below.

- It is an offence for a person to whom the Act applies to carry on a licensable activity without a valid licence.
- Under section 10 of the Act, all persons to whom the Act applies (whether licensed or not) must indemnify the UK Government against any claims for damage or loss arising out of licensable activities.
- UK Space Agency standard insurance requirement is that licensees must insure themselves (currently to £100million) against third party liabilities arising from each licensed activity (i.e. the launch and in-orbit phases of the mission). The UK Government must be named as an additional insured party and in the case of applications from companies in the Overseas Territories and Crown Dependencies, the relevant territorial Government should also be named.
- Additional conditions may be imposed, depending on the circumstances of each application.

The third licence requirement listed above mandates licensees carry a minimum £100 million insurance policy against third-party liability. In other jurisdictions third party liability insurance is not required.

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[25] UK Space Agency, *REVISED GUIDANCE FOR APPLICANTS OUTER SPACE ACT 1986*

Therefore the annual premium as a required cost to UK space object licensees should be considered a de facto licence fee.

The only actual required fee to obtain a licence from the UK space agency is a one-time, non-refundable fee of £6,500 to cover application costs.

However, the annual premium on the £100 million mandated insurance policy mentioned above is approximately 0.1% of the coverage amount, or £100,000, and therefore represents the only annual licence fee for UK satellite licences.

### 3.8.4 United States[26]

Satellite licences in the US are issued by the **Federal Communications Commission** as Geostationary (GSO) and Non-Geostationary (NGSO) satellite space station licences. US licensees also pay an additional licence fee for Fixed Earth Stations.

Section 9 regulatory fees are mandated by Congress and are collected to recover the regulatory costs associated with the Commission's enforcement, policy and rulemaking, user information, and international activities.

The annual regulatory fee amount to be collected is established each year in the Commission's Annual Appropriations Act which is adopted by Congress and signed by the President and which funds the Commission. For 2010 that annual amount is $335,794,000.

Each fiscal year, the Commission proportionally allocates the total amount that must be collected via Section 9 regulatory fees. To collect the $335,794,000 required by Congress, the FCC adjusted the FY 2009 amount downward by 1.8 percent and allocated this amount across the various fee categories. Consistent with past practice, it then divided the FY 2010 amount by the number of estimated payment units in each fee category to determine the unit fee. As in prior years, for cases involving small fees, e.g., licences that are renewed over a multiyear term, the FCC divided the resulting unit fee by the term of the licence and then rounded these unit fees consistent with the requirements of section 9(b)(2) of the Act.

The table below lists the 2010 Revenue requirements and the number of payment units and the 2010 licence fees for GSOs, NGSOs and Earth Stations.

**Table 10 FCC satellite licence fees, 2010**

| Licence Type | Payment Units | 2010 Revenue Requirement (US$) | 2010 Licence Fee (US$) |
|---|---:|---:|---:|
| Geostationary Space Stations | 87 | 11,130,522 | 127,925 |
| Non-Geostationary Space Stations | 6 | 828,238 | 138,050 |
| Earth Stations | 3,600 | 868,038 | 240 |

Source: FCC, Notice of Proposed Rulemaking: Assessment and Collection of Regulatory Fees for Fiscal Year 2010.

In addition to its annual licence fees, the FCC charges one-time application fees. These fees are listed in the table below by licence type.

**Table 11 FCC satellite licence application fees**

| Licence Type | Fee Type | Fee (US$) |
|---|---|---:|
| GSO | Launch & Operate Application | $115,990 |
| NGSO | Launch & Operate Application | $399,455 |
| Earth Station | Authorization Application | $9,330 |

Source: FCC, Notice of Proposed Rulemaking: Assessment and Collection of Regulatory Fees for Fiscal Year 2010.

[26] FCC, *Notice of Proposed Rulemaking: Assessment and Collection of Regulatory Fees for Fiscal Year 2010*.

To incent satellite licensees to build and launch satellites within an appropriate time frame, the FCC mandates licences post $3-$5 million performance bonds within 30 days of licence grant ($3 million for GSO space stations and $5 million for NGSO space stations).[27] The bonds are posted for 3 to 5 year terms as appropriate, and the cost of capital associated with posting the bonds is therefore a de facto licence fee. Using the weighted average cost of capital (WACC) of 9% calculated in Section 4.3.4, the cost of posting a US$3 million bond for three years is approximately US$885,087.

### 3.8.5 Mexico

Cofetel (**Comisión Federal de Telecomunicaciones**) and SCT (**Secretaría de Comunicaciones y Transportes**) are the two Mexican government entities that control satellite communications in Mexico. In addition, CFC (**Comisión Federal de Competencia**), the competition authority, has jurisdiction over approving bidders in Mexico's spectrum auctions. Cofetel performs technical and market studies to recommend that orbital slots and associated frequency bands be auctioned, and SCT gives its approval. Cofetel then proceeds to conduct an auction.

The concessions that have been issued for the development of satellite services using orbital slots assigned to Mexico are listed in the table below.

**Table 12 Mexican satellite orbital slot licences**

| Concessionaire | Date | Term (Years) | Band | Orbital Slot | Coverage |
|---|---|---|---|---|---|
| Satélites Mexicanos, S.A. de C.V. | 1997 | 20 | C, Ku | 109.2° W | National |
| Satélites Mexicanos, S.A. de C.V. | 1997 | 20 | C, Ku | 113.0° W | National |
| Satélites Mexicanos, S.A. de C.V. | 1997 | 20 | C, Ku | 116.8° W | Continental |
| QuetzSat, S. de R.L. de C.V. | 2005 | 20 | C, Ku | 77° W | National, USA |

Source: Cofetel

The most recent information on fees comes from the latest concession. Late in 2004, QuetzSat, S.R.L. de C.V., a Mexican entity created to bid in Cofetel's auction, won rights to develop the orbital slot at 77° W, and the concession was issued in 2005. QuetzSat is a joint venture between SES, a Luxembourg company, which owns 49 percent of the company, and Grupo Medcom of Mexico. QuetzSat's payment to Mexico's Treasury was MXP 153 million, or about USD$ 14 million using exchange rates prevalent at that time.

Concessions to use frequency bands have been issued for variable terms ranging from 10 to 20 years. The fees for frequency use are determined in the Federal Law for Frequency Rights (Ley Federal de Derechos). This law contains schedules that detail the specific payments to be made according to the services required to be done. It is a cost recovery basis, insomuch that the various schedules describe the fees for the different studies and inspections that Cofetel would need to perform associated with an operator's use of frequency bands.

In addition, there is a government-owned satellite operator, Telecomm, which offers services mostly to government entities, but also to the private sector to a lesser extent.

### 3.8.6 Brazil

Anatel (**Agência Nacional de Telecomunicações**), the Brazilian telecoms regulator, administers the licensing of satellites and their associated services in Brazil. The provision of space capacity is offered by entities possessing Satellite Exploitation Rights for either Brazilian or foreign satellites for the

[27] Source: http://www.fcc.gov/Daily_Releases/Daily_Business/2010/db0603/FCC-10-100A1.txt, Part III, paragraph 16.

transportation of telecommunication signals. Resolution 220/2000 adopted a regulation that provides for the conditions to confer the Satellite Exploitation Right.

The satellite operator, whether Brazilian or foreign, can only provide the space capacity to the entity that holds a concession, permit or authorization to provide telecommunications services or to the armed forces.

There are two kinds of satellite exploitation rights that Anatel issues: Brazilian Satellite Exploitation Right, and Foreign Satellite Exploitation Right. The Brazilian licence includes the assignment of an orbital slot. Both licences include the use of radio frequencies for the control and monitoring of the satellite as well as for the telecommunications being transmitted.

Current Brazilian satellite exploitation right licence holders are listed in the table below.

**Table 13 Brazilian satellite exploitation right licence holders**

| Satellite Operator | Satellite | Band | Orbital Slot |
|---|---|---|---|
| HISPAMAR SATÉLITES S.A. | AMAZONAS-1 | C, Ku | 61,0° W |
| | AMAZONAS-2 | | |
| TELESAT BRASIL CAPACIDADE DE SATÉLITES LTDA. | ESTRELA DO SUL | Ku | 63,0° W |
| | ESTRELA DO SUL 2 | Ku | 63,0° W |
| STAR ONE S.A. | BRASILSAT-B1<br>BRASILSAT-B2<br>BRASILSAT-B3<br>BRASILSAT-B4 | C, X<br>C, X<br>C<br>C | 68,0° W<br>92,0° W<br>75,0° W<br>84,0° W |
| | STAR ONE C1 | C, X, Ku | 65,0° W |
| | STAR ONE C2 | C, X, Ku | 70,0° W |
| | STAR ONE C3 | C, Ku | 75,0° W |
| | STAR ONE C4 | C, L, S | |

Source: Anatel

Brazilian Satellite Exploitation Rights licences are awarded through an auction process. The most recent auction series started in 2006, awarded licences for three new satellites in three sequential auctions, and concluded in November of 2007. The results were:

- Star One won the first licence with an offer of R$ 6.1 million.
- Star One also won the second licence with an offer of R$ 3 million.
- Loral Skynet do Brasil won the third licence with a bid of R$ 1.938 million.

These licences have a term of 15 years and are renewable.

However, although the process used in all instances was an auction, the auction results in some cases did not result in market-based values. For example, the licence won by Loral Skynet for R$1.938 million was actually for extended KU-band capacity in a slot previously won at auction by Loral Skynet. Although the spectrum was put to auction, Loral was effectively the only interested party and therefore won by bidding the reserve price.

Holders of Foreign Satellite Exploitation Rights licences must have a local representative in Brazil. Over 30 such licences have been issued. The operators are listed in table 15.

**Table 14 Foreign satellite exploitation right licence holders in Brazil**

| Satellite Operator | Satellite(s) Operated |
|---|---|
| EMPRESA BRASILEIRA DE TELECOMUNICAÇÕES - EMBRATEL | INMARSAT – 3 AOR EAST |

| Satellite Operator | Satellite(s) Operated |
|---|---|
| | INMARSAT – 3 AOR WEST-2 |
| VIZADA S.A.S | INMARSAT – 3 AOR EAST<br>INMARSAT – 3 AOR WEST-2<br>INMARSAT –4 F2 |
| MORSVIAZSPUTNIK | INMARSAT – 3 AOR EAST<br>INMARSAT – 3 AOR WEST-2<br>INMARSAT –4 F2 |
| STRATOS WIRELESS, INC | INMARSAT – 3 AOR EAST<br>INMARSAT – 3 AOR WEST-2<br>INMARSAT –4 F2 |
| TELENOR SATELLITE SERVICES AS | INMARSAT – 3 AOR EAST<br>INMARSAT – 3 AOR WEST-2 |
| VIZADA A.S | INMARSAT –4 F2 |
| TELECOM ITALIA S.p.A | INMARSAT – 3 AOR EAST<br>INMARSAT – 3 AOR WEST-2<br>INMARSAT –4 F2 |
| XANTIC BV | INMARSAT – 3 AOR EAST<br>INMARSAT – 3 AOR WEST-2<br>INMARSAT –4 F2 |
| EUTELSAT S/A | ATLANTIC BIRD 1<br>ATLANTIC BIRD 2<br>ATLANTIC BIRD 3<br>W2A |
| HISPASAT S/A | HISPASAT – 1C<br>HISPASAT – 1D<br>AMAZONAS 2 |
| INTELSAT LLC | IS 10-02<br>IS-805<br>IS-901<br>IS-903<br>IS-905<br>IS-907 |
| INTELSAT NORTH AMERICA LLC. | GALAXY 28 |
| SKYNET SATELLITE CORPORATION | TELSTAR 12 |
| NEW SKIES SATELLITES B.V. | NSS-806<br>NSS-7 |
| PANAMSAT LICENSEE CORPORATION | IS-1R<br>IS-3R<br>GALAXY 3C<br>IS-11 |
| PANAMSAT CORPORATION | IS-9 |
| SATÉLITES MEXICANOS S/A | SATMEX 5<br>SATMEX 6 |
| SES AMERICOM INC. | AMC – 4<br>AMC–12 |
| TELESAT CANADA | ANIK F1 |

Source: Anatel
http://www.anatel.gov.br/Portal/verificaDocumentos/documentoVersionado.asp?numeroPublicacao=240825&documentoPath=240825.pdf&Pub=&URL=/Portal/verificaDocumentos/documento.asp

Foreign licensees pay a set fee that is calculated based on the number of years of the licence being requested and the number of transponders to be used. For example, the fee charged to Telesat Canada for ANIK F1 for an eight year term was R$ 952,932.69 in November 2007.
The formula for the fee is as follows:

$$V = Pref \times (Be/Bref) \times (te/tref)$$

Where:

- V: means value, in Brazilian Reals, to be paid as the published price for a Foreign Satellite Exploitation Right and for use of associated radio frequencies referenced in the provision of space capacity for Brazil
- Pref: means minimum price calculated for the Brazilian satellite exploitation right and use of the associated radio frequencies, set at the last awarding of such rights by public notice where there is a published price set by Anatel (currently R$1,570,000.00)
- Be: means the sum of the bandwidth, in MHz, to be used by the foreign satellite for providing capacity in Brazil, in multiples of half a transponder
- Bref: means 1872 MHz, sum of the bandwidth of the transponders of a reference satellite
- te: time, in years, corresponding to the term of the foreign satellite exploitation right and use of the associated radio frequencies, adopting, for fractional periods of validity, the next highest whole value;
- tref: means 15 years.

Furthermore, there is an annual fee of R$13,408.00 charged for each operating satellite.

### 3.8.7 Luxembourg

ILR, the **Institut Luxembourgeois de Régulation** licences satellite spectrum and sets satellite spectrum licence fees (‘redevances de concession’) and administrative taxes (‘certaines taxes administratives concernant la gestion du spectre radioélectrique’).

Satellite licensing in Luxembourg has been on a first come-first serve basis and been dominated entirely by SES la Société Européene des Satellites SA - headquartered in Luxembourg, since its first licence was granted in 1988.

The fee structure (‘cahier des charges’) was designed as part of an industrial strategy on the part of the Government. The fee structure varies according to the pre-tax earnings of SES - the licensee, generated from its satellite licence. The fee structure is based on escalating fees levels corresponding to three categories or levels of earnings: an initial fee-exempt category, a base level fee and a higher fee level. The fee structure was designed as a state-firm co-risk structure which allowed SES to be largely fee exempt in its initial capital intensive, low margin years and subsequently in a progressive fashion, allow the state to participate in increasing levels of profitability through base and higher fee levels. As the first fee exempt category is designed to allow SES to earn a ‘normal’ rate of return on capital invested, this threshold for the second level varies according to yearly average rate of return for industrial firms. This co-risk model has been largely successful for Luxembourg as SES’ Astra satellites became profitable.

In 2001, the variable fee structure was converted to a fixed fee structure based on negotiations between the licensee and the Government and is fixed for a 20-year period (2001-21). In the case of an eventual second licensee, the initial fee structure for SES would apply to the new operator.

The basis for calculation of administrative fees or ‘taxes’ (‘certaines taxes administratives concernant la gestion du spectre radioélectrique’) is cost recovery – with actual application of the administrative fees subject to SES profitability.

### 3.8.8 France

ANFR, **Agence nationale des fréquences** licenses individual operators and sets satellite and ground station fees.

Satellite spectrum licensing is based on administrative processes – first come, first serve, and comparative review.  Auctions have not been used in the past and this option is not being considered. ANFR licensing reflects the need to harmonize with other countries in the European Community and wider ITU Region 1 as any satellite licensed in France covers several countries.

The satellite spectrum fee structure is based on the direct time and associated salary costs of professional and administrative personnel involved (person-months). The time estimates are based on summary studies. The fee structure is reviewed every seven years whereas the actual fee levels are updated every two years.

The fee levels are set lower than terrestrial spectrum fees in function of a number of factors:

- the view that satellites operate beyond French airspace;[28]
- the relatively concentrated market structure in the satellite industry;
- the high capital requirements and risk associated with satellite launch;
- the need to facilitate the operations of national operators such as Eutelsat in order to generate significant economic benefits; and,
- relatively modest fee levels set in neighbouring licensing jurisdictions and in particular, jurisdictions of convenience.

The last update of the fee structure was undertaken in 2006. The fee structure is comprised of satellite and ground station fees. The satellite fee ('autorisation d'exploitation d'une assignation de fréquence a un systeme satellitaire') is a one-time application fee for the exploitation of a geo-stationary satellite in an orbital slot (i.e. could operate in several bands). ARCEP licenses and imposes fees on fixed satellite services. Broadcast satellites are licensed by the broadcast regulator. The ARCEP satellite fee - a relatively low €20,000, is a one-time fee.

Ground station licences are restricted to telecommunications operators. Fees are broken out into 3 parts:

- an authorization fee ('taxe administrative annuelle'),
- a management fee ('redevances de gestion')
- and a spectrum availability fees ('redevances de mise en disposition').

The authorization fee is an annual flat fee of €20,000.  The management fee is set according to the number of bands = G ('le nombre d'assignations) and the bandwidth G' ('les allotissements'). The current fee levels are as follows: G=€50 per band and G'=€1,575.

The spectrum availability fee structure takes into account the intensity of use, competition, bandwidth, territory covered, economic cycle and inflation where the coefficient 'l' represents the bandwidth (MHz) licensed; coefficient 'bf' differentiates among frequency bands, coefficient 'a' represents the economic value of the fixed and mobile frequency blocks for the licensee.

The current values for coefficient 'a' are 2.5 and 30 for fixed and mobile services respectively. The current values for the coefficient 'bf' are as follows:

[28] According to the Traite sur l'Activité atmosphérique' stipulates that national airspace is limited to 200K.

**Table 15 Ground station coefficient values**

| Frequency Category | Sub-frequencies | 'bf' Coefficient Values |
|---|---|---|
| 35 | 29,7 et 54 MHz | 1 |
| 70 | 68 et 87,5 MHz | 1 |
| 150 | 146 et 174 MHz | 1 |
| 400 | 406,1 et 410 MHz | 1 |
| 410-430 | 410 et 430 MHz | 1 |
| 440 | 440 et 450 MHz | 1 |
| 450-470 | 450 et 470 MHz | 1 |
| 1,5/2 | 1 375 et 2 290 MHz | 8,7 |
| Bande L (SFS) | 1 518 et 1 675 MHz | 8,7 |
| Bande S (SFS) | 1 970 et 2 690 MHz | 8,7 |
| 3/4 | 3 400 et 4 200 MHz | 3,3 |
| Bande C (SFS) | 3 400 et 7 025 MHz | 2,2 |
| 5/6 | 5 725 et 7 110 MHz | 2,2 |
| 7/8 | 7 110 et 8 500 MHz | 1,6 |
| 10/11/12 | 10,5 et 12,75 GHz | 1,2 |
| 13/14/15 | 12,75 et 15,35 GHz | 1 |
| Bande Ku (SFS) | 10,7 et 14,5 GHz | 1 |
| 17/18/19/20 | 17,3 et 20,2 GHz | 0,7 |
| Bande Ka (SFS) | 17,3 et 30 GHz | 0,6 |
| 21/22/23 | 21,2 et 23,6 GHz | 0,6 |
| 25/26/28/32 | 24,25 et 33,4 GHz | 0,5 |
| 38 | 37 et 39,5 GHz | 0,3 |
| 40 | 39,5 et 43,5 GHz | 0,3 |
| 60 | 59 et 66 GHz | 0,2 |
| 70/80 et supérieures | Supérieures à 71 GHz | 0,07 |
| Autres bandes | - | 1 |

Source: ANFR

# 4 Income Approach Valuation

## 4.1 Introduction

### 4.1.1 Background

At the core of our valuation research and analysis is the income approach valuation. The income approach is a commonly used methodology for estimating the market value of an asset such as spectrum. Financial analysts use the income approach to estimate the intrinsic value of a business or asset. This intrinsic value forms the basis of the valuation realized in a market transaction, because it will often set the boundary for the highest price that a buyer would be willing to pay in a transaction involving the asset.

Broadcasting regulators in the UK and New Zealand have, from time to time, used the income approach – or derivatives of it – to estimate the market value of broadcasting (spectrum) licences and to set new licence fees accordingly. In the late 1990s, the UK employed a derivative of the income approach to set the renewal fees for broadcasting licences originally issued by auction in 1991.[29] The Government of New Zealand used a derivative of the income approach – commonly referred to as the Covec approach – to estimate the value of radio and television broadcasting licences up for renewal.[30]

The income approach rests on the assumption that the value of an asset – such as spectrum – is a function of the discounted cash flow (DCF) that the asset has the potential to generate for the entity that controls the asset. In this regard, the income approach is a forward-looking approach because it considers the future benefits and costs that the asset will yield and ignores any historical costs.

Under the income approach, one utilizes a DCF model of the satellite service opportunity. This DCF model yields an estimate of the net present value (NPV) of the satellite business opportunity. In other words, it yields an estimate, in current monetary terms, of the surplus economic value generated by operating a satellite business. It is important to note that the NPV results take into account the business' operating costs as well as its *cost of capital*. That is, the NPV takes into account the required rate of return that the business' shareholders and other suppliers of capital will demand in exchange for the risk of their investment. In that regard, the NPV estimate represents an estimate of the *economic profit* generated by the satellite opportunity.

Economic profit differs from the more traditional accounting profit in the sense that it takes into account the opportunity costs associated with the various inputs to the satellite business opportunity. Most notably, economic profit takes into account the opportunity cost of the financial capital provided to the satellite opportunity, whereas accounting profit does not. Indeed, it is entirely plausible that a business can be earning a positive accounting profit, while at the same time generating a zero or even negative economic profit, if its surplus cash flow does not cover shareholders' opportunity cost.

The fact that the NPV estimate represents the value of the stream of future economic profit is crucial to the valuation analysis. Where the business opportunity is related to some type of market protection granted by a limited resource or government licence – such as is the case in Canada's satellite market – the NPV estimate can also represent an estimate of the *economic rent* associated with the market protection afforded to the spectrum user by virtue of the fact that entry to the satellite market is somewhat restricted, although still competitive. In theory, the government could collect or capture this economic rent in the form of a spectrum fee and still leave the shareholders in the satellite business indifferent to their market participation: they would not withdraw from the satellite market because they would still be earning

[29] PricewaterhouseCoopers and Nordicity Group Ltd., *Review of the Methodologies to Assess the Economic Value Broadcasting Licences Held for Commercial Benefit*, prepared for department of Canadian Heritage, January 2006, p. 23-24.

[30] PricewaterhouseCoopers-New Zealand Institute of Economic Research, *Methodology for pricing renewal of spectrum rights for cellular services*, July 2006, para. 6.8.

a rate of return required to compensate them for the risk associated with their investment in the satellite business.

An estimate of the economic rent associated with a satellite spectrum licence, therefore, becomes an estimate of the upper boundary for a market transaction involving a satellite spectrum licence: it represents the maximum amount that the shareholders in a satellite business would pay to keep their spectrum licence. In practice, however, it is extremely difficult for a government to extract 100% of this economic rent, unless it knows with precision how the satellite licence holder's free cash flow (FCF) and cost of capital. Furthermore, one cannot be certain that any estimate of economic rent is entirely attributable to the spectrum input; it could also include the value of patents, trademarks or customer goodwill, which permits licensees to charge prices yielding extra-normal profits. In other words, the spectrum licensees' extra-normal profits may not be entirely due to market entry limited by the spectrum licence, but rather, may be due, in some part, to the licensees' own business model.

The difficulties associated with identifying and estimating the economic rent associated with the market protection offered by a spectrum licence warrant the use of some type of market-based mechanism to discover the economic rent. Auctions are one mechanism or tool used by governments to discover the value of the economic rent and maximize their capture of that economic rent.[31] However, auction observations are not always available to an analyst. An income-approach valuation analysis is a tool for estimating the economic rent valuations that an auction might produce.

### 4.1.2 Outline

In this study, we use the income approach to estimate the overall economic rent associated with a satellite business opportunity utilizing a satellite spectrum licence assigned by the Government of Canada. This estimate of economic rent can provide the basis for establishing a market-based licence fee rate. Our implementation of the income approach to a Canadian satellite licence involves the development of two separate but related DCF models. One DCF model entails the estimation of the cash flows for a generic dual-band satellite (C band and Ku band). While these two bands are deployed for very different types of satellite service, the structure of their markets are well established, and so, the costs and revenue potential are relatively well known.

The market for Ka band satellite services is less-established: the information for the satellite construction costs and revenue potential are less known. What is more, the use of spot beams, rather than continent-wide beams, makes the revenue-projection aspect of the income approach modelling distinct from that of the C and Ku bands.

To address to the distinct aspects of the Ka band, we have developed a valuation model that attempts to replicate the economics of Telesat's Anik F2 satellite. We have chosen Anik F2 for several reasons. First, it is a tri-band satellite that includes a commercial Ka-band payload. Other Canadian satellites also have Ka band payloads; however, they may not be in commercial use. Second, there is information available to derive the average revenue per spot beam, and thereby, prepare a projection of Ka band revenues. Third, there is information in public reports that provide an indication of the overall cost of the satellite. In contrast to many other Canadian satellites, there are reliable data on the upfront capital expenditures, which is a key element in the development of the income approach valuation model.

In the remainder of Section 4, we detail the inputs, assumptions, calculations and results of our income approach valuation for both the generic satellite and Anik F2. We begin with a general overview of the income approach methodology. This is followed by the presentation of the generic satellite model and then the Anik F2 model. At the conclusion of Section 4, we present a sensitivity analysis, and summarize and interpret the results in the context of Industry Canada's licence fee requirements.

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[31] For example, when the Crown uses an auction to license three spectrum blocks, the winners pay the NPV of the *fourth* bidder plus the bidding increment. Indeed, the fact that the auction result represents the NPV or licence valuation of the n+1 bidder has important implications for any approach to estimating market value by attempting to replicating the outcome of an auction.

## 4.2 Methodology

The income approach valuation methodology has four essential elements: (i) upfront capital expenditures (ii) a forecast of FCF, (ii) cost of capital, and (iii) terminal value. We discuss each of these four essential elements and indicate where we vary the derivation of these elements for each of the two valuation models – generic and Anik F2.

### 4.2.1 Upfront capital expenditures

Upfront capital expenditures form one the most important cash costs for a satellite licensee. These upfront capital expenditures largely consist of the cost of building and launching a satellite, and the insurance for the satellite launch. Public reports indicate that the cost of building, launching and insuring a satellite is in the range of US$300 million. These costs vary depending on the satellite payload. In Sections 4.3 and 4.4, we discuss in more detail the satellite costs that we use for the generic and Anik-F2 models.

### 4.2.2 Forecast of free cash flows

At the core of the income approach valuation model is forecast of FCF. The analyst must develop a multi-year forecast of FCF generated by a spectrum-licence holder's satellite operation. There are several approaches to calculating FCF, but essentially it is equal to operating cash flow (OCF), less *ongoing* capital expenditures (O-CAPEX) and the annual change in working capital (ΔWC). Because satellite businesses do not maintain product inventory or goods in production, one can drop the ΔWC variable. In the context of an individual satellite, satellite operators also face negligible O-CAPEX: the vast majority of the capital expenditures are incurred on an upfront basis before the launch of the satellite. For this reason, we can further simplify the calculation of FCF by assuming that O-CAPEX is equal to zero.

Given these simplifying assumptions, OCF is equal to operating (cash) revenues less operating (cash) expenses; so it excludes any deduction for depreciation and amortization.

$$FCF = OCF - O\text{-}CAPEX - \Delta WC$$

$$FCF = OCF$$

$$FCF = \text{Operating cash revenues} - \text{Operating cash costs}$$

To construct a DCF model, the analyst must generate a multi-year forecast for each of these financial variables. As such, the exercise requires a thorough understanding of future pricing trends and revenues, and ongoing operating costs. In Sections 4.3 and 4.4, we discuss in more detail how we derived projections of the operating cash revenues and operating cash costs for the generic and Anik-F2 models.

### 4.2.3 Cost of capital

The third key element of the DCF model is the derivation of the cost of capital, more commonly referred to as the weighted average cost of capital (WACC). The use of WACC is intended to reflect the fact that most businesses make use of capital with differing return expectations (i.e., debt vs. equity). The following equation summarizes the calculation of WACC, where *r* is the cost of debt, *D* is the market value of debt held by the satellite spectrum licensee, *E* is the market value of equity held by the satellite spectrum licensee, and *k* is the cost of equity capital, i.e., the equity rate of return demanded by company shareholders.

$$WACC = r\left(\frac{D}{D+E}\right) + k\left(\frac{E}{D+E}\right)$$

There are well-established approaches to estimating the WACC that involve the estimation of its component variables. For example, the analyst can often use corporate bond yields to estimate the cost of debt; the bond coupon rate does not provide a correct reflection of the *market* cost of debt.

The estimation of the cost of equity capital, *k*, entails obtaining the risk-free-rate of return (*RFR*), the equity-market premium (*ERP*), and the *β* associated with company stocks in the industry under analysis. *β* is a measure of a particular company's relative variability with respect to the overall return on the stock market. In this regard, how risky a particular stock's return is in relation to overall market return.

With these inputs, the analyst can then use the following formula to derive the cost of equity capital, *k*.

$$k = RFR + \beta \times ERP$$

The WACC used in the modelling should reflect the risk of the FCF generated by various segments of the satellite communications sector. With *r* and *k* in hand, the analyst will use the information on the overall capital structure for satellite operators with public financial reports to derive an industry-wide capital structure that can be used to calculate an industry-wide WACC. The analyst can then use the resulting WACC to discount the project or company's FCF and compare this discounted amount to any upfront capital expenditures (i.e., satellite construction and launch costs faced by the satellite operator). The following is a generalized formula that an analyst can use, where *T* is the term of satellite licence.

$$NPV = Upfront\ capex + \frac{FCF_1}{(1+WACC)} + \frac{FCF_2}{(1+WACC)^2} + \frac{FCF_3}{(1+WACC)^3} + \cdots + \frac{FCF_T}{(1+WACC)^T}$$

### 4.2.4 Terminal value

The fourth element in the DCF model – and one which often has substantial bearing on the final valuation – is the estimate of the terminal value. The terminal value could be an estimate of some price for which the shareholders could sell the business or satellite at some point in the future. More commonly, the terminal value represents the present value of the FCF earned beyond the forecast period of the DCF model.

To simplify the DCF modelling, the analyst will typically assume that FCF grows at a constant rate beyond the forecast period. This constant FCF growth rate is often referred to as *g*. The analyst will also assume that the WACC remains fixed beyond the forecast period. Under these assumptions, one can estimate the terminal value of an ongoing business by using the following formula:

$$Terminal\ value = \frac{FCF_{T+1}}{WACC - g}$$

The terminal value, therefore, is equal to the estimate of FCF in the first year beyond the forecast period or length of the licence term (year = *T+1*), divided by the difference between WACC and *g*.

The terminal value formula can be combined with the general DCF model formula to form the following infinite-period DCF-model equation.

$$NPV = Upfront\ capex + \frac{FCF_1}{(1+WACC)} + \frac{FCF_2}{(1+WACC)^2} + \frac{FCF_3}{(1+WACC)^3} + \cdots + \frac{FCF_T}{(1+WACC)^T} + \left[\frac{FCF_{T+1}}{WACC-g}\right] \times (1+WACC)^{-T}$$

When developing of a terminal value that can be applied to a valuation of spectrum licences, the renewal terms of the licence are crucial. If a spectrum licence has a low likelihood of renewal then a case could be made to set the terminal value at zero, since the licensee has no economic value to recover at the end of the licence renewal. If a spectrum licence has a high likelihood of renewal – as is the case in Canada's satellite sector – then the terminal value should reflect the FCF that the licensee could earn in subsequent licence terms *less the licensee's incremental cost of licence renewal*. The standard terminal value formula (above) could be used to estimate the terminal value under a scenario of high likelihood of renewal, with an adjustment for incremental licence renewal costs.

Even with the high likelihood of licence renewal, the business characteristics of the satellite industry warrant a customized approach. Because a satellite has a fixed lifespan (approximately 15 years), satellite businesses never reach a so-called *steady state*, from which the analyst can assume a constant growth rate for FCF. Instead, at the end of satellite spectrum licence's term, the licensee would enter another cycle of significant upfront capital expenditures for the construction and launch of a new satellite. Due to this aspect of the satellite business, and the fact that our modelling is based on the useful life of a satellite, it is reasonable to assume that the satellite spectrum licence will have no terminal value. Therefore, we do not incorporate a terminal value in our income approach valuation modelling.

## 4.3 Generic satellite model

In the following section we detail the inputs and assumptions used to construct the generic satellite valuation model, and discuss the valuation results generated by the model.

### 4.3.1 Upfront capital expenditures

Information found in press reports and Telesat's public financial reports indicate that it now costs US$250 million to US$300 million to build, launch and insure a new satellite.[32] To be conservative in our modelling and ensure that we have captured the costs of a dual-band satellite – upon which our model is based, we use an assumption of$350 million (in Canadian currency).

### 4.3.2 Operating revenues

The operating revenues for the generic satellite model consist of wholesale revenues earned from the lease of C-band and Ku-band transponder capacity. To calculate these revenues required three key data points: the number of transponders, the capacity utilization rate for this transponders, and transponder lease rates. The following formula summarizes the calculation of wholesale revenues as constructed in our DCF model.

[32] Telesat Canada, *Annual Report for the year ended December 31, 2009*, Securities and Exchange Commission document 20-F, p. 6. Ottawa Citizen, "Latest Telesat launch moved up," *Ottawa Citizen*, August 12, 2008. Peter de Selding, "Telesat says it has buyer for at least one of its satellites," *Space News*, November 14, 2008.

$$\text{Transponder wholesale revenue} = \text{number of transponders} \times \text{capacity utilization rate}$$

$$\times \text{transponder lease rate}$$

***Number of transponders***

Most of the dual-band satellites operated by Telesat Canada and other North American satellite operators consist of a standard configuration with 24 C-band transponders and 32 Ku-band transponders. All of the Anik family of satellites have this configuration.

***Capacity utilization***

We assume that the generic satellite had a maximum capacity utilization of 90% during the first 10 years of its 15-year useful life. For the final five years of the generic satellite's useful life, we reduce the capacity utilization rate to 80%. We note that as of March 31, 2010, Telesat Canada's North American fleet had a capacity utilization rate of 87%. As this overall rate reflects a fleet with spacecraft of varying ages, our capacity utilization pattern can be considered reasonable and conservative for the North American arc.

**Table 16 Capacity utilization rates**

| | Year 1 to Year 10 | Year 11 | Year 12 | Year 13 | Year 14 | Year 15 |
|---|---|---|---|---|---|---|
| Capacity utilization rate | 90% | 88% | 85% | 81% | 76% | 70% |

Source: Nordicity research

***Transponder lease rates***

The most crucial assumption in the model is the transponder lease rate. This figure largely dictates the revenues that the generic satellite will generate. Anecdotal information suggests that annual lease rates for North American C- and Ku-band transponders can vary from $1 million to an upwards of $3 million, depending on the length of the lease, geographic coverage of the transponder and other market variables. While this lease price range is quite broad, our goal is to arrive at an average rate that we can apply on a uniform basis to all of the transponders in the generic model. We approach this goal from two perspectives.

First we calculate Telesat Canada's average revenue per transponder, based on its public financial reports for 2009. In 2009, Telesat Canada earned a total of $787 million in operating revenues. It earned these revenues from three lines of business: broadcast, enterprise and consulting. These three lines of business encompass revenues earned from not only wholesale transponder leases, but also end-user value-added services such as very small aperture terminal (VSAT) services and also ground-station services. We isolate Telesat Canada's transponder wholesale revenues by, at least, excluding consulting revenues from the base amount used to calculate average revenues per transponder. After removing Telesat Canada's $31 million in consulting revenues in 2009, we arrive at a revenue base of $756 million.

While this amount still includes revenues from VSAT and ground station revenues, we use it to calculate average revenue pre transponder by dividing it by the 490 active transponders carried on Telesat Canada's global fleet. The resulting average annual revenue per transponder is just over $1.5 million per annum.

**Table 17 Calculation of average annual revenue per transponder**

| | 2009 |
|---|---|
| Broadcast ($ millions) | 407 |
| Enterprise ($ millions) | 349 |
| Consulting ($ millions) | 31 |
| **Total ($ millions)** | **787** |
| Broadcast + Enterprise ($ millions) | 756 |
| Number of transponders | 490 |
| **Average annual revenue per transponder (broadcast + enterprise)** | **$1,542,857** |

Source: Nordicity calculations based on Telesat Canada public financial reports

We have also engaged industry representatives to conduct research of the transponder lease rates currently prevailing in the North American satellite market. This research indicates that the lease rate for C-band transponders is typically $3,000 per Mbps per month, while the lease rate for Ku-band transponders is typically $4,000 per Mbps per month. To convert these bandwidth lease rates to transponder lease rates we multiply them by a data modulation rate of 1.2 Mbps (megabits per second) per MHz and the average amount of spectrum occupied by each transponder.

**Table 18 Calculation of average transponder wholesale lease revenues**

| Line | Item | C-band | Ku-band |
|---|---|---|---|
| A | Transponders | 24 | 32 |
| B | Frequency bandwidth per transponder | 36 MHz | 27 MHz |
| C | Modulation rate | 1.2 Mbps per MHz | 1.2 Mbps per MHz |
| D | Digital transmission bandwidth | 43.2 Mbps | 32.4 Mbps |
| E | Lease rate (per Mbps per month) | $3,000 | $4,000 |
| **F** | **Annual revenue per transponder (=D×E×12)** | **$1,555,200** | **$1,555,200** |

Source: Nordicity calculations based on industry research

Coincidentally, the calculation of the average revenue per transponder based on these industry data results in an equivalent rate of $1,555,200 for the C- and Ku-bands. This calculation approach also yields an estimate of the average revenue per transponder that is very close to Telesat Canada average revenue per transponder of $1,542,857.

On the basis of these two lines of evidence, we conclude that a blended rate (C and Ku bands) for average annual revenue per transponder in the North American market is in the range of between $1.5 million and $1.6 million. Other published reports tend to support this conclusion. In a March 2010 presentation to investors, Hughes Communications Inc. reported that its average transponder lease cost for the delivery of its satellite broadband data service was $1.5 million.[33] A satellite industry research report published by the Near Earth LLC in July 2006 pointed to Ku-band transponder lease rates of $1.6 million in the North American market.[34]On the basis of our analysis of Telesat's financial statements and published research, we believe that a transponder lease rate of **$1.5 million** is a reasonable assumption for the C and Ku bands.

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[33] Hughes Communications, Inc. *Investor Presentation, March 2010*, p. 11.

[34] Near Earth LLC, *The Fixed Satellite Services Industry*, July 2006, downloaded at <http://www.nearearthllc.com/analysis/presentations/FSS%20Industry.pdf> on July 28, 2010, p. 34.

#### *Price inflation*

While long-term transponder lease contracts are often characterized by fixed prices that do not vary through time, for our model, we preserve the real value of satellite market revenues by incorporating a price inflation factor. The incorporation of a price inflation factor also makes the operating revenues and operating costs in the model consistent with the cost of capital used in the model. The interest rates and cost of equity capital used to construct the cost of capital reflect creditors' and investors' expectations that the economic environment will include a certain degree of price inflation (see Section 4.3.4). For our model we use an assumption of 2% annual price inflation. This rate represents the mid-point of the Bank of Canada inflation target.

### 4.3.3 Operating costs

We use a *top-down* approach to estimate the operating costs of satellite licensees. This top-down approach combines forecasts of a satellite licensee's operating revenues (see above) and industry-wide margins for earnings before interest, taxes, depreciation and amortization (EBITDA) to construct a forecast of a satellite licensee's annual operating costs during the term of a licence. This approach can be expressed by the following formula:

$$\text{Operating Costs} = \text{Operating Revenues x } (1 - \text{EBITDA Margin})$$

We estimate EBITDA, by researching EBITDA margins among satellite service operators and then applying an appropriate EBITDA margin to the total satellite revenues in our generic satellite model. We examine Telesat's historical EBITDA margins, as well as the EBITDA margins of two other fixed satellite service operators, SES and Eutelsat.

Telesat's EBITDA margin ranged from 54.5% to 70.6% between 2004 and 2009. SES's EBITDA margin ranged from 67.5% to 73.0% during this period. Eutelsat's EBITDA margin was 79% in 2008 and 2009. On the basis of this research, we use an EBITDA margin of **60%** throughout the modelling.

**Table 19 Telesat EBITDA ($ millions)**

| | 2004 | 2005 | 2006 | 2007* | 2008 | 2009 |
|---|---|---|---|---|---|---|
| Operating revenues | 362.2 | 474.7 | 479 | 569.2 | 711.4 | 691.6 |
| Operations and administration | 117.7 | 161 | 183.4 | 187.6 | 247.6 | -- |
| Cost of equipment sales | 18.9 | 45.7 | 33.6 | 41.2 | 24.4 | -- |
| Cost of sales-type lease | -- | -- | 1.0 | 15.5 | -- | -- |
| Total expenses | 136.6 | 206.7 | 218.0 | 244.3 | 272.0 | -- |
| EBITDA | 225.6 | 268.0 | 261.0 | 324.9 | 439.4 | 488.1 |
| **EBITDA margin** | **62.3%** | **56.5%** | **54.5%** | **57.1%** | **61.8%** | **70.6%** |

Source: Telesat financial reports

**Table 20 SES EBITDA (€ millions)**

| | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 |
|---|---|---|---|---|---|---|
| Revenues | 1,077.8 | 1,258 | 1,617.2 | 1,610.7 | 1,630.3 | 1,701.6 |
| EBITDA | 786.8 | 881.1 | 1,080.4 | 1,090.3 | 1,100.0 | 1,189.5 |
| **EBITDA margin** | **73.0%** | **70.0%** | **66.8%** | **67.7%** | **67.5%** | **69.9%** |

Source: SES financial reports

**Table 21 Eutelsat EBITDA (€ millions)**

| | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 |
|---|---|---|---|---|---|---|
| Revenue | -- | -- | -- | -- | 878 | 941 |
| Operating costs | -- | -- | -- | -- | 69 | 72 |
| Selling, general and administrative expenses | -- | -- | -- | -- | 113 | 126 |
| Total operating costs (excl. depreciation and amortization) | -- | -- | -- | -- | 182 | 198 |
| EBITDA | -- | -- | -- | -- | 696 | 742 |
| **EBITDA margin** | **--** | **--** | **--** | **--** | **79.3%** | **78.9%** |

Source: Eutelsat financial reports

### 4.3.4 Cost of capital

As noted in Section 4.2.3, in order to estimate the cost of capital, or WACC, for our DCF model, we need to estimate the components of the WACC equation.

$$WACC = r\left(\frac{D}{D+E}\right) + k\left(\frac{E}{D+E}\right)$$

***Cost of debt (r)***

In the case of Telesat Canada, we have published information for its term loan facility. According to its public financial reports, Telesat Canada had just over $3 billion in outstanding debt financing as of December 31, 2009.[35] Approximately 59% of this debt financing, or $1.8 billion, was comprised of Telesat Canada's US term loan facility.[36] Since this was Telesat Canada's largest single debt instrument, we use its interest rate terms to establish a cost of debt for the satellite service market. We note that all of Telesat Canada's various debt instruments carry somewhat similar interest rate terms.

Telesat Canada's US term loan facility charges it interest at LIBOR[37] plus 300 basis points.[38] Based on these terms, Telesat Canada's average effective interest rate in 2009 was 3.8%,[39] as LIBOR was at historical lows. In 2008, when LIBOR was higher, the average interest rate was 6.4%.[40] Rather than use these two particular average interest rates to establish the debt cost, we obtained a forecast of Treasury Bill yields and information on the LIBOR-T-Bill spread to construct a cost of debt that could reflect the forecast period relevant to the valuation model.

According to TD Waterhouse the return on cash – i.e., the yield on short-term Treasury Bills – is expected to be 4.0% as the economies in Canada and other countries experience economic recovery.[41] Historically, the spread between the risk-free bond rate and LIBOR has averaged 0.3%.[42] So, we use a

[35] Telesat Canada, Form 20-F 2009, p. F-24.
[36] Telesat Canada, Form 20-F 2009, p. F-24.
[37] LIBOR – London Interbank Offered Rate is the interest rate that major global banks charge each for short term cash loans.
[38] Telesat Canada, Form 20-F 2009, , p. F-25.
[39] *Ibid*.
[40] *Ibid*.
[41] TD Economics, "Evaluating long-term returns in uncertain times" *TD Economics Special Report*, February 12, 2009, p. 3.
[42] The spread between three-month LIBOR and the yield on three-month US Treasury Bill yields is referred to as the TED spread. Historically, the TED spread has ranged between 10 and 50 basis points with a average of

long-term LIBOR rate of 4.3% in our modelling. We add Telesat Canada's 300 basis-point premium to arrive at a long-term cost of debt of 7.3%.We apply a tax rate of 30% to convert this pre-tax debt cost to an after-tax cost of 5.1%.

$$r = (RFR + \text{LIBOR spread} + \text{Telesat credit risk premium}) \times (1 - \text{tax rate})$$

$$r = (4.0\% + 0.3\% + 3.0\%) \times (1 - 30\%)$$

$$r = 7.3\% \times 70\%$$

$$r = 5.1\%$$

***Cost of equity (k)***

To estimate the cost of equity (*k*), we research each of the parameters of the cost-of-equity equation, below.

$$k = RFR + \beta \times ERP$$

For the RFR we refer back to the forecast by TD Economics. We also refer back to the TD Economics report for a forecast of the ERP. TD Economics forecasts the ERP to be 4.4%. We were unable to find conclusive information for a $\beta$ that reflects the risk within the satellite services sector. According to *Yahoo Finance*, Loral has a $\beta$ equal to 2.0; however, this probably reflects the higher-risk nature of its satellite manufacturing business. For the modelling, therefore, we use a $\beta$ of 1.5.

$$k = RFR + \beta \times ERP$$

$$= 4.0\% + 1.5 \times 4.4\%$$

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approximately 30 basis points (see http://cambridgeforecast.wordpress.com/2010/05/14/risk-barometers-money-market/). As of July 28, 2010, the TED spread was 30 basis points.

$$= 10.6\%$$

These parameter assumptions yield a cost of equity of 10.6%. We note that this cost of equity capital is in the same range as the estimated cost of equity capital rates for other Canadian communications companies and selected publicly traded international satellite companies (Table 22).

**Table 22 Cost of equity capital for comparable Canadian communications and international satellite companies**

| Company | Estimated cost of equity capital |
|---|---|
| Loral Space & Communications, Inc. | 10.3% |
| BCE, Inc. | 9.3% |
| Rogers Communications Inc. | 9.6% |
| Shaw Communications Inc. | 9.3% |
| British Sky Broadcasting Group | 9.7% |
| DirecTV | 10.8% |
| EchoStar Corp. | 9.5% |
| DISH Network Corp. | 9.3% |
| ViaSat, Inc. | 10.8% |

Source: Wikiwealth.com
Note: In the calculation of the cost of equity capital, Wikiwealth.com uses an RFR of 4.2%, compared to 4.0% in our model. Its assumption for ERP is 5.0%, compared to 4.5% in our model.

### *Weighted average cost of capital (WACC)*

To arrive at the WACC we obtain data on the capital structures of several satellite service companies for which public financial data are available. Based on the capital structure data for nine companies operating in the satellite services industry, we find that the average capital structure is 30% debt and 70% equity. Indeed the distribution of capital structures is very tight: seven of the nine companies have debt ratios of 19% to 33% (Table 23).

**Table 23 Capital structures of satellite service companies**

| Company | Debt ($ millions) | Market value of equity ($ millions) | Enterprise value ($ millions) | Debt ratio (*D*) | Equity ratio (*E*) |
|---|---|---|---|---|---|
| Loral Space & Communications, Inc. | 2,308 [1] | 1,550 [2] | 3,858 | 60% | 40% |
| SES Americom | 4,867 | 9,778 | 14,685 | 33% | 67% |
| Eutelsat Communications S.A. | 3,098 | 7,475 | 10573 | 29% | 71% |
| Inmarsat plc | 1,758 | 5,483 | 7,241 | 24% | 76% |
| British Sky Broadcasting Group | 4,628 | 15,869 | 20,497 | 23% | 77% |
| DirecTV | 8,800 | 34,230 | 43,030 | 20% | 80% |
| EchoStar Corp. | 447 | 1,620 | 2,067 | 22% | 78% |
| DISH Network Corp. | 6,490 | 9,010 | 15,500 | 42% | 58% |
| ViaSat, Inc. | 332 | 1,460 | 1792 | 19% | 81% |
| **Simple average [3]** | | | | **30%** | **70%** |

Source: Loral Space & Communications, Inc. from public financial reports and Yahoo Finance; SES Americom, Eutelsat and Inmarsat from Merrill Lynch, "Bird Watch: The 10% dividend growth club," March 15, 2010, p. 4; British Sky Broadcasting from Wikiwealth.com; DirecTV, Echostar Corp., DISH Network Corp. and ViaSat Inc. from Yahoo Finance.
<u>Notes:</u>
[1] Loral Space & Communications, Inc. long-term liabilities of $380 M 64% of Telesat Canada long-term debt of $3,013 M.

[2] Loral Space & Communications, Inc. market capitalization of $1,460 M + 64% of Telesat Canada preferred shares of $141 M.
[3] The weighted average rates are 27% for debt and 73% for equity.

By applying the industry-wide average capital structure of 30% debt and 70% equity, the resulting WACC is 9.0%.

$$WACC = r \times 30\% + k \times 70\%$$

$$= 5.1\% \times 30\% + 10.6\% \times 70\%$$

$$= 9.0\%$$

We use this rate as our baseline WACC assumption in our income approach modelling. We note that the WACC of 9.0% for our satellite model is consistent with the WACCs for other Canadian communications companies and international satellite services companies, as calculated by the Wikiwealth.com web site (Table 24).

**Table 24 WACCs for comparable Canadian communications and international satellite companies**

| Company | WACC |
|---|---|
| Loral Space & Communications, Inc. | 9.0% |
| BCE, Inc. | 8.0% |
| Rogers Communications Inc. | 8.0% |
| Shaw Communications Inc. | 8.0% |
| British Sky Broadcasting Group | 8.0% |
| DirecTV | 8.0% |
| EchoStar Corp. | 8.0% |
| DISH Network Corp. | 9.0% |
| ViaSat, Inc. | 10.0% |

Source: Wikiwealth.com
Note: In the calculation of the cost of equity capital, Wikiwealth.com uses an RFR of 4.2%, compared to 4.0% in our model. Its assumption for ERP is 5.0%, compared to 4.4% in our model.

### 4.3.5 Valuation results

In this section, we summarize the valuation results; the detailed calculations can be found in Appendix B.

When we compare the upfront capital expenditures of $350 million to the discounted forecast of annual FCF of $398.7 million (discounted at a WACC of 9.0%), we find that the generic satellite displays an NPV of $48.7 million. In other words, the generic satellite generates an estimated $48.7 million in economic rent for the licence holder over the 15-year life of the satellite.

**Table 25 Summary of valuation results**

| Line | Item | Amount |
|---|---|---|
| A | Upfront capital expenditures | 350,000,000 |

| | | |
|---|---|---|
| B | Sum of discounted FCF | 398,719,667 |
| C | Net present value [=B−A] | 48,719,667 |
| | Share of revenues | |
| D | C-band | 43% |
| E | Ku-band | 57% |
| | Allocation of net economic rent | |
| F | C-band [=C×D] | $20,879,857 |
| G | Ku-band [=C×E] | $27,839,810 |
| | Licensed spectrum (MHz) | |
| H | C-band | 1,000 |
| I | Ku-band | 1,000 |
| | Economic rent per MHz | |
| J | C-band [=F÷H] | $20,880 |
| K | Ku-band [=G÷H] | $27,840 |
| | Annualized* economic rent per MHz | |
| **L** | **C-band** | **$2,304** |
| **M** | **Ku-band** | **$3,073** |
| | | |
| **N** | **Implied annual economic rent [=(L×H)+(M×G)]** | **$5,377,038** |

Source: Nordicity estimates based on data from Telesat Canada, Industry Canada and industry research
* Instead of dividing amounts J and K by 15 years to arrive at an annualized amount, we calculate the annual payment at a discount rate of 9.0%, over a 15-year period that is equivalent to the present value of the economic rent.

We allocate this NPV (economic rent) to each band on the basis of their respective share of total revenues. The C-band accounted for 43% of revenues, while the Ku-band accounted for 57% of revenues.

We divide the allocated economic rent by the total amount of spectrum in each band (1,000 MHz) to arrive at estimates of the economic rent generated on a per-MHz basis. We then determine an annualized payment, discounted at 9.0%, that is equivalent to the present value of the economic rent. Following this approach, we arrive at an estimate of **$2,304 per MHz per annum for the economic rent generated by the C-band licence. For a Ku-band licence, we estimate the total economic rent at $3,073 per MHz per annum.**

## 4.4 Anik F2 Ka-band model

The Anik F2 Ka-band valuation model differs from the generic model in two key respects. First, instead of using an assumption of $350 million for the upfront capital expenditures, we use an amount that has been reported as the estimated cost of building, launching and insuring Anik F2. The Anik F2 model also differs from the generic model because it incorporates a module for the Ka-band revenue potential for the satellite's 45 Ka transponders. In estimating the revenues, however, we do not use the same annual average revenue per transponder that we use for the C- and Ku-bands; instead we calculate a rate specific to the Ka-band spot beams on the Anik F2.

### 4.4.1 Upfront capital expenditures

Public reports indicate that the cost of Anik F2 was US$408 million.[43] Since, the contract for construction of Anik F2 was struck in 2000, although the satellite was not launched until 2004, we first apply an inflation adjustment to inflate the satellite cost to 2010 dollars. Considering that satellite construction started in 2000, but the launch was not until 2004, we divide the total satellite cost of $408 million into a satellite construction cost, and launch and launch insurance cost and apply separate inflation factors. We assign 80% of the total satellite cost or US$326.4 million to the satellite construction cost and then apply

[43] Analytics Graphics Inc. "Anik F2," *Spacecraft Digest*, downloaded on June 29, 2010 at http://www.stk.com/resources/downloads/data/spacecraft-digest/display.aspx?i=148.

an inflation factor of 1.1992.[44] We assign the remaining 20% of the overall satellite cost, or $81.6 million to the launch and launch insurance costs, and then apply an inflation factor of 1.0926. The inflation-adjusted satellite cost is US$480.6 million in 2009 dollars.

To convert the US dollar amount to Canadian dollars, we use the average exchange rate for May 2010; this rate is $1.04 per US$1.00. The Canadian dollar satellite cost is $499.8 million. We use this inflation-adjusted Canadian-dollar amount in our model.

### 4.4.2 Operating revenues

To derive the operating revenues for the Ka-band, we first derive a spot beam revenue rate based on the reported contract between Telesat Canada and Wildblue Communications Inc. ("Wildblue"). In 2000, Telesat Canada entered into an agreement with Wildblue that provided the latter with exclusive use of 30 of the 45 Ka-band spot beams on Anik F2 for the life of the satellite.[45] In exchange for this exclusive use, Telesat Canada received cash and Wildblue stock worth US$200 million.[46]

We use an iterative calculation process to convert this contract amount into an annuity at a WACC of 9.0%. This iterative calculation requires us to solve for *p* in the following equation.

$$V = \frac{p}{(1+WACC)} + \frac{p}{(1+WACC)^2} + \frac{p}{(1+WACC)^3} + \cdots + \frac{p}{(1+WACC)^T}$$

Where:

*V* is the present value of transponder capacity contract ($200 million).

*p* is a fixed perpetual annualized.

*WACC* is weighted average cost of capital (9.0%).

*t* is number of years from the beginning of the term of length T years(15 years).

**Table 26 Summary of valuation results**

| Line | Item | Amount |
|---|---|---|
| A | Value of Wildblue agreement | $200,000,000 |
| B | Discount rate | 9.0% |
| C | Useful life of satellite | 15 years |
| D | Annual perpetuity | $24,800,000 |
| E | Number of spot beams | 30 |
| F | Implied wholesale revenue per spot beam | $827,000 |
| G | Inflation-adjustment factor | 1.1992 |
| F | Implied wholesale revenue per spot beam (2009 dollars) | $991,000 |
| G | Total number of Anik F2 Ka transponders | 45 |
| H | Maximum annual Ka-band revenues | $44,629,000 |

Source: Nordicity estimates based on data from Telesat Canada, Industry Canada and industry research

At a WACC of 9.0% an upfront payment of $200 million is equivalent to a 15-year annuity of $24.8 million. We then divide this amount by the 30 spot beams that comprise the agreement. This calculation implies that the spot beam lease was $827,000 per annum. We then use an inflation factor of 1.1992 to inflate

[44] The inflation factor is equal to the rate of change in the Canadian all-items consumer price index (CPI) from a particular year to 2009 (annual average CPI data are not yet available for 2010). For example, an inflation factor of 1.1992 for 2000 indicates that the annual average all-items CPI increased by 19.92% between 2000 and 2009.

[45] *Ibid*.

[46] Telesat Canada, "History of World Firsts," *Telesat Canada*, downloaded on June 29, 2010 at http://old.telesat.com/aboutus/worldfirsts-e.asp.

this amount into a 2009 dollar amount of $991,000 per spot beam per annum. On the basis of this calculation, we assume that annual lease rate for a Ka-band spot beam is **$1 million**.

### 4.4.3 Valuation results

We use the same general process to convert the NPV into an estimate of the annual per-MHz economic rent for spectrum in each band. In this case, we amortize the satellite cost over three bands on the basis of each band's share of revenues.

The valuation results for the C and Ku band are higher than those of the generic model. The economic rent valuation for the C-band is $3,466 per-MHz on an annual basis; for the Ku-band, the valuation result is $4,621 per MHz on an annual basis.

**For the Ka-band, our valuation model indicates that the economic rent generated on an annual basis is equal to $4,322 per MHz.**

**Table 27 Summary of valuation results**

| Line | Item | Amount |
|---|---|---|
| A | Upfront capital expenditures | $499,788,822 |
| B | Sum of discounted FCF | $612,319,489 |
| C | Net present value [=B−A] | $112,530,667 |
| | Share of revenues | |
| D | C-band | 28% |
| E | Ku-band | 37% |
| F | Ka-band | 35% |
| | Allocation of net economic rent | |
| G | C-band [=C×D] | $31,403,907 |
| H | Ku-band [=C×E] | $41,871,876 |
| I | Ka-band [=C×F] | $39,254,884 |
| | Licensed spectrum (MHz) | |
| J | C-band | 1,000 |
| K | Ku-band | 1,000 |
| L | Ka-band | 1,000 |
| | Economic rent per MHz | |
| M | C-band [=G÷J] | $31,404 |
| N | Ku-band [=H÷K] | $41,872 |
| O | Ka-band [=I÷L] | $19,627 |
| | Annualized* economic rent per MHz | |
| **P** | **C-band** | **$3,466** |
| **Q** | **Ku-band** | **$4,621** |
| **R** | **Ka-band** | **$4,322** |
| | | |
| **S** | **Implied annual economic rent [=(P×J)+(Q×K)+(R×L)]** | **$12,419,660** |

Source: Nordicity estimates based on data from Telesat Canada, Industry Canada and industry research
* Instead of dividing amounts M, N and O by 15 years to arrive at an annualized amount, we calculate the annual payment at a discount rate of 9.0% over a 15-year period that is equivalent to the present value of the economic rent.

## 4.5 Summary of valuation results

We have employed two separate but related income approach valuation models: the generic model and the Anik-F2 model. While the assumptions and data inputs to these two models in certain respects, particularly with respect to the upfront capital costs, are different, the valuation results for the C and Ku bands are very close.

While one might argue that more weight should be given to the generic model as a tool for arriving at a valuation of the economic rent in the C and Ku bands, for the purposes of the overall analysis, we have given the two models equal weighting, and therefore, we use the midpoint of the two results as our conclusory valuation result. Our only valuation result for the Ka band comes from the Anil-F2 model.

**Table 28 Summary of conclusory valuation results ($ per MHz per annum)**

| Band | Range | Midpoint |
|---|---|---|
| C band | $2,304 to $3,466 | **$2,885** |
| Ku band | $3,073 to $4,621 | **$3,847** |
| Ka band | -- | **$4,322** |

Source: Nordicity estimates based on data from Telesat Canada, Industry Canada and industry research

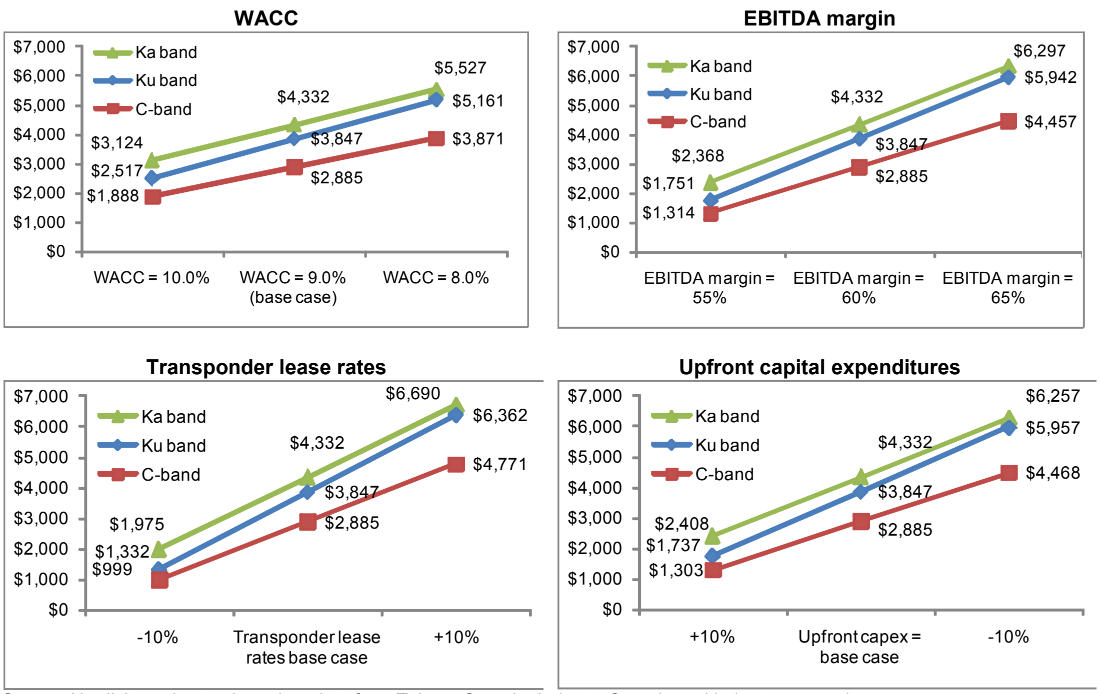
Based on this approach, we conclude that the valuation of the economic rent generated each of the satellite spectrum bands is the following:

- C-band: **$2,885 per MHz per annum**
- Ku-band: **$3,847 per MHz per annum**
- Ka-band: **$4,322 per MHz per annum**

## 4.6 Sensitivity analysis

This section presents the results of an analysis of the sensitivity of the estimates of annualized *economic rent per MHz* in each band to various key modelling assumptions: WACC, EBITDA margin, upfront capital expenditures (satellite launch costs), and transponder lease rates. We test a 150 basis point variation in the WACC; a five percentage point variation in the EBITDA margin; a 10% variation in upfront capital expenditures; and a 10% variation in the transponder lease rates.

**Table 29 Sensitivity analysis (per MHz per annum)**




Source: Nordicity estimates based on data from Telesat Canada, Industry Canada and industry research

The sensitivity results indicate that small changes in the key assumptions can have significant impact on the valuation results. The imposition of less-conservative assumptions lifts the valuation results for the C band from $2,885 per MHz per annum to approximately $3,900 to $4,800 per MHz per annum. For the Ku band, the valuation results increase to a range of $5,200 to $6,400 per MHz per annum. For the Ka band, less-conservative assumptions lift the valuation result from $4,322 per MHz per annum to approximately $5,500 to $6,700 per MHz per annum.

The imposition of more-conservative assumptions lowers the C-band valuation from $2,885 to approximately $1,000 to $1,900 per MHz per annum. The Ku-band valuation decreases from $3,847 to approximately $1,300 to $2,500 per MHz per annum, and the Ka-band valuation decreases from $4,322 per MHz per annum to $2,000 to $3,100 per MHz per annum.

# 5 Valuation based on market comparables

## 5.1 Introduction

Market comparables provide another potential route for developing a valuation of spectrum assets. Under the market comparables approach, the analyst obtains data from market transactions involving similar spectrum assets and then derives some type of valuation multiple – such as $ per MHz – which can then be applied to the spectrum asset subject to valuation. In other words the unitary value revealed by transactions for similar spectrum provides information on the spectrum that is not subject to a market transaction.

Ideally, the analyst would try to source market-comparables data from auctions of similar spectrum and then adjust the multiples revealed by the winning auction amounts, so that he or she may apply the resulting multiples to the spectrum under analysis. However, in the case of satellite spectrum, there have been very few auctions from which an analyst can draw multiples. What is more, the limited number of auction results for satellite spectrum means that it can difficult to establish any empirically based adjustment factors.

Corporate transactions involving companies that hold licences to satellite spectrum assets provide another source of market comparables data beyond spectrum auctions. Where the analyst can derive or obtain the portion of any transaction purchase price attributable to the satellite spectrum asset – i.e., the intangible asset held by the purchased company – the analyst could obtain a market comparable that can then be applied to similar satellite spectrum.

Where satellite spectrum is held by public companies, current share prices can also provide market comparables. The current share price reflects the public's current valuation of the satellite licensee's business on an ongoing basis, including the contribution of all its identifiable and non-identifiable assets – tangible and intangible. Similar to the analysis to corporate transactions, the conversion of a share price into a valuation of the spectrum assets requires some method for allocating the overall market capitalization of the publicly traded company under analysis.

Regardless of the source of the market comparables – auction results, corporate transactions or public-share data – the main challenge is to establish that the market conditions that prevail in the comparable's market also prevail in the valuation-subject's market. The analyst should establish that the micro and macro conditions that prevail in the comparable market are close enough to apply the market comparable multiple – such as $ per MHz – to the valuation subject. Micro conditions would include the number of potential buyers and sellers of the spectrum and these buyers' and sellers' respective bargaining positions. The macro conditions would include the growth prospects and profit potential associated with the customer base served by the satellite spectrum. Where the analyst cannot establish close enough similarity in the micro and macro conditions, she must develop and apply some type of adjustment process.

In this section, we present market comparables drawn from the results of eight auctions of satellite orbital slots auctions. We also utilize the asset valuations resulting from Loral Space & Communications Inc.'s 2007 acquisition of a minority interest in Telesat Canada – a corporate transaction involving Canadian satellite spectrum held by Telesat Canada. We also examine the valuation implied by a subsequent restatement of Telesat Canada orbital slot intangible asset in December 2008. Finally, we utilize the share price of Loral Space & Communications Inc. ("Loral") as of December 2009 in combination with data from the financial statements of Loral and Telesat Canada to derive an estimate of the value for Telesat Canada's Canadian orbital slots as of December 2009 – a close proxy for the current value.

## 5.2 Auctions

As noted above in the fee benchmarking section, presently only two jurisdictions use auctions to set satellite services licence fees: Mexico and Brazil. However, the FCC auctioned DBS satellite services licences in 1996 before abandoning auctions as a licensing process for satellite. As well, the Australian Communications and Media Authority attempted to auction two five-year space apparatus licences in 2001, but received only one applicant and thus sold the licence at the reserve price. The results of that attempted auction, plus results from Brazil[47] and Mexico are presented in the table below, in jurisdictional and Canadian values, as well as annual $ per MHz.

**Table 30 Satellite orbital slot auction results**

| Country | Year | Licensee | Licence | Term (Years) | Annual | Bandwidth | $/MHz/ Year |
|---|---|---|---|---|---|---|---|
| US | 1996 | MCI Telecommunications Corp. | $955,500,000 | 15 | $63,700,000 | 672 MHz | $94,792 |
| US | 1996 | EchoStar | $73,213,700 | 15 | $4,880,913 | 576 MHz | $8,474 |
| Brazil | 1999 | Loral Skynet do Brasil | R$32,433,179 | 15 | $1,782,959 | 1,500 MHz | $1,189 |
| Brazil | 2007 | Star One | R$6,100,000 | 15 | $224,196 | 2,060 MHz | $109 |
| Brazil | 2007 | Star One | R$3,000,000 | 15 | $110,260 | 2,900 MHz | $38 |
| Brazil | 2007 | Loral Skynet do Brasil | R$1,938,000 | 15 | $71,228 | 500 MHz | $142 |
| Mexico | 2005 | QuetzSat | MXP153,000,000 | 20 | $850,680 | 1,000 MHz | $850 |
| Australia (reserve price) | 2001 | FOXTEL | A$1,000,000 | 5 | $160,160 | 500 MHz | $320 |

Source: Nordicity research
See Appendix A for currency exchange rates
* Loral's licence period was for 30 years after launch, with 3 years granted to launch the satellite.

Although the sample is limited, past orbital slot fees as a result of auctions, particularly when averaged over the duration of the licence term on a per-MHz basis, are extremely varied – from $36/MHz to $94,792/MHz. While many of the values achieved at auction are comparable to the cost-recovery fees charged by the FCC or the liability insurance premium paid by UK satellite licensees, others – the 1996 US and 2005 Mexican results in particular – are far greater. The caution in using auctions for fee benchmarking is that although auction results are often considered to provide a strong indication of market value, they are also very sensitive to multiple variables. These variables include time (particularly the condition of the economy during the auction), competition, the auctioned good, geographic and social conditions (particularly population, population density and challenges posed by the geography of the potential service areas), and irrational bidder exuberance.

For instance, North American DBS satellite services are likely to garner higher auction bids than auctions for C- or Ku-band satellite services because DBS includes protection against foreign market entry and therefore provides access to a set market. Even then, the vast difference in the two values achieved in the 1996 US auctions illustrates how one variable can severely impact auction results. The most significant advantage of the licence obtained by MCI is that it provided full US national coverage, while the EchoStar licence did not cover parts of the US east coast. Yet MCI paid almost $900 million more for its licence than EchoStar.

Auction values are additionally effected by particular circumstances. For example, although the process used to issue all of the Brazilian licences profiled above was an auction, the auction results in some

[47] The Brazilian figures presented in the tables in Section 3 are based on the average of three auctioned licences in 2007.

cases did not result in market-based values. For example, the licence won by Loral Skynet for R$1.938 million in 2007 was actually for extended Ku-band capacity in a slot previously won at auction by Loral Skynet. Although the spectrum was put to auction, Loral was effectively the only interested party and therefore won by bidding the reserve price.

## 5.3 Corporate transactions

In this section, we derive a market-comparables-based valuation of Canadian satellite spectrum by examining the fair market value estimates publicly reported by Telesat Canada for the orbital slot licences it held at the time of the Loral transaction and following a restatement of the fair value of its orbital slot assets in December 2008.

We have obtained data from Telesat Canada's public financial filings, which report the book value[48] of the orbital slot licences it held at the time of the Loral transaction. We have also obtained data for the restated fair value of the orbital slot licences held by Telesat Canada as of December 31, 2008. We have used these data in combination with information on Telesat's total licensed Canadian satellite spectrum (supplied by Industry Canada) to derive annualized estimates of the value of satellite spectrum on a dollars-per-MHz basis. At this point, this methodology does not permit us to derive separate estimates for the C, Ku and Ka bands.

### *Valuation approaches*

We derive valuation estimates under two approaches. The first approach assumes that orbital slot licences are valued on a *perpetuity basis*. Under the perpetuity basis, we assume that Telesat Canada views the orbital slot licences as having a virtually infinite term by virtue of the fact that they have a high likelihood of renewal by Industry Canada. On the basis of this assumption, we use the following formula to convert the asset value for the orbital slot licences to an annualized amount.

$$V = \frac{p}{WACC}$$

Where:

*V* is the present value of the asset.

*p* is a fixed perpetual annualized.

*WACC* is weighted average cost of capital.

V represents the observed balance sheet asset value for the orbital slot licences. We derive a WACC based on our research of the costs of debt and equity capital faced by Telesat Canada. With these two data points, we can use the following formulation to solve for the annualized equivalent value of the orbital slot licence.

$$p = V \times WACC$$

The second approach uses the average remaining life for Telesat's satellite fleet to impose a fixed term on the orbital slot licences.[49] This approach requires that we use an iterative process to solve for *p* in the following equation.

[48] The book value amount reported by Telesat reflects the fair value of the orbital slots at the time of the Loral-Telesat transaction and following an impaired asset adjustment in 2008.
[49] We use a simple average rather than a weighted average based on the payload of each satellite.

$$V = \frac{p}{(1+WACC)} + \frac{p}{(1+WACC)^2} + \frac{p}{(1+WACC)^3} + \cdots + \frac{p}{(1+WACC)^T}$$

Where *T* is length of the licence term in years.

#### *Valuation periods*

We also consider the book value reported at two points in time: the time of Loral's purchase of a minority stake in Telesat Canada on October 30, 2007; we refer to this as the *pre-merger* book value. We also consider the book value of Telesat Canada's orbital slot asset as of December 31, 2009, following a significant asset restatement in 2008; we refer to this as the *December 2009* scenario.

At the time of the Loral-Telesat transaction (October 30, 2007), Loral reported the allocation of the purchase price to various Telesat Canada assets. Of the estimated purchase price of $3,277.1 million, Loral attributed $510.5 million to the orbital slot intangible assets held by the combination of Loral Skynet and Telesat Canada.[50] Of this amount, Loral attributed $494.1 million to Telesat Canada's orbital slot intangible assets.[51]

On December 31, 2008, Telesat Canada restated the fair market value of its orbital slot intangible assets to $113.3 million; it remained at this level at December 31, 2009. Following tests performed in the fourth quarter of 2008, Telesat Canada found that its orbital slot asset was impaired.[52] According to Telesat, the impairment of the orbital slot asset was largely due to a decrease in the present value of the cash flows associated with the orbital slot licences. Telesat attributed this lower present value to a higher discount rate (i.e., WACC) due to financial market conditions, the impact of the strengthened US dollar on the costs of satellites, and increases in satellite insurance and launch costs.[53] As a result of the reduced present value of the orbital slot asset, Telesat recorded an impairment charge of $483 million for the orbital slot asset and restated its fair value to $113.3 million.[54]

#### *Geographic allocation*

Our analysis only considers Canadian satellite spectrum licensed to Telesat Canada by the Government of Canada; however, Loral only reports a current intangible asset for its global portfolio. As such we need a method to isolate the value associated with the Canadian orbital slot licences. We isolate the value of the Canadian orbital licences by calculating the percentage of Telesat Canada's 2009 operating revenues earned from customers in North America and use this revenue-share to proxy the geographic allocation of the fair market value of the Canadian orbital slot asset.

This approach reflects the fact that Telesat Canada uses Canadian satellite spectrum to provide coverage to Canada, the US and Mexico, and serves clients based in these jurisdictions. This approach assumes that there is a strong correlation between profitability and revenue. According to Telesat Canada's annual financial statements for 2009, North America accounted for 83% of worldwide revenues.

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[50] Loral Space & Communications Inc., Form 8-K, October 29, 2007, Exhibit 99.10, p. 5.
[51] *Ibid*.
[52] Loral Space & communications Inc., Form 10-K 2008, p. F-93.
[53] *Ibid*.
[54] *Ibid*.

**Table 31 Calculation of revenue share for Canadian satellite spectrum (12 months to December 31, 2009)**

| Region | Revenues ($ millions) | Share |
|---|---|---|
| North America | 652 | 83% |
| Asia and Australia | 24 | 3% |
| Europe, Middle East and Africa | 66 | 8% |
| Latin America | 45 | 6% |
| **Total** | **787** | **100%** |

Source: Nordicity calculations based on data from Telesat Canada, Form 8-K 2009, p. 33

**Table 32 Calculation of geography-adjusted orbital-slot asset value**

| Region | Loral-Telesat transaction October 30, 2007 | December 31, 2009 |
|---|---|---|
| Book value of orbital slots intangible asset ($ millions) | 494.1 | 113.3 |
| North America share of revenues | Not applicable | 83% |
| Adjusted book value of orbital slots intangible asset ($ millions) | 494.1 | 94.0 |

Source: Nordicity calculations based on data from Telesat public financial reports

### 5.3.1 Perpetuity basis valuation

We first convert the book value of the orbital slots intangible asset into an annualized amount by applying a perpetuity valuation approach. We use the same baseline WACC assumption of 9.0% as we do in the income approach valuation. With a WACC of 9.0%, the adjusted book value of $494.1 million is equivalent to a perpetual income stream of $44.5 million per annum. When this annualized amount is divided by 11,500 MHz of Canadian satellite spectrum under licence to Telesat, it implies that satellite spectrum has a value of **$3,867 per MHz** on an annual basis.

We also apply this approach to the book value of Telesat's orbital slots intangible asset on December 31, 2009. With a WACC of 9.0%, the adjusted book value of $94.0 million is equivalent to a perpetual income of $8.4 million per annum. When this annualized amount is divided by 18,600 MHz of Canadian satellite spectrum under licence to Telesat, it implies that the satellite spectrum has a value of **$454 per MHz** on an annual basis.

**Table 33 Calculation of perpetuity-basis value of satellite spectrum**

| Line | Item | Loral-Telesat transaction October 30, 2007 | December 31, 2009 |
|---|---|---|---|
| A | Adjusted book value of orbital slot intangible asset ($ millions) | 494.1 | 94.0 |
| B | WACC | 9.0% | 9.0% |
| C | Annualized value - based on perpetuity ($ millions) [=A×B] | 44.5 | 8.4 |
| D | Total Canadian satellite bandwidth (MHz)* | 11,500 | 18,600 |
| **E** | **Valuation (per MHZ per annum) [=C÷D]** | **$3,867** | **$454** |

Source: Nordicity calculations based on data from Telesat public financial reports and Industry Canada
* Total bandwidth amounts provided by Industry Canada; see Appendix A.

On the basis of these valuation results, the spectrum used by a satellite such as Nimiq 1 with 32 Ku-band transponders and 1,000 MHz of licensed Ku-band spectrum would have an estimated annualized market value of **$3.87 million** based on the pre-merger asset value or **$454,000** based on the December 2009 asset value.

**Table 34 Calculation of market value of Nimiq 1 spectrum (perpetuity basis)**

| Line | Item | Loral-Telesat transaction October 30, 2007 | December 31, 2009 |
|---|---|---|---|
| A | Bandwidth | 1,000 MHz | 1,000 MHz |
| B | Valuation (per MHZ per annum) | $3,867 | $454 |
| **C** | **Annualized market value[=A×B]** | **$3.87 million** | **$454,000** |

Source: Nordicity calculations based on data from Telesat public financial reports and Industry Canada

### 5.3.2 Remaining-life basis valuation

We also convert the fair value of the orbital slot intangible asset into an annualized amount by applying a fixed term valuation approach. We use an iterative process to solve for an annual income that equates the book value of the orbital slots to a nine-year annuity. The nine-year term of the annuity is based on a calculation of the average remaining life of Telesat's North American satellite fleet at both the time of the Loral-Telesat transaction and as of December 31, 2009.

We assume that each satellite had a 15-year life, in order to calculate the average length of the remaining life of its fleet. Using this approach, we find that in September 2007, Telesat's satellite fleet had an average remaining useful life of 8.7 years. At December 31, 2009, the average remaining useful life was 8.6 years for the North American fleet. For both the pre-merger and current valuations, we use an average remaining useful life of nine years.

In the case of the Loral-Telesat transaction, with a WACC of 9.0%, the adjusted book value of $494.1 million is equivalent to a nine-year annuity of $82.4 million. When this annualized amount is divided by 11,500 MHz of Canadian satellite spectrum under licence to Telesat as of October 2007, it implies that Canadian satellite spectrum has a value of **$7,167 per MHz** on an annual basis.

We also apply this approach to the December 2009 book value of Telesat's orbital slots intangible asset. With a WACC of 9.0%, the adjusted book value of $94.0 million is equivalent to a nine-year annuity of $15.7 million. When this annualized amount is divided by 18,600 MHz of Canadian satellite spectrum under licence to Telesat, it implies that Canadian satellite spectrum has a value of **$842 per MHz** on an annual basis.

**Table 35 Calculation of remaining-life-basis value of satellite spectrum**

| Line | Item | Loral-Telesat transaction October 30, 2007 | December 31, 2009 |
|---|---|---|---|
| A | Adjusted book value of orbital slots intangible asset ($ millions) | 494.1 | 94.0 |
| B | Discount rate (cost of capital) | 9.0% | 9.0% |
| C | Average remaining useful life on fleet | 9 years | 9 years |
| D | Annualized value - based on fixed discounted cash flow* ($ millions) | 82.4 | 15.7 |
| E | Total bandwidth (MHz)** | 11,500 | 18,600 |
| **F** | **Valuation (per MHZ per annum) [D÷E]** | **$7,167** | **$842** |

Source: Nordicity calculations based on data from Telesat public financial reports and Industry Canada
* An iterative process based on the discount rate and term of the useful life was used to solve for the annualized value.
** Total bandwidth amounts provided by Industry Canada; see Appendix A.

On the basis of these valuation results, the spectrum used by a satellite such as Nimiq 1, with 32 Ku-band transponders, would have an estimated market value of **$7.17 million** (pre-merger) or **$842,000** (December 2009).

**Table 36 Calculation of market value of Nimiq 1 spectrum (remaining life basis)**

| Line | Item | Loral-Telesat transaction October 30, 2007 | December 31, 2009 |
|---|---|---|---|
| A | Bandwidth | 1,000 MHz | 1,000 MHz |
| B | Valuation (per MHZ per annum) | $7,167 | $842 |
| **C** | **Annualized market value [=A×B]** | **$7.17 million** | **$842,000** |

Source: Nordicity calculations based on data from Telesat public financial reports and Industry Canada

### 5.3.3 Interpretation of valuation results

We note that there is a significant difference in the results produced by the perpetuity basis and remaining-life basis. While the fact that satellite orbital slot licences come with a high likelihood of renewal suggests that the perpetuity-basis valuation would be most appropriate, there is no assurance that Telesat considers the orbital slots to have infinite lives; all we can conclude is that it classifies the slots as having an *indefinite* life. For this reason, the perpetuity-basis valuation may underestimate the annualized per-MHz value of the spectrum. In our view the remaining-life basis likely provides a better – and more conservative – indication of the annualized value of the spectrum.

Even with the perpetuity-basis valuation, we note that there is a significant variation in the valuation of Telesat's orbital slot intangible assets due to the restatement of this asset in 2008. In accordance with Generally Accepted Accounting Principles (GAAP), for intangible assets, Telesat conducts impairment tests on an annual basis or whenever events of circumstances indicate that the carrying amount of these assets is likely to exceed their fair value.[55] It is important to note that GAAP only permits companies, such as Telesat, to restate intangible assets if they are impaired; it does permit a company to restate the fair value of its intangible asset on the upward basis.

This aspect of GAAP is relevant because it implies that while the fair value of the orbital slots may have dropped (precipitously) in the fourth quarter of 2008, it does not rule out a scenario in which the fair value of the orbital slot asset may have subsequently recovered in 2009 and 2010 as some of the valuation drivers – such as the discount rate – changed. Any such recovery would not appear on Telesat's balance sheet as GAAP does not permit it to restate the asset on an upward basis.

There are good reasons to believe that the fair value of the orbital asset may have recovered. We note that in the fourth quarter of 2008, the global economy was in the grips of a financial crisis and economic recession. On the eve of the Loral-Telesat transaction, Loral's share price stood at US$40; by December of 2008, it was below US$7. It has since recovered to the $40 range. Loral's share price provides an indirect barometer on economic prospects for the satellite industry; however, because Loral is also engaged in satellite manufacturing, its economic prospects and share price are likely more volatile than that of the satellite services market, per se. For that reason, one might also consider the share price of SES, which is closer to a pure satellite services company as a better proxy for the economic prospects in the satellite services market.

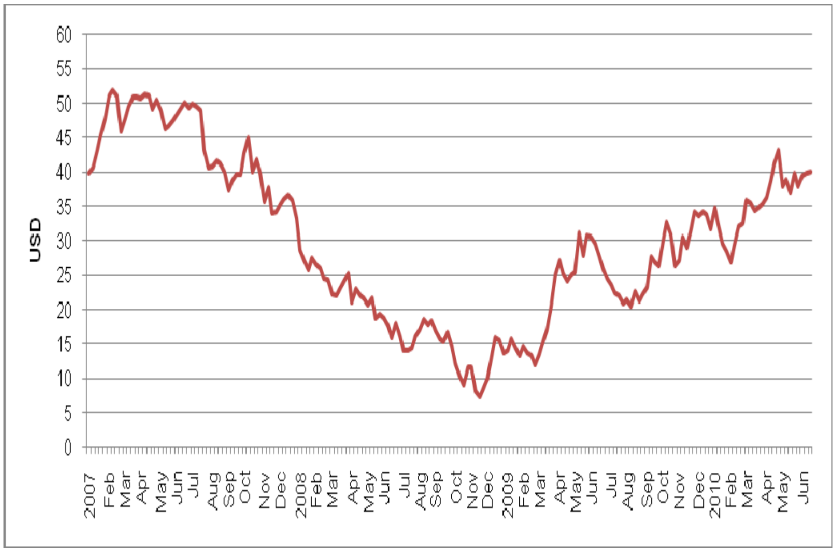
SES's share price (SES.F [Frankfurt]) also experienced a sharp drop in the fourth quarter of 2008. It dropped from €18 in January 2008 to €13 to €14 range by December 2008. It has recently recovered to €18. The fluctuations in the share prices of Loral and SES suggest that the satellite service industry's prospects had likely weakened in the fourth quarter of 2008, but have since recovered. While it is unclear whether the improved economic prospects warrant an upward restatement of Telesat's orbital slot asset,

[55] Loral 10-K 2009, p. F-72.

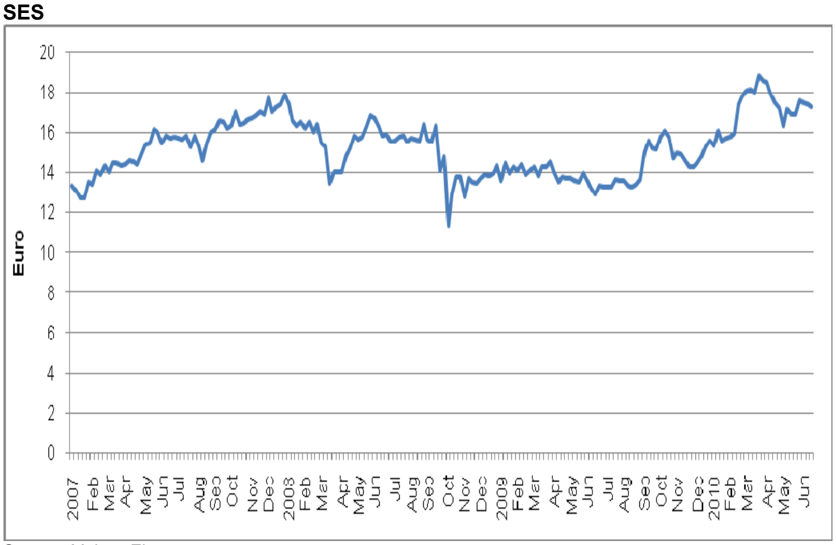
what is clear is that the current book value of $113.3 million (geography-adjusted book value of $94.0 million) probably significantly understates the fair value of the orbital slot asset. For this reason, the results for the current valuation (remaining-life basis), $799 per MHz per annum, understate the market value of the orbital slots. The current market value of the orbital slot assets, and therefore Telesat's spectrum holdings, is probably much higher.

**Table 37 Share prices for Loral and SES (January 2007 to June 2010)**

**Loral**




**SES**




Source: Yahoo Finance

If one uses the 30% appreciation in SES's share price since the fourth quarter of 2008 as a guide to the improvement in the economic prospects in the satellite services market, then the current valuation of Telesat's Canadian satellite spectrum should be closer to $1,000 per MHz per annum

($799×1.3 = $1,039). We believe that this rate of $1,000 per MHz per annum represents a floor on the valuation of Canadian satellite spectrum, since it is largely based on the impaired asset amount reported by Telesat Canada.

## 5.4 Share-price-based residual-value approach

Recognizing that the December 2009 (and current) book value of Telesat's orbital slots may significantly understate its fair value, we also attempt to use the share price of Loral as of December 2009[56] in combination with Loral and Telesat's financial statements to derive a valuation of the orbital slot asset. We refer to this valuation method as the residual-value method, since we essentially deduct the value of all other identifiable assets to arrive at a residual amount that we attribute to the orbital slot asset.

We begin by estimating the enterprise value of Loral and converting this into an estimate of the market value of Telesat's equity. We combine the market value of Loral's shares and the book value of its long-term liabilities to estimate its enterprise value. We use the book value of Loral's long-term liabilities as a substitute for the *market value* of its debt capital. We deduct the value of various identifiable assets such as cash and fixed assets. We use book values since market values are unavailable for these assets, except for cash and other liquid assets.

**Table 38 Calculation Loral's enterprise value and franchise value**

| Line | Item | Calculation | Amount (US$) |
|---|---|---|---|
| A | Stock price | -- | 35.00 |
| B | Shares outstanding | -- | 29,850,000 |
| C | Market capitalization | =A×B | 1,044,750,000 |
| D | Long-term liabilities | -- | 380,143,000 |
| **E** | **Enterprise value** | **=C+D** | **1,424,893,000** |
| F | Less: cash and other liquid assets | -- | 168,205,000 |
| G | Less: fair value of fixed assets | -- | 207,996,000 |
| H | Less: long-term receivables | -- | 248,097,000 |
| I | Less: value of intangible assets | -- | 20,300,000 |
| J | Less: other identifiable assets | -- | 27,998,000 |
| K | Total market value of assets | =∑F to J | 672,596,000 |
| **L** | **Franchise value of LORAL** | **E−K** | **752,297,000** |

Source: Loral 2009 10-K and *Yahoo Finance*

After deducting the estimated market values of Loral's identifiable assets, we arrive at an estimate of its franchise value. We determine Loral's enterprise value – i.e., the value of all its long-term capital – is equal to US$1.4 billion. Of this amount, we identify US$672.6 million in assets that contribute to this enterprise value. The balance of Loral's enterprise can be attributed to the presented value of the economic profit that its ongoing business operations in satellite manufacturing and satellite services generate for its capital suppliers. This can also be referred to as Loral's franchise value and is equal to an estimated US$752.3 million.

We use the relative contribution of Loral's two lines of business – satellite manufacturing and satellite services – to its overall EBITDA to allocate its overall franchise value. We find that satellite services contributed US$488.0 million of Loral's total 2009 EBITDA of US$579.0 million. As such, we allocate 84%

[56] We use the share price as of December 2009, so that it matches with detailed financial statement data we require to implement this valuation methodology. We note that Loral's shares were trading at around US$35.00 in December 2009. As of June 2010, the share price was at US$40.00; so, we believe the results of this analysis are still applicable.

of Loral's franchise value to its satellite services business, including its economic interest in Telesat. We find that the franchise value associated with Loral's satellite services business is US$634.1 million.

**Table 39 Allocation of franchise value**

| Line | Item | Calculation | Amount |
|---|---|---|---|
| A | **Franchise value of LORAL (US$)** | -- | **752,297,000** |
| | EBITDA by Segment, 2009 (US$) | | |
| B | Satellite manufacturing | -- | 91,000,000 |
| C | Satellite services | -- | 488,000,000 |
| D | Total | -- | 579,000,000 |
| | Adjusted EBITDA shares | | |
| E | Satellite manufacturing | -- | 16% |
| F | Satellite services | -- | 84% |
| G | Total | -- | 100% |
| | Allocation of franchise value (US$) | | |
| H | Satellite manufacturing | =E×A | 118,236,661 |
| **I** | **Satellite services** | **=F×A** | **634,060,339** |

Source: Loral 2009 10-K

Due to foreign ownership restrictions in place at the time of the Loral-Telesat transaction, Loral holds a 64% economic interest in Telesat, but only a 33% voting interest. As a result, Loral treats its investment in Telesat as a minority interest investment. Because Loral only holds a minority interest, its investment is subject to a minority-interest discount. This discount reflects the fact that it cannot offer a potential purchaser enough voting shares for it to take control of Telesat. Minority interest discounts can range from 25% to 40%. We use a rate of 30% and adjust Loral's satellite service franchise value to reflect this. The adjusted value of Loral's equity interest in Telesat is US$824.3 million.

To convert Loral's investment in Telesat into an estimate of the total market value of Telesat's equity, we have to take into account that Loral's holds a 64% economic interest. In other words, it has a claim on 64% of the dividends and net value of Telesat. If Loral's 64% economic interest in Telesat is worth an estimated US$824.3 million (by our calculations), then 100% of Telesat's equity has to be worth US$1,287 million or $1,339 million in Canadian currency (based on an exchange rate of $1.04 per US$1.00).

**Table 40 Calculation of implied market value of Telesat equity**

| Line | Item | Calculation | Amount |
|---|---|---|---|
| A | **Franchise value of LORAL's satellite services business ($)** | -- | **634,060,339** |
| B | Minority interest discount | -- | 30% |
| C | Adjusted value of Telesat economic interest | =A÷ (1+B) | 824,278,440 |
| D | Loral share of Telesat | -- | 64% |
| E | Implied market value of Telesat shareholders' equity | =D÷ (1+D) | 1,287,935,063 |
| F | Exchange rate | -- | 1.04 |
| **G** | **Implied market value of Telesat shareholders' equity (Canadian currency)** | **=D×F** | **1,339,452,465** |

Source: Loral 2009 10-K, Bank of Canada and Nordicity research

To this estimate of the market value of Telesat's common equity we add estimates of the market value of its other sources of capital – long-term debt and preferred shares – to arrive at an estimate of its enterprise value.

**Table 41 Estimate of Telesat enterprise value**

| Line | Item | Calculation | Amount |
|---|---|---|---|
| A | **Implied market value of Telesat shareholders' equity** | -- | **1,339,452,465** |
| B | Debt financing | -- | 3,013,738,000 |
| C | Tax liability | -- | 269,193,000 |
| D | Other long-term liabilities | -- | 671,523,000 |
| E | Preferred shares | -- | 141,435,000 |
| F | Total debt and preferred shares | =∑B to E | 4,095,889,000 |
| **G** | **Enterprise value (Debt + preferred shares + market value of equity)** | **=A+F** | **5,435,341,465** |

Source: Nordicity calculations and Telesat 2009 20-F

We deduct the estimated market value of Telesat's liquid, tangible and finite-life intangible assets to arrive at an estimate of the residual value of Telesat not accounted for identifiable assets. We identify $2,519 million in liquid, tangible and finite-life intangible assets, and deduct this sum from Telesat's estimated enterprise value of $5,435 million to arrive at estimate of its residual value – value not accounted for by identifiable assets – of $2,917 million.

**Table 42 Estimate of residual market value of Telesat**

| Line | Item | Calculation | Amount |
|---|---|---|---|
| A | **Enterprise value (Debt + preferred shares + market value of equity)** | -- | **5,435,341,465** |
| B | Less: cash and other liquid assets | -- | 154,189,000 |
| C | Less: fair value of fixed assets | -- | 1,926,190,000 |
| D | Less: other long-term assets | -- | 41,010,000 |
| E | Less: finite-life intangible assets | **--** | 380,328,000 |
| F | Less: value of trade name | -- | 17,000,000 |
| G | Total market value of liquid, tangible and finite-life intangible assets | ∑B to F | 2,518,717,000 |
| **H** | **Residual market value of Telesat** | **=A−G** | **2,916,624,465** |

Source: Nordicity calculations and Telesat 2009 20-F

Finally, we allocate this amount between goodwill and the only remaining unvalued asset – orbital slots. We perform this allocation referring back to the distribution of the Loral purchase price in October 2007. At the time of the Loral-Telesat transaction, the goodwill was equal to 4.1 times the value ascribed to the orbital slots. This implies that the orbital slots accounted for 19.6% of the value allocated to these two intangible assets. If we apply this 19.6% distribution share to our estimate of residual market value Telesat at December 2009, we find that the orbital slot intangible asset has an estimated fair market value of $571.7 million. As 83% of this amount can be attributed to North America, we assign a valuation estimate of **$474.5 million** to Telesat's Canadian satellite spectrum.

**Table 43 Estimate of residual market value of Telesat**

| Line | Item | Calculation | Amount $ |
|---|---|---|---|
| A | **Residual market value of Telesat** | -- | **2,916,624,465** |
| B | Orbital slot share of balance sheet allocation to goodwill and orbital slots at October 2009 | -- | 19.6% |
| **C** | **Estimate of current value of orbital slot** | **=A×B** | **571,658,395** |
| D | North America share of revenues | -- | 83% |

| Line | Item | Calculation | Amount $ |
|---|---|---|---|
| **E** | **Estimate of current value of Canadian orbital slots** | **=C×D** | **474,476,468** |

Source: Nordicity calculations and Telesat 2009 20-F

This result is consistent with our view that the book value of this asset should be higher than it currently appears on Telesat's balance sheet. Moreover, it reflects our view that economic conditions in the satellite services market have recovered to where they were at the time of the Loral-Telesat transaction in October 2007.

The estimate of the current fair market value of Telesat's orbital slots can be converted to annualized per-MHz amount in the same manner as we converted the reported book values. Using the perpetuity-basis, a fair market value of $474 million is equivalent to an annualized amount of **$2,291 per MHz**. Using the remaining-life basis method, the valuation of the spectrum is held by Telesat is **$4,246 per MHz per annum**.

## 5.5 Summary of valuation results

In this section, we have used three market comparables valuation methods to generate estimates of Canadian satellite spectrum. We have examined the results of a limited number of satellite spectrum auctions. We have also referred to the fair value of orbital slots reported by Telesat in its financial statements at the time of the Loral-Telesat transaction and following a December 2008 restatement of the carrying value of the orbital slot asset. We have also used Loral's current share price to deduce the current value of Telesat's orbital slot asset. In preparing these valuation estimates, we have applied a perpetuity-basis approach and a remaining-life basis approach. The valuation results are summarized in Table 44.

Table 44 indicates that market comparables valuation approaches generate a very wide range of valuation results. The auction results provide very little precision. The results generated may be somewhat inflated on account of transaction premiums paid at the time of the Loral-Telesat transaction. The December 2009 valuation results, while more recent than the October 2007 results, invariably, understate of the current value of the intangible asset. The December 2009 valuation results reflect economic conditions at the depth of the financial crisis of 2008. GAAP offers no provision for companies, such as Telesat, to re-value their intangible assets as economic conditions improve.

**Table 44 Summary of market comparables valuation results ($ per MHz per annum)**

| | Auctions | October 2007 | December 2009 | Updated (based on share) | Share-price residual value approach |
|---|---|---|---|---|---|
| Perpetuity basis | -- | 3,867 | 454 | ~500 | 2,291 |
| Useful-life / fixed-term basis | 36 to 94,792 | 7.167 | 842 | ~1,000 | 4,246 |

Source: Nordicity analysis

When the December 2009 valuation results are adjusted upwards by 30% – the approximate appreciation of in the share of satellite services company, SES – the valuations results are somewhat higher, but still lower than the amounts suggested by a residual-value approach whereby Loral's current share price is used to deduce the value of Telesat's Canadian satellite orbital slots.

# 6 Optimized Deprival Valuation

Another approach to spectrum pricing pioneered by Ofcom in the United Kingdom – and increasingly being adopted by spectrum managers in other jurisdictions – involves determining fees using the marginal value of spectrum based on its opportunity cost:

> *The opportunity cost of spectrum… reflects the value to a user that is deprived of the use of that spectrum, and is based on the user that places the most value on that being able to use a particular band of spectrum out of the potential users currently excluded from its use.*[57]

The use of incentive-based prices for spectrum is commonly referred to as administrative incentive pricing (AIP).

The objective of this pricing methodology is to influence spectrum users so that:[58]

- decisions on spectrum use reflect the value of that use;
- users of the spectrum consider alternative means of communication – not necessarily requiring access to the radio spectrum – and seek to avoid use of the most congested frequencies;
- existing users examine their spectrum needs and shed surplus spectrum; and,
- new entrants and new technologies have a greater chance of gaining access to the spectrum if their use has a higher potential value.

Calculation of the opportunity cost of spectrum is a non-trivial exercise and can be extremely time-consuming, depending on the nature of the services operating over the spectrum band. It requires economic models of a representative user that include a number of inputs and assumptions, which may have varying degrees of risk and uncertainty. Such models also require an understanding of the costs and cost drivers of the services utilising the spectrum.

A variation of AIP – optimized deprival value (ODV) – has been used in New Zealand in the utility sector, and for valuing spectrum in the 800/900 MHz bands. Key concepts within the ODV approach include: [59]

- costs should be based on modern equivalent assets;
- assets should be costed using an optimal configuration, in terms of cost efficiency;
- the value based on a modern equivalent, optimized system should not exceed the present value of the future cash flows that can be generated from utilising the assets.

The incremental ODV approach seeks to quantify the incremental costs that are incurred to deliver the same quantity and quality of services with a reduced amount of spectrum. By owning the spectrum rights, these costs are avoided and thus represent the value of the spectrum to the operator.

As this is an incremental approach, it is only necessary to consider those costs that are affected by the deprival of spectrum, and thus a full business model is not required.

[57] Ofcom (2007) *Modifications to spectrum pricing*, statement, January 10, 2007.
[58] Ofcom (2006) *Modifications to spectrum pricing*, consultation, July 6, 2006.
[59] PricewaterhouseCoopers and NZIER (2006) *Renewal of spectrum rights for cellular services pricing methodology*, discussion paper for the New Zealand Ministry of Economic Development, July 2006.

### 6.1.1 Opportunity cost and social benefits

Various commentators have also noted that the opportunity cost, as determined by AIP, does not take into account social benefits that may be associated with particular services, such as those related to public service broadcasting, or emergency services. In its 2004 review[60] of spectrum pricing in the UK, Indepen – an economics consultancy - considered whether externalities or social benefits should be considered as part of the opportunity cost methodology. Indepen concluded that such considerations should be addressed by subsidising end users rather than subsidising the price of spectrum. Ofcom noted[61] that efficiency may be affected if AIP is modified with the aim of promoting particular social benefits, and that such goals should be addressed using other mechanisms.

## 6.2 Optimization

The hypothetically efficient operator is an underlying assumption commonly associated with regulatory cost modelling. In practice, however, this level of efficiency is impossible for any operator to achieve due to various practical considerations, such as constraints on the location of infrastructure, the capacities of network assets as supplied by vendors, or the need to provision spare capacity ahead of time to meet anticipated demand. Indeed it can be argued that it is more cost-effective for an operator to deploy some level of spare capacity than to increase capacity on a just-in-time basis. It is therefore common practice to permit regulatory costs to include some reasonable level of spare capacity.

Operator benchmark data may be used to determine how much spare capacity can be considered acceptable.

Unlike terrestrial infrastructure, for which it is normally a straightforward exercise to upgrade equipment or increase capacity as demand increases, the technical configuration of a satellite is largely fixed for the entire physical lifetime of the satellite, which is typically around 15 years.

Operators must therefore plan to have sufficient capacity installed on the satellite to meet the anticipated demand over the satellite's lifetime. This means that the early years of a satellite can be characterized by a significant amount of spare capacity.

Some of the strategies for addressing satellite spectrum deprival (discussed in the next section) assume there is sufficient spare capacity to deliver services on an alternative satellite or spectrum band.

## 6.3 Defining the deprival for satellite spectrum

The underlying assumption of the ODV approach is that spectrum and network configuration are substitutable inputs for maintaining a given level of output. Certainly this is true for terrestrial mobile cellular networks. A cellular operator can deploy additional cell sites to compensate for the reduced spectrum, and there may be other options available for increasing capacity of existing cell sites, depending on the characteristics of the base stations.

The situation is very different for a satellite operator. Once a satellite is launched, there are few, if any, options available to reconfigure the satellite to address a reduction in spectrum. Loss of spectrum means that the services delivered via satellite are reduced, which will also result in reductions in revenue. So the pertinent question becomes: What options are there for maintaining services (and revenue)?

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[60] Indepen, Aegis Systems and Warwick Business School (2004) *An economic study to review spectrum pricing*, February 2004.

[61] Ofcom (2006) *Modifications to spectrum pricing*, consultation, July 6, 2006.

The options include:

- **Shift services to another spectrum band**. Due to the differing characteristics of the various satellite bands, and the services that use those bands, it is generally not feasible to shift services to an alternative band, even if there is sufficient capacity on the satellite.

- **Shift services to another satellite.** Capacity on another satellite could be used to deliver services. However, this does not represent the substitution of spectrum by network configuration; rather, it is the use of spare capacity on the operator's network or purchasing capacity from an alternative supplier.

Clearly, in the case of satellites, the premise that spectrum and network configuration are substitutes for maintaining a given output does not hold.

Other issues associated with the definition of the deprival margin include the following:

- There may be certain 'natural' increment sizes which are technology-dependent, for example UMTS requires spectrum in multiples of 5 MHz.
- The relationship between spectrum amounts and costs may be non-linear, in which case a marginal increase in spectrum will give a different result from a marginal decrease in spectrum.
- The spectrum remaining after a marginal decrease must be sufficient to support coverage and service quality within the market environment.

Although we identified that the ODV methodology is not directly transferable to the case of satellite spectrum, we developed a model that uses an adaptation of ODV. While it would not be appropriate for use in setting spectrum prices (for the reasons outlined above), it does provide an illustration of the modelling process and various implementation issues associated with ODV, and thus may assist Industry Canada in the application of ODV to other more suitable spectrum bands.

The increment of deprival spectrum was defined to be the capacity of one transponder, as this was viewed as the 'natural' increment size for satellites.

Deprival – under all scenarios – therefore involves the removal of the capacity of one or more satellite transponders, which reduces the spectrum available to the satellite. The different scenarios refer to the approach taken by the satellite operator in addressing the loss of the spectrum. We considered three scenarios:

- **Large operator** – the operator obtains capacity to replace the lost transponder capacity from another of its own satellites.
- **Small operator** – as above, but the operator leases capacity from an alternative satellite operator.
- **Reduced capacity –** the deprival capacity is not replaced, and the services offered are reduced.

The following sections outline our approach.

## 6.4 The ODV model

We developed a model framework – implemented in Microsoft Excel – that will allow the user to explore the effects on spectrum value due to the various scenarios of spectrum deprival and other assumptions.

The model is based on the satellites used in the income approach valuation, namely a generic C- and Ku-band satellite and the Anik F2 Telesat Canada satellite.

The ODV model calculates the cashflows for the deprival and non-deprival situations over a period of 15 years for the selected assumptions. The NPV is determined for each situation, and then the ODV for the 15-year period is calculated as the difference between the two NPVs.

An annualized ODV per MHz is calculated by dividing the ODV by the capacity of the deprived transponders (in MHz), and annualized by dividing by 15.

Choice of assumptions can have a significant effect on the model result.

## 6.5 Costs and cost drivers

Estimation of the ODV requires the identification of the costs that are affected by the deprival of spectrum.

Under the deprival situation, there will be an incremental cost incurred by the operator, which is dependent on the scenario selected and can comprise:

- **transition costs** – there will be costs associated with moving demand onto a transponder from another satellite (for example, realigning antennas); these costs are dependent on the type of demand, the number of affected sites and the location of those sites (note that under the reduced capacity scenario, transition costs are not incurred)
- **operating costs** – under a catastrophic deprival situation, in which all transponders are removed, the satellite is effectively unused, and thus the operator will no longer incur operating costs for that satellite, reducing costs (if however at least one transponder is still delivering service, the full satellite operating costs will continue to be realized)
- **leasing costs** – for the small operator scenario, there will be leasing costs associated with the replacement capacity
- **loss of revenue –** under the reduced capacity scenario, the reduced services will return a lower revenue.

Note that under the large operator scenario, if the satellite operator is not required to pay any transition costs, the ODV is zero. This assumes that the operator has sufficient spare capacity on another of its satellites.

Under the small operator scenario, if the satellite operator is not required to pay any transition costs, the ODV represents solely the cost of leasing replacement capacity from another satellite operator.

### 6.5.1 Transition costs

The transition costs can be a key driver for the incremental cost of deprival. These represent the one-off costs incurred in transferring to an alternative satellite the demand (traffic) that would have utilized the transponder capacity removed through the spectrum deprival.

These costs include activities such as realigning, or re-pointing, antennas, and are dependent upon the type of demand served by the transponder and the location of the antenna that is affected.
The two main factors that influence the cost of an antenna re-point are:

- the size of the antenna and therefore the manpower and cost required to undertake the re-point of the antenna, and
- time required for the technician/technicians to travel to and from the location of the antenna.

For DTH and small antennas this travel time is commonly known as a truck roll. A technician will drive to the antenna site and can re-point a small DTH antenna within a short time. The most significant cost in this case, even though it is relatively small, is the time to travel to and from the site.

Most networks in remote areas are at C-band, for which the antennas are much larger (typically 3 to 4.5m) than those for DTH (60 to 70cm). Larger antennas take longer to re-point but the most significant cost for remote sites is the travel time and expense as these site visits would often require an air charter.

In the case of DTH, rather than re-pointing the antenna, the transition cost includes the installation of equipment that enables the antenna to receive service from an additional satellite (as well as from the original satellite).

The assumed transition costs are based on typical costs incurred for re-pointing antennas, and are shown in table 45.

**Table 45 Transition costs per site**

| Type of site | Transition cost per site |
|---|---|
| Television site | 5,000 |
| DTH subscriber | 150 |
| Broadband subscriber – populated area | 150 |
| Broadband subscriber – rural area | 1,000 |
| Broadband subscriber – remote area | 5,000 |
| Data network hub | 5,000 |
| Data network remote | 150 |

Source: Nordicity

Our model also included an option for a fixed transition cost – that is, a transition cost that is not driven by the number of sites affected by deprival – however we have assumed this to be zero.

We have also assumed that the transition costs are incurred in year 1 of the model time horizon.

The important question relating to transition costs is: who pays for the transition costs, the satellite operator or the wholesale customer whose earth segment will be affected by the loss of a transponder?

The satellite operator would generally seek to externalize the costs of re-pointing of the antennas and other transition costs if at all possible. However, should the wholesale customer be burdened with the transition costs incurred due to the loss of a transponder on their provider's satellite, or is some level of compensation warranted?

In the situation where the satellite operator externalizes the costs and, if demand is elastic, then there is a risk of losing customers and therefore revenue. Maintaining output under deprival is one of the fundamental principles of the ODV methodology.

Whether compensation is paid may depend on the nature of the contract between the satellite operator and its wholesale customer. In our modelling, we have assumed (unless otherwise specified) that the satellite operator will pay the transition costs – this assumption can be changed within the model, via an assumption regarding the proportion of transition costs that are payable by the satellite operator.

### 6.5.2 Financial and satellite data

Capital expenditure, operational expenditure, revenues and satellite characteristics for the modelled satellites are based on the same sources of information used for the Income Approach Valuation model – the relevant cells within the ODV model are explicitly linked to the Income Approach Valuation model.

As the satellite may have transponders for more than one spectrum band, the model allocates capital and operational expenditure to each of the spectrum bands in proportion to the number of transponders in each band. Other allocation methods could be used, however as the model focuses only on incremental costs, alternative allocations have no material effect on the model results.

## 6.6 Other inputs and assumptions

### 6.6.1 Site snapshots

The ODV model includes a number of profiles, or ‘site snapshots’ that represent examples of the demand that could be served by a transponder. Each site snapshot specifies the number of sites for various types of site, including:

- television distribution sites
- DTH subscribers
- broadband, for three area types – populated, rural and remote
- data networks.

### 6.6.2 Cost of capital

The cost of capital that was used in the income approach valuation – 9.0% – was used in the ODV model.

## 6.7 Model results

The results presented here should be viewed in the context of illustrating the analysis of results from an ODV model. As discussed previously, we have found that the ODV approach is not appropriate for use in setting prices for satellite spectrum.

Our key findings were:

Choice of site snapshot can have a huge effect on the model results – the more sites that are affected by the deprival, the higher the cost of deprival (if the satellite operator internalizes the transition costs).

Some outcomes would not be realistic for the satellite operator, as the strategy selected to address the deprival scenario would not be economically feasible for the operator to undertake.

The different satellites have little effect on the total costs. This is because the licence fee is driven largely by earth segment costs, not space segment costs. Any variation in results between satellites is generally due to variations in capacity (in MHz) of the deprived transponders, thus affecting the cost per MHz.

### 6.7.1 C-band

C-band is used for satellite distribution of content to cable head-ends and within the broadcaster's regional network. Television distribution typically involves 400 to 500 sites, although regional networks could comprise around 40–70 sites. C-band is also used for broadband in remote areas.

We developed five site snapshots for C-band which give a wide range of results, due to the variation in the number of sites affected by deprival (table 46). In this case, all satellites give the same results as only earth segment costs affect deprival costs.

**Table 46 ODV model results for C-band using the large operator scenario and the satellite operator paying all transition costs (annualized ODV per MHz)**

| Snapshot number | Sites per transponder | Service | Annualized ODV per MHz |
|---|---|---|---|
| 1 | 500 | Television distribution sites | 4,247 |
| 2 | 400 | Television distribution sites | 3,398 |
| 3 | 70 | Television distribution sites | 595 |
| 4 | 40 | Television distribution sites | 340 |
| 5 | 50 | Broadband – remote areas | 425 |
| **Mean** | | | **1,801** |
| **Median** | | | **595** |

Source: Network Strategies

If we use the small operator scenario with the satellite operator not paying any transition costs, then the annualized ODV per MHz is $25,020 for all site snapshots.

### 6.7.2 Ku-band

Ku-band is used primarily for DTH, and so the three site snapshots used in the model are all for DTH (table 47). While some data networks still use Ku-band, we understand that these are migrating to Ka-band, and so no data network snapshots were developed for Ku-band.

**Table 47 Ku-band site snapshots used in the ODV model**

| Snapshot number | DTH subscribers | Comments |
|---|---|---|
| 1 | 1,900,000 | Equivalent to Bell ExpressVu subscribers |
| 2 | 900,000 | Equivalent to Shaw subscribers |
| 3 | 500,000 | Hypothetical smaller operator |

Source: Nordicity

Subscribers for the first two site snapshots are equivalent to those for Bell ExpressVu and Shaw, while the third is a hypothetical smaller operator created to assess the impact on the costs for an operator with fewer sites.

Deprival costs are identical for all satellites, as they are driven only by earth segment costs.

Due to the large numbers of DTH antennas that require re-pointing, the transition cost is extremely high, resulting in a median ODV per MHz of $305,810 (table 48).

**Table 48 ODV model results for Ku-band using the large operator scenario and the satellite operator paying all transition costs (annualized ODV per MHz)**

| Snapshot number | DTH subscribers | Annualized cost per MHz |
|---|---|---|
| 1 | 1,900,000 | 645,600 |
| 2 | 900,000 | 305,810 |
| 3 | 500,000 | 169,895 |
| **Mean** | **1,100,000** | **373,768** |
| **Median** | **900,000** | **305,810** |

Source: Network Strategies

In fact, in this case an operator would not employ a strategy of re-pointing antennas – it would be uneconomic due to the large number of sites involved.

A more realistic scenario for the operator would be to offer a reduced service to its subscribers at a reduced price. This is however contrary to the fundamental ODV principle in which under deprival the same service is offered and returning the same revenue.

Nevertheless, we have also assessed the outcome for Ku-band using the reduced capacity scenario (table 49). Under this scenario the net effect on costs is a reduction in revenue proportional to the loss of transponder capacity, which is not dependent on the number of DTH subscribers.

**Table 49 ODV model results for Ku-band using the reduced capacity scenario (annualized ODV per MHz)**

| Snapshot number | DTH subscribers | Annualized cost per MHz |
|---|---|---|
| 1 | 1,900,000 | 29,300 |
| 2 | 900,000 | 29,300 |
| 3 | 500,000 | 29,300 |
| **Mean** | **1,100,000** | **29,300** |
| **Median** | **900,000** | **29,300** |

Source: Network Strategies

If we use the small operator scenario with the satellite operator not paying transition costs, then the annualized ODV per MHz is $33,360 for all site snapshots, which is comparable to the reduced capacity scenario.

Another strategy to address deprival would be for the operator to replace the satellite. An existing satellite (either already owned by the operator or available for acquisition from another operator) could be moved into the orbital slot, however this assumes that there is a suitable satellite with sufficient spare capacity available. Alternatively a replacement satellite could be commissioned and launched, however this would incur a lead time of two to three years before services become commercially available. The cost of either option would be quite high, and there would need to be a valid business case for moving a satellite into the orbital slot rather than leasing transponders, especially if only a small number of transponders are required.

As an illustration, if we consider replacing the Nimiq 1 satellite with a new satellite in that orbital slot, the capital expenditure would be approximately $191 million (comparable to that for the Nimiq 1 satellite), then as the deprival amount is the full capacity of the Nimiq 1 satellite, and assuming that the total bandwidth in use is 1000MHz, the annualized cost per MHz would then be $11,736. This also assumes that the operating expenses of the new satellite are the same as those for the replaced satellite, the replaced satellite no longer incurs operating costs, there are no decommissioning costs for this satellite and that the replacement satellite can be acquired in year 1 (no lead time required).

### 6.7.3 Ka-band

Ka-band is used mostly for broadband services, as well as for data networks.

The maximum number of broadband subscribers that can be served by a single transponder is 6,000, however a long period of subscriber growth is generally required to achieve that level of demand. We therefore selected three site snapshots relating to broadband subscribers, representing 100%, 50% and 25% capacity.

We have also incorporated two site snapshots for data networks. Data networks can comprise 50 to 500 remotes per hub, and any single data network could be served by up to three or four transponders. Both site snapshots comprise five data networks, with one assuming 50 remotes per hub and the second 500 remotes per hub.

The five site snapshots are summarized in table 50.

**Table 50 Ka-band site snapshots used in the ODV model**

| Snapshot number | Sites per transponder | Comments |
|---|---|---|
| 1 | 6,000 | Broadband subscribers |
| 2 | 3,000 | Broadband subscribers |
| 3 | 1,500 | Broadband subscribers |
| 4 | 5 | Data networks with 50 remotes per hub |
| 5 | 5 | Data networks with 500 remotes per hub |

Source: Nordicity

Only the Anik F2 satellite within the model has Ka-band transponders. There is a wide range of results across the various site snapshots (table 50).

Selecting the small operator scenario with the satellite operator not paying any transition costs gives an annualized ODV per MHz of $10,723 for all site scenarios.

**Table 51 ODV model results for Ka-band using the large operator scenario and the satellite operator paying all transition costs (annualized ODV per MHz)**

| Snapshot number | Generic | Anik F2 |
|---|---|---|
| 1 | -- | 983 |
| 2 | -- | 491 |
| 3 | -- | 246 |
| 4 | -- | 68 |
| 5 | -- | 437 |
| **Mean** | **--** | **445** |
| **Median** | **--** | **437** |

Source: Network Strategies

### 6.7.4 Obtaining a point estimate from a range of results

As we have seen above, the results are highly dependent on the assumptions and span a wide range of values. The modeller would normally eliminate less likely scenarios and assumptions to reduce the range of results and facilitate the process of establishing a point estimate for use in setting a spectrum price. In the case of satellites, the lack of typical profiles creates additional challenges.

The simplest approach to obtaining a point estimate for a range of values is to average the results, however this may not necessarily be the most appropriate measure in this instance.

The average, or mean, is a calculated value that does not necessarily represent a valid site snapshot. Although it would be possible to reverse-engineer site snapshots that would deliver an ODV equal to, or close to, the mean value, the derived site snapshot may not necessarily be realistic with respect to the satellite market, in particular if the site snapshots represent very different types of demand.

An alternative measure that could be used is the median. This has the advantage that it does represent a valid site snapshot, and the ODV value can be assessed against the likelihood of the relevant site snapshot. Other measures that also have this characteristic are quartiles or percentiles, as well as the maximum and the minimum.

## 6.8 Summary

We find that due to the characteristics of satellite spectrum and satellite technology, the ODV approach is not appropriate to be used for setting spectrum prices.

The main problem is that in the case of satellites, spectrum and network configuration are not substitutes for maintaining a given level of output, which thus contravenes a basic premise of the ODV approach. However, our description of the implementation process for developing an ODV model should provide Industry Canada with valuable information that will facilitate the application of ODV for spectrum bands that are more compatible with the underlying principles of the methodology.

# 7 Assessment of valuation methodology and results

In this section, we examine the relative strength of the three valuation methodologies: income approach, market comparables and ODV and assess which one provides the strongest basis for developing a satellite fee structure. We compare these results to the international benchmarking results as mandated by the *User Fees Act*. Finally, we determine a recommended methodology for satellite fee setting. We also examine the merits of a number of arguments which have currency in the industry to determine whether these might influence the validity or application of the recommended methodology.

## 7.1 Assessment of the relative strengths of three methodologies

In developing the market comparables approach, we examined data from auctions, corporate transactions and share prices.

There have been very few auctions and the results have varied when averaged over the duration of the licence term on a per-MHz basis – from $36 per MHz per annum to $94,792 per MHz per annum. While many of the values achieved at auction are comparable to the cost-recovery fees charged by the FCC or the liability insurance premium paid by UK satellite licensees, others – the 1996 US and 2005 Mexican results in particular – are far greater. The caution in using auctions for fee benchmarking is that although auction results are often considered to provide a strong indication of market value, they are also very sensitive to multiple variables. These variables include time (particularly the condition of the economy during the auction), competition, the auctioned good, geographic and social conditions (particularly population, population density and challenges posed by the geography of the potential service areas), and irrational bidder exuberance.

There have been relatively few corporate transactions in the global satellite business in which the financial details of the satellite assets were made public. Fortunately, the Loral-Telesat transaction involved the largest Canadian operator, was recent (2007-08) and provided financial data. We applied both the perpetuity and remaining economic life methodologies to this transaction. The perpetuity valuation approach, which converts the book value of the orbital slot intangible asset into an annualized amount generates a value of **$3,867 per MHz** on an annual basis at the time of the original deal but only **$454 per MHz** on an annual basis based on the current book value. On a remaining-life basis, the original transaction valuation generates a value of **$7,167 per MHz** per annum; while the current book value of Telesat's orbital slot intangible asset points to a value of **$842 per MHz** per annum.

While GAAP requires companies to restate downwards the value of indefinite-life intangible assets, it does not also make provision to restate upwards the value of these assets. This is relevant because the economic prospects of the global satellite market have improved since late 2008 when Telesat restated the value of its orbital slot asset. After accounting for improvements in the economic prospects within the satellite services market, we raised the market comparables valuation based on Telesat Canada's financial statements to $1,000 per MHz per annum. This value, in effect, represents a floor on the valuation of Canadian satellite spectrum, since it is largely based on the impaired asset amount reported by Telesat Canada.

Using the current share price to deduce a value for Telesat's Canadian orbital slots yields valuation results of **$2,291 per MHz** per annum (perpetuity basis) to **$4,246 per MHz** per annum (remaining-life basis).

The results for the **market comparables** approach (based on auction results, corporate transactions, and public-share data) are higher than the fee benchmarking but less than the Income Approach.

In the **income approach,** we estimate the overall economic rent associated with satellite business opportunity utilising a satellite spectrum licence assigned by the Government of Canada. Our implementation (or application) of the income approach to a Canadian satellite licence involves the development of two separate but related DCF models: a generic dual-band satellite (C-band and Ku-band) and a valuation model based on the economics of Telesat's Anik F2 satellite. The economic rent valuation for the C-band is **$2,885 per-MHz** on an annual basis; for the Ku-band, the valuation result is **$3,847 per MHz** on an annual basis. For the Ka-band, our valuation model indicates that the economic rent generated on an annual basis is equal to **$4,332 per MHz**.

The strength of the income approach is that it is a commonly used methodology by regulators (e.g. UK, NZ for broadcasting spectrum) and financial analysts for estimating the market value of an asset such as spectrum. Financial analysts use the income approach to estimate the intrinsic value of a business or asset. This intrinsic value forms the basis of the valuation realized in a market transaction, because it will often set the boundary for the highest price that a buyer would be willing to pay or that a seller would be willing to accept in a transaction involving the asset. The income approach rests on the assumption that the value of an asset – such as spectrum – is a function of the discounted cash flow (DCF) that the asset has the potential to generate for the entity that controls the asset.

The income approach does have several limitations. While it provides an estimate of the economic rent generated by a satellite business opportunity, there is no assurance that 100% of this estimated economic rent can be attributed to the spectrum licence, per se. If any other inputs to the satellite business are priced below their market value, then, in theory, this under-pricing would also contribute to the economic rent estimate. Also, it is important to recognize that the estimate of the economic rent represents an upper boundary of what the satellite licensee would pay for the licence. In an auction, the licence winner would only need to pay one dollar more than the economic rent that the runner-up would have been willing pay. As such, auction wining bids are below the winner's full estimate of the licence's economic rent. For these reasons, it is extremely difficult for governments to extract 100% of any economic rent estimated by an income approach valuation, either through an auction or other means.

The results of the **ODV model** while valuable in demonstrating the methodology and instructive in illustrating the unique operating conditions of the satellite industry, do not meet the stringent requirements of the model for identical pricing and operating conditions for the client.

Overall, the **Income Approach** is the most robust and generally-accepted methodology. Using the Income approach – informed and supported by results from the Market Comparables Approach would provide the strongest basis for going forward in developing a satellite spectrum fee structure.

In setting spectrum fees, the application of a single fee parameter: $ per MHz which can be generated by both approaches would be administratively simpler for both the Ministry and the licensees.

## 7.2 Comparison of international benchmarking of fees to valuation results

In this section, we examine the results for the eight benchmark jurisdictions, then compare these with Canada and finally compare the fees with the results generated by the three methodologies.

### 7.2.1 Satellite spectrum fees for eight benchmark jurisdictions and for Canada

Although international satellite fees are based on a variety of policy regimes, annual satellite licence fees are surprisingly similar. For instance, the only fee paid by UK space station licensees is a mandated insurance premium, while US licensees contribute to the recovery of FCC costs and Brazilian licences were awarded through an auction, yet the annual fees for these three jurisdictions all fall in the $130,000 to $300,000 range.

It is a general rule globally that jurisdictions charging a substantial fee for space stations do not charge a fee of any significance for earth stations, and vice versa. The only anomaly on this front is the UK, which levies fees on earth stations and also requires space station licensees to "insure themselves (currently to

£100million) against third party liabilities arising from each licensed activity (i.e. the launch and in-orbit phases of the mission).” The annual premiums to carry such a policy are approximately £100,000,[62] resulting in a de facto annual licence fee for space stations in addition to Ofcom’s earth station transmission fees.

**Table 52 Satellite licence fees**

| Country | Licence | Band | Bandwidth | Annual Fee (Canadian $) | $/MHz/Year (Canadian $) |
|---|---|---|---|---|---|
| **Canada** | Satellite | C/Ku | 2,000 MHz | $666,667 | $333 |
| | | C | 1,000 MHz | $291,667 | $292 |
| | | Ku | 1,000 MHz | $375,000 | $375 |
| **UK** | Space station | n/a | **2,000 MHz** | $148,367* | **$74** |
| **US** | GSO space station | n/a | **2,000 MHz** | **$242,693** | **$121** |
| | NGSO space station | n/a | **2,000 MHz** | **$301,491** | **$151** |
| **Mexico** | Orbital Slot | n/a | 1,000 MHz | $850,680 | $850 |
| **Brazil** | Brazil Satellite | n/a | **1,820 MHz** | **$135,228** | **$74** |
| | Foreign Satellite | n/a | **2,000 MHz** | **$73,061** | **$37** |

Source: Nordicity research
See Appendix A for exchange rates

By and large, Canadian fees are higher than foreign fees – with the exception of those of Mexico. In particular, US fees are lower than current Canadian satellite fees.

### 7.2.2 Comparison of spectrum fees and valuation results

The eight jurisdictions comprising the Fee Benchmarking Approach generate results significantly lower than the Income Approach and the Market Comparables Approach as summarized in the figure below.

**Table 53 Comparison of spectrum fees and valuation results**

| Methodology Approach | Band & $/MHz per annum | | | | |
|---|---|---|---|---|---|
| | C/Ku | C | Ku | Ka | Undifferentiated |
| Income | -- | $2,885 | $3,847 | $4,332 | -- |
| Market Comparables | -- | -- | -- | -- | $1,000 to $4,246 |
| Benchmarking of eight jurisdictions | -- | -- | -- | -- | <$90 without Mexico; Approx. $175 |
| Canada (current licence fees) | $547 | $469 | $625 | -- | -- |

Source: Nordicity analysis

With the exception of Mexico, all of the countries have equivalent fees of less than $90 per MHz per annum. Current Canadian fees, while significantly higher than seven of eight jurisdictions, are lower than the fees derived from either the Income or Market Comparables Approach.

## 7.3 Limitations of analysis

The limitations of the income approach lies in the recognition that while providing an estimate of the economic rent associated with a satellite spectrum licence, it is in fact an estimate of the upper boundary

[62] Atrium Space Insurance Consortium

for a market transaction involving a satellite spectrum licence: it represents the maximum amount that the shareholders in a satellite business would pay to keep their spectrum licence. In practice, however, it is extremely difficult for the Crown to extract 100% of this economic rent, unless it knows with precision the satellite licence holder's future FCF and cost of capital.

# 8 Developing a Recommended Fee Schedule

In this section, we examine public policy objectives for satellite spectrum as well as industry arguments along with the results of our previous analysis (three methodological models, benchmarking, and current Canadian fee levels) in order to develop a new recommended satellite fee structure and transition period.

## 8.1 Ministerial and Canadian government objectives

In applying the Income Approach model, the Department must take into account various policy objectives, regulatory requirements, and limitations inherent to the model.

As indicated in the Benchmarking section, in setting satellite spectrum fees, Industry Canada is required to meet the requirements of the Department of Industry Act, the User Fees Act, the 2007 Spectrum Policy Framework (SPF) for Canada and Treasury Board Directive on public goods which confer ‘rights and privileges’. As stated in IC RFP for this project:

> *…the SPF dictates that in managing spectrum, the Department must "earn a fair return for the Canadian public for the privilege of access to spectrum - a public resource." The challenge is to set fees that reflect the underlying market value while taking into account the wide variations in different markets and comparing prices paid for the spectrum in different auctions, which is further complicated by varying economic conditions, different auction bidding strategies and the overall demand for the spectrum at the time.*

In devising a fee structure, Industry Canada must also take into account the contribution of satellite industry to national social and economic goals as set out in Section 2 Satellite Industry Overview. This would indicate that operators generate benefits for Canadians by their investment in the development of new technologies, construction of facilities, employment and purchase of goods and services.

## 8.2 Industry arguments regarding satellite fee structure and levels

### 8.2.1 Need for competitive business conditions

A number of satellite operators have expressed concern about the level of licence fees and the impact on Canada’s competitiveness in the international satellite market. In this industry argument, it follows that the Industry Canada in setting satellite fees should consider the international nature and specific North American nature of the satellite market. As indicated in Section 1 Overview of the Market, Canadian and US operations of most satellites are indissociable and the value of the American market for Canadian satellite operators far exceeds the value of the domestic market. Operators have argued that Canada fees should be competitive with US fees. Thus, the implication would be to give more weight to the US results in the international fee comparison than to results of other countries (see Fee Benchmarking section).

***Materiality of fees in the satellite business***

In assessing these US and foreign fee levels the materiality/substantiality of the fees as a cost item in the context of over all costs must also be taken into account. Under the current fee structure it would appear that neither the current level of Canadian licence fees nor those proposed within this study would have a substantial impact on the business plans of Canadian satellite operators.

### 8.2.2 Fairness/equity

Some portions of the satellite band provide similar if not identical services to terrestrial bands, and in some cases, the same band can be used by either satellite or terrestrial service providers. It might be argued that the Department, as the national regulatory authority, has the obligation to treat different categories of users – satellite and terrestrial equitably in setting fees and any differences in fee methodology and approach must be justified and transparent. Services which are similar and/or use the same band are generally charged fees on the same basis. With a change to the proposed market based fees for satellite spectrum, the Department will no doubt be under some pressure to develop a similar market based fee for terrestrial services. We understand that the Department is undertaking a complete review of all of its radio licence and spectrum fees and would suggest that this fairness/equity issue should be addressed within that process.

### 8.2.3 Canada coverage versus US coverage

The Department asked the Consultant to consider the market value of Canadian versus US coverage and whether this should be taken into account in setting the fee structure.

Though not uniform, most Canadian licensed satellites have North American (NA) footprints for C-, Ku- and Ka-bands, though in the case of Ka and the newer Ku satellites the use of spot beams can offer satellite capacity to specific locales within the NA coverage.

Much of the Ku capacity on Canadian satellites is sold to Canadian DTH providers, who can only offer service in Canada.

In licensing these satellites, the Canadian Government (through Industry Canada) has given special attention to ensuring that these satellite operators provide foreseeable services to Canadians; i.e. requiring Canadian satellite operators to canvas potential satellite users to determine Canadian needs before allowing the operators to sign deals to provide capacity to foreign entities.

Notwithstanding this, since most of the Canadian satellites have North American coverage, we believe that true market based licence fees should reflect that fact.

Of course, if the Ku band of the satellites were to be used to provide service to both Canadian and US customers, the value of the business would be greater that it currently is given the larger US market.

Offsetting this is the fact that under the Canadian government's satellite use policy, Canadian DTH providers can generally only use Canadian satellites to distribute their services, thereby giving Telesat and now Ciel, once it launches more satellites with Canadian coverage, a virtual duopoly for Ku-band capacity and therefore the ability to set appropriate prices.

The bottom line therefore is that trying to separate out the Canadian spectrum values of these satellites is not appropriate as the satellite business is international; furthermore Canadian satellite companies always take into account the North American potential prior to building and launching any satellite into a Canadian orbital slot and generally design their satellites with North American coverage patterns. Market value for the spectrum within those satellite slots should be based on this fact.

### 8.2.4 Orbital slots entirely outside the Canadian orbital arc

The Department asked the consultants to consider whether the regulator should actively file with the ITU orbital slots which lie entirely outside of the Canadian arc for satellite operators and if so, should the fee structure charged for such slots differ from that charged for slots in the Canadian arc.

The arguments for the Department to pursue these slots are the potential benefits to Canada in employment, technology development as well as potential lower costs of doing business which would be generated by satellite operators having these additional orbital slots. The satellite business is international and satellite spectrum outside the Canadian arc (e.g., European, Asian, mid-Atlantic and mid-Pacific slots) are critical to operators which provide data, voice, video services to the Canadian market in order to efficiently service their clients. In this argument, it follows that Canadian business benefit when new non-Canadian arc orbital capacity is added.

The potential benefits to Canada in employment, technology development as well as potential lower costs of doing business which would be generated by satellite operators having these additional orbital slots would likely be highest for mid Atlantic and mid Pacific slots which have significant Canadian traffic. These slots are critical for operators to service international business (data, voice, video) of Canadian and international clients. The potential benefits are likely much less when orbital slots which have minimal Canadian traffic as a percentage of total traffic (i.e., over Europe, Africa or Asia).

The question is whether there would be significant additional benefits over those which already occur in absence of any pro-active role by the Department in filing with the ITU for these slots i.e. the outcomes under a proactive approach have to be tested against the outcome under the status quo. To test the incremental impact, the following questions need to be answered:

Is there an orderly process which:

- Does the current licensing process of additional satellite capacity in international orbital slots (under status quo: the Department's role limited to Canada), result in an orderly and predictable process of new capacity globally (i.e. is there a supply capacity shortage issue which must be addressed internationally)?
- If the response to the first question is no, then do Canadian consumers and businesses already benefit from a fair share of the additional capacity resulting from the current international licensing regime?
- Would there be significant additional benefits to Canadian companies and the satellite sector from a proactive Department approach and consequently a closer working relationship between Department and satellite operators (i.e. would Canada gain a competitive advantage from closer collaboration in the licensing of satellite capacity outside the Canadian arc)?

We believe that there are no significant issues of delays in the addition of new international satellite capacity or of Canadian access to that new capacity. There appears to be an orderly process of addition of new satellite spectrum and large satellite companies file with NRAs in many jurisdictions simultaneously. Our research did not turn up best practice models of national regulators proactively filing for new satellite capacity in orbital slots outside their national arcs.

It is not certain whether the operators would file more with Canada if the Department as the NRA actively pursued the slots with the ITU. Most importantly, the benefits for Canadian satellite users whether the additional capacity was licensed in Canada or another jurisdiction are not obvious. In any case, filing in a jurisdiction is likely dependent on a host of considerations – including fees, business and personal taxes and business climate.

The Department has limited resources with which to serve its existing Canadian arc licensees and in adding new activity, service levels to current clients might suffer. The Department would have to have access to new resources in order to provide spectrum management and coordination for the licensing and subsequent operation of a new category of 'extraterritorial' licensees. In particular, the Department would need to be able to provide resources and possibly an internationally office(s) in order to respond to partial and catastrophic satellite failure.

In the case that the Department was to actively pursue international orbital slots outside the Canadian arc, it would be appropriate to charge the licensees/operators of these slots the full administrative costs of servicing this activity.

## 8.3 Proposed new satellite fee structure and fee levels

In devising the new satellite fee structure, we rely principally on the Income Approach supported by the Market Comparables Approach.

In developing the fee structure, we recognize that the economic rent values by these approaches cannot be applied without adjustments for satellite's economic and social contributions as well as the inherent uncertainties of economic models. Thus, it is recognized that satellite operators are the sole provider of broadband communications and broadcasting services in many remote areas and developed innovative solutions for business and consumers in those areas together with regional service providers. In many regional markets, satellite provides consumers a real alternative to incumbents and correspondingly, a choice in service packages, selection of individual programming and market-based pricing.

We also note that there inherent uncertainties in the calculation of economic value of satellite spectrum – irrespective of the approach or model used, due to data availability and validation, development of assumptions and the selection of scenarios.

The satellite industry is dominated by a few large global operators and financial results are not available for individual markets such as Canada. In developing our approaches, we were fortunate in being able to capture financial data from Telesat pre-2008 acquisition by Loral as well as some market transactions. Thus, as indicated in the Income Approach section, in developing the approaches, we were required to make assumptions at both the macro-economic (weighted average cost of capital, exchange rates and inflation) and at the operating level of an efficient operator (allocation of satellite capacity by band, launch costs, and commercial relationships between operators and users)

In setting the fee methodology and levels, the Ministry must take into account both the contribution of operators and the uncertainties inherent in the development of the models. One way of recognizing this contribution would be to calculate satellite spectrum fees based on a portion of the economic rent rather than on the full economic value of the spectrum. We believe a reasonable approach - to adjust for both contribution and uncertainties, would be to base the satellite fee structure on 40 to 70% of the economic value of the satellite spectrum, depending on the weight the Department puts on these factors. As an example, if one were to place the percentage of economic rent it wanted to garner at 50% of the value generated by the income approach, the Department could set fees at:

- C-band spectrum: **$1,400 per MHz** per annum
- Ku-band spectrum: **$1,900 per MHz** per annum
- Ka-band spectrum: **$2,200 per MHz** per annum

Alternately one could make a case for C/Ku band spectrum, which carries the preponderance of broadcasting application spectrum, having a value in the range of **$1,650 per MHz per annum** and Ka set at **$2,200 per MHz per annum**.

In the income approach fee analysis, we considered whether we should develop fees based on Canadian only coverage or North American coverage. We came to the conclusion that generally the true value of the spectrum in any particular orbital slot is based on North American coverage. We thus recommend that the calculation of fees continue to be based on the full geographic market coverage.

We consider a band specific fee because of the impact of the technologies that drive new efficiencies across bands. However, because of typical multi-band configurations of new satellites, we recommend the same fee for all three bands. This single cross-band fee rate would be set between $1,400 per MHz and $2,200 per MHz. For example, the Department could use the midpoint, $1,800 per MHz. Alternatively; the Department could use a weighted average (weighted by the current amount of assigned spectrum). Based on the current assignments, the weighted average would be $1,900 per MHz. As well, this approach offers more administrative efficiencies than separate fees for separate bands. As well, for purposes of administrative efficiency and simplicity, we conclude that the fees should be applied on a

$/MHz basis.

We would suggest that the question of fairness and equity in treatment of licensees across all terrestrial and satellite bands should be addressed by Industry Canada as it moves forward in its reviews all of its licence fees.

Overall, the proposed fee structure meets the criteria for global best practice in fee design in that is based on a rigorous examination of the evidence, consideration of alternative methodologies, testing against fee levels in other jurisdictions and relative simplicity and efficiency in its application.

### 8.3.1 Licence fee impact analysis

In this section we assess the impact of a scenario in which the Department sets satellite spectrum licence fees at a rate equal to 50% of the estimated economic rent associated with the spectrum. In particular, as part of our assessment, we calculate how the implementation of this licence fee scenario would affect the EBITDA of Telesat Canada.

According to Industry Canada, Telesat Canada currently remits $5.97 million, annually, in satellite licence fees, including spectrum licence fees and radio licence fees. We use this amount as the baseline amount in our impact analysis. Telesat Canada's current licence fees represent 0.8% of its total 2009 revenues of $727.8 million and 1.1% of its 2009 EBITDA of $559.8 million.

Under a scenario where the Department set licence fees equal to 50% of the estimated economic rent, the higher licence fee rates would increase Telesat Canada's annual licence fee remittances by $12.78 million to a total of $18.75 million. Telesat Canada's licence fees as a percentage of EBITDA would increase from 1.1% to 2.3%. Its EBITDA would drop to $546.7 million, and its EBITDA margin would drop from 71.1% to 69.5%. Overall, therefore, this licence fee scenario would cause Telesat Canada's annual satellite licence fee payments to the Department to more than triple, while causing its EBITDA margin to drop by nearly two percentage points.

**Table 54 Analysis of financial impact of licence fees in Telesat Canada**

| | Baseline: current licence fees | Impact of licence fee scenario (50% of economic rent) |
|---|---|---|
| **Spectrum in use (MHz)** | | |
| C band | 3,000 | 3,000 |
| Ku band / BSS | 6,500 | 6,500 |
| Ka band | 2,000 | 2,000 |
| Total | 12,500 | 12,500 |
| **Licence fees ($ per MHz)** | | |
| C band | -- | 1,400 |
| Ku band / BSS | -- | 1,900 |
| Ka band | -- | 2,200 |
| Total licence fees ($) | 5,970,000* | 18,750,000 |
| Net increase in annual licence fees ($) | -- | 12,780,000 |
| Annual revenue ($) | 787,200,000 | 787,200,000 |
| Licence fees % | 0.8% | 1.6% |
| EBITDA ($) | 559,500,000 | 559,500,000 |
| Licence fees % | 1.1% | 2.3% |
| EBITDA margin (baseline) | 71.1% | 71.1% |
| New EBITDA ($) | -- | 545,720,000 |
| New EBITDA margin | -- | 69.5% |

Source: Industry Canada and Nordicity analysis

* This amount includes $1,300,000 for C-band spectrum, $1,720,000 for Ku-band spectrum, $850,000 for Ka-band spectrum and $2.1 million in other licence fees.

Implementing the 50% of economic rent scenario would result in Canadian fee levels rising above those of all the countries benchmarked for this study. Most importantly the 50% economic rent fee scenario would be higher than Canada's major NAFTA commercial partners – both the US and Mexico – which currently have the highest fee levels (see Table 54 above). It could be argued that the 50% economic rent fee scenario would have a relatively modest impact on satellite operators' EBITDA, and would not put Canadian operators at competitive disadvantage vis-à-vis foreign operators. Thus, there would be little incentive for Canadian operators to register in another jurisdiction with lower fees.

However, satellite operators are increasingly mobile and their operations not tied to any one national jurisdiction – mirroring the global structure of the satellite market. Canadian satellite operators have underlined the importance of having a fee schedule in line with that of our major trading partners – in particular, the US. Thus, the possibility that satellite operators might use the higher fee levels as the occasion to move functions and jobs out of the country and register in another jurisdiction – especially for the launch of future satellite services – cannot be discounted.

### 8.3.2 Changes to Canadian Ownership and Control of Satellite Services

On July 12, 2010, Parliament[63] enacted legislation to eliminate Canadian ownership and control (O&C) requirements for license holders on Canadian satellite carriers. This decision allows eligible foreign satellite operators to obtain an FSS or BSS space station license from Industry Canada in one of the ITU-assigned Canadian orbital slots.

The decision to open the satellite market to foreign ownership harmonizes Canada with the regulatory US approach on satellite services. It opens the perspective of new investment in the satellite sector in Canada as it eliminates any limitations on voting shares, shareholders' rights or the composition of the board of directors. This change is also consistent with the 1998 decision to remove foreign ownership restrictions for fixed satellite services (FSS) and mobile satellite services (MSS) earth stations.[64]

In 2007-08, Loral Space and Communications purchased 64% economic interest but in keeping with the then restrictions on foreign ownership, only 33.3% voting interest in Telesat.[65] As a relatively small global operator (4th in terms of fleet size), it makes sense for Loral to consolidate ownership structures of its holdings in order to better compete in the global marketplace and/or to make itself more attractive to be bought out by a larger competitor as noted in the following trade magazine article:

> *"With the regulatory restrictions now removed, Telesat is an eligible acquisition target. Satellite*

[63] Section 16.2 of the *Telecommunications Act* was amended by Bill C-9 (the budget implementation act), to remove satellites from the application of the Canadian ownership requirements i.e. the term "satellites" added to the list of exempt transmission facilities. See following link http://www2.parl.gc.ca/HousePublications/Publication.aspx?DocId=4645839&Language=e&Mode=1&File=812. Also see article 'Canada Removes Foreign-ownership Restrictions on Satellite Carriers', Blakes Bulletin on Communications, July 2010 (http://www.mondaq.com/canada/article.asp?articleid=105744). Industry Canada 'Proposed Regulatory Text; Regulations Amending the Radiocommunication Regulations http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf01647.html

[64] "This amendment to the *Radiocommunication Regulations* concerns the eligibility requirements for licensing earth stations in the fixed and mobile satellite services. The existing regulations require that radiocommunication carriers be Canadian-owned and controlled in terms of voting shares, board membership, and control of the corporation. "These licensing eligibility requirements will be broadened to meet Canada's GATS-ABT commitments. Accordingly, a new provision is being added to the regulation*s* that complements the provision in the *Telecommunications Act* under which Canadian ownership and control provisions do not apply to "earth stations that provide telecommunications services by means of satellites".
"The new provision removes the requirement for Canadian ownership and control of licence holders for earth stations in the FSS and MSS that provide telecommunications services by means of satellites."

[65] Canada's PSP Investments, a pension fund, has a minority economic interest in the company but majority voting rights.

*fleet operator SES of Luxembourg has suggested it may be interested, and industry officials have said Paris-based Eutelsat is also a potential buyer. SES and Eutelsat, both cash rich and with little debt, are respectively the world's second- and third-largest fleet operators when measured by revenue."*[66]

The July 2010 legislation marks a sea change in Canada's traditional approach for the development of satellite services. Starting in the 1960s, Telesat was given the status of national operator – with exclusivity on FSS, BSS and MSS services, ground stations and overseas traffic. In exchange, Telesat had to accept license conditions that ensure complete coverage of Canadian territory and priority provision of services to Canadians. This 'quid pro quo' was especially important in regional and remote areas of the country that did not have alternative telecommunications platforms and by and large, this approach was successful. However, with the development of global satellite operators, the cost structure and service provision model in satellite market changed fundamentally. The licensing of CIEL effectively ended any vestiges of Telesat's role as a 'national operator'.[67]

The provision of coverage and access to modern satellite to Canadians across the country has been one of the successes of the existing satellite policy. In keeping with Canadian satellite use policy on coverage, current licence conditions would continue to apply – notably service requirements for coverage and access to services for all eligible satellite operators - foreign or domestic - in the Canadian assigned slots.

However, it is not clear whether the elimination of foreign O&C restrictions might effectively diminish the leverage of the regulator and ultimately diminish the access and provision of satellite services to Canadians.[68].

In the context of the global satellite industry (and well prior to the lifting of ownership and control restrictions in Canada), there have been pressures on national regulators with regulatory obligations globally – to reduce or eliminate licensing obligations and/or regulatory fees. These pressures arise from 'regulatory shopping' on the part of some operators for jurisdictions with minimal/no license obligations or fees as well as the consolidation in the global satellite industry. Consolidation has lead to much larger operators with the financial ability to file applications for slots in multiple jurisdictions. Foreign and Canadian-owned operators in Canadian slots might argue for reduced license conditions based on more favourable regulatory regimes elsewhere.

Thus, while the O&C lever is no longer available to the regulator, the key public policy challenges remain:

- Ensuring access to modern satellite services for Canadians – especially in regional and remote areas to satellite services; and,
- Ensuring a critical mass of Canadian talent and technical expertise for the development and management of the satellite industry remains in Canada.

In the case that operators judge rural/remote Canadian markets too small and/or unprofitable to service, there is a risk that some Canadians will not have access to the next generation of telecommunications services. There is also a risk that Canada satellites serving Canada will be managed off shore - both on a day-to-day basis and in conditions of partial or total failure. Not only would this result in loss of talent and technical expertise but also, service levels for Canadian satellite users might be compromised. Looking

[66] Space News August 5, 2010 'Regulatory Reform Opens Telesat to non-Canadian Ownership' *http://www.spacenews.com/policy/100805-reform-opens-telesat-ownership.html*

[67] Telesat's monopoly on the provision of facilities for overseas and fixed satellite services were eliminated previously.

[68] Broadcasting satellite services are under the jurisdiction of the Broadcasting Act and regulated by the CRTC. As stated in the new legislation: "The new provision excludes services, i.e., over-the-air TV, radio, and cable TV, regulated under the *Broadcasting Act* and measures affecting such services, and telecommunications services supplied for the transmission of services, i.e. Direct to Home and Direct Broadcasting Satellite, regulated under the *Broadcasting Act* where such services are intended for direct reception by the public."

forward, the loss of expertise would deprive Canada the opportunity to be a centre for innovation and technological development for the satellite industry.

It is not expected that the quantum in license fees resulting from potential changes in license fee methodology would influence global satellite operators' corporate decisions (e.g. mergers and acquisitions, location of operations, or provision of services to the Canadian marketplace). To the degree that the potential changes in methodology for fee calculation generate licensing fees that reflect the global market value of Canadian spectrum and regulatory services, these changes would be in line with the federal government's decision to open the satellite market.

### 8.3.3 Transition period for the implementation of the new fee schedule

Given the magnitude of increase in fees under the recommended fee regime, we recommend that the new regime be implemented over a seven-year period with a graduated ramp up over that period. This would correspond with the similar period afforded to PCS operators.

# Appendix A: Data Tables

### Table 55 Currency exchange rates, annual averages (C$ per unit of foreign currency)*

| | 1996 | 1999 | 2001 | 2005 | 2007 | 2009* |
|---|---|---|---|---|---|---|
| Australia | -- | -- | 0.8008 | -- | -- | 0.8969 |
| Brazil | -- | 0.8246 | -- | -- | 0.5513 | 0.5738 |
| Euro zone | -- | -- | -- | -- | -- | 1.5855 |
| Mexico | -- | -- | -- | 0.1112 | -- | 0.0845 |
| New Zealand | -- | -- | -- | -- | -- | 0.7193 |
| UK | -- | -- | -- | -- | -- | 1.7804 |
| US | 1.4000 | -- | -- | -- | -- | 1.1420 |

Source: Bank of Canada
* The exchange rate is calculated as the average of the daily closing for the 251 trading days.

### Table 56 Calculation of Telesat's Canadian satellite spectrum, pre-merger (MHz)

| Satellite | Band | 72.5 W | 82 W | 91 W | 107.3W | 111.1W | 118.7W | Total |
|---|---|---|---|---|---|---|---|---|
| Leased Satellites | 12 GHz BSS | 1,000 | | | | | | 1,000 |
| Nimiq 2 & Leased Satellite(s) | 12 GHz BSS | | 1,000 | | | | | 1,000 |
| Nimiq 1 & Leased Satellite(s) | | | | 1,000 | | | | 1,000 |
| Anik F1/F1R | C | | | | 1,000 | | | 1,000 |
| Anik F1/F1R | Ku | | | | 1,000 | | | 1,000 |
| Anik F1/F1R | XKu | | | | 500 | | | 500 |
| Anik F2 | C | | | | | 1,000 | | 1,000 |
| Anik F2 | Ku | | | | | 1,000 | | 1,000 |
| Anik F2/WB-1 | Ka | | | | | 1,000 | | 1,000 |
| Anik F3 | C | | | | | | 1,000 | 1,000 |
| Anik F3 | Ku | | | | | | 1,000 | 1,000 |
| Anik F3 | Ka | | | | | | 1,000 | 1,000 |
| **Total** | | **1,000** | **1,000** | **1,000** | **2,500** | **3,000** | **3,000** | **11,500** |

Source: Nordicity tabulations base don data from Industry Canada

**Table 57 Calculation of Telesat's Canadian satellite spectrum, current (MHz)**

| Satellite | Band | 72.5 W | 82 W | 86.5 W | 91 W | 107.3W | 111.1W | 118.7W | Total |
|---|---|---|---|---|---|---|---|---|---|
| Nimiq 5 | 12 GHz BSS | 1,000 | | | | | | | 1,000 |
| *2008 assignment* | *17 GHz BSS* | *1,000* | | | | | | | *1,000* |
| Nimiq 4 | 12 GHz BSS | | 1,000 | | | | | | 1,000 |
| *2008 assignment* | *17 GHz BSS* | | *1,000* | | | | | | *1,000* |
| *2008 assignment* | *17 GHz BSS* | | | *1,000* | | | | | *1,000* |
| Nimiq 1 & 2 | 12 GHz BSS | | | | 1,000 | | | | 1,000 |
| Anik F1/F1R | C | | | | | 1,000 | | | 1,000 |
| Anik F1/F1R | Ku | | | | | 1,000 | | | 1,000 |
| Anik F1/F1R | XKu | | | | | 500 | | | 500 |
| Anik F2 | C | | | | | | 1,000 | | 1,000 |
| Anik F2 | Ku | | | | | | 1,000 | | 1,000 |
| Anik F2/WB-1 | Ka | | | | | | 1,000 | | 1,000 |
| *2008 assignment* | *XKu* | | | | | | *750* | | *750* |
| Anik F3 | C | | | | | | | 1,000 | 1,000 |
| Anik F3 | Ku | | | | | | | 1,000 | 1,000 |
| Anik F3 + *2008 assignment* | Ka | | | | | | | 3,350 | 3,350 |
| *2008 assignment* | Ka | | | | | | | *1,000* | *1,000* |
| **Total** | | 2,000 | 2,000 | 1,000 | 1,000 | 2,500 | 3,750 | 6,350 | **18,600** |

Source: Nordicity tabulations base don data from Industry Canada

Nordicity

# Appendix B: Income Approach Calculations

### Table 58 Generic model - income approach valuation calculations

| Year | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| C-band transponders | | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 |
| Frequency per transponder (MHz) | | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 |
| Modulation rate (Mbps) | | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 |
| Mbps per transponder | | 43.2 | 43.2 | 43.2 | 43.2 | 43.2 | 43.2 | 43.2 | 43.2 | 43.2 | 43.2 | 43.2 | 43.2 | 43.2 | 43.2 | 43.2 |
| Price per Mbps per month | | $3,000 | $3,000 | $3,000 | $3,000 | $3,000 | $3,000 | $3,000 | $3,000 | $3,000 | $3,000 | $3,000 | $3,000 | $3,000 | $3,000 | $3,000 |
| Revenue per transponder per month | | $129,600 | $129,600 | $129,600 | $129,600 | $129,600 | $129,600 | $129,600 | $129,600 | $129,600 | $129,600 | $129,600 | $129,600 | $129,600 | $129,600 | $129,600 |
| Annual revenue per transponder | | $1,500,000 | $1,530,000 | $1,560,600 | $1,591,812 | $1,623,648 | $1,656,121 | $1,689,244 | $1,723,029 | $1,757,489 | $1,792,639 | $1,828,492 | $1,865,061 | $1,902,363 | $1,940,410 | $1,979,218 |
| Capacity utilization | | 90% | 90% | 90% | 90% | 90% | 90% | 90% | 90% | 90% | 90% | 88% | 85% | 81% | 76% | 70% |
| Total satellite revenue per annum | 0 | $32,400,000 | $33,048,000 | $33,708,960 | $34,383,139 | $35,070,802 | $35,772,218 | $36,487,662 | $37,217,416 | $37,961,764 | $38,720,999 | $38,617,743 | $38,047,254 | $36,981,931 | $35,393,077 | $33,250,865 |
| | | | | | | | | | | | | | | | | |
| Ku-band transponders | | 32 | 32 | 32 | 32 | 32 | 32 | 32 | 32 | 32 | 32 | 32 | 32 | 32 | 32 | 32 |
| Frequency per transponder (MHz) | | 27 | 27 | 27 | 27 | 27 | 27 | 27 | 27 | 27 | 27 | 27 | 27 | 27 | 27 | 27 |
| Modulation rate (Mbps) | | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 |
| Mbps per transponder | | 32.4 | 32.4 | 32.4 | 32.4 | 32.4 | 32.4 | 32.4 | 32.4 | 32.4 | 32.4 | 32.4 | 32.4 | 32.4 | 32.4 | 32.4 |
| Price per Mbps per month | | $4,000 | $4,000 | $4,000 | $4,000 | $4,000 | $4,000 | $4,000 | $4,000 | $4,000 | $4,000 | $4,000 | $4,000 | $4,000 | $4,000 | $4,000 |
| Revenue per transponder per month | | $129,600 | $129,600 | $129,600 | $129,600 | $129,600 | $129,600 | $129,600 | $129,600 | $129,600 | $129,600 | $129,600 | $129,600 | $129,600 | $129,600 | $129,600 |
| Annual revenue per transponder | | $1,500,000 | $1,530,000 | $1,560,600 | $1,591,812 | $1,623,648 | $1,656,121 | $1,689,244 | $1,723,029 | $1,757,489 | $1,792,639 | $1,828,492 | $1,865,061 | $1,902,363 | $1,940,410 | $1,979,218 |
| Capacity utilization | | 90% | 90% | 90% | 90% | 90% | 90% | 90% | 90% | 90% | 90% | 88% | 85% | 81% | 76% | 70% |
| Total satellite revenue per annum | 0 | $43,200,000 | $44,064,000 | $44,945,280 | $45,844,186 | $46,761,069 | $47,696,291 | $48,650,217 | $49,623,221 | $50,615,685 | $51,627,999 | $51,490,324 | $50,729,672 | $49,309,241 | $47,190,770 | $44,334,486 |
| | | | | | | | | | | | | | | | | |
| Ka-band transponders | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Frequency per transponder (MHz) | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Modulation rate (Mbps) | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Mbps per transponder | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Price per Mbps per month | | $5,000 | $5,000 | $5,000 | $5,000 | $5,000 | $5,000 | $5,000 | $5,000 | $5,000 | $5,000 | $5,000 | $5,000 | $5,000 | $5,000 | $5,000 |
| Revenue per transponder per month | | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| Annual revenue per transponder | | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| Capacity utilization | | 90% | 90% | 90% | 90% | 90% | 90% | 90% | 90% | 90% | 90% | 88% | 85% | 81% | 76% | 70% |
| Total satellite revenue per annum | 0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| | | | | | | | | | | | | | | | | |
| **Total satellite revenue** | **$0** | **$75,600,000** | **$77,112,000** | **$78,654,240** | **$80,227,325** | **$81,831,871** | **$83,468,509** | **$85,137,879** | **$86,840,636** | **$88,577,449** | **$90,348,998** | **$90,108,068** | **$88,776,926** | **$86,291,172** | **$82,583,847** | **$77,585,351** |
| | | | | | | | | | | | | | | | | |
| EBITDA margin | 60.0% | 60.0% | 60.0% | 60.0% | 60.0% | 60.0% | 60.0% | 60.0% | 60.0% | 60.0% | 60.0% | 60.0% | 60.0% | 60.0% | 60.0% | 60.0% |
| | | | | | | | | | | | | | | | | |
| Operating expenses | | $30,240,000 | $30,844,800 | $31,461,696 | $32,090,930 | $32,732,749 | $33,387,403 | $34,055,152 | $34,736,255 | $35,430,980 | $36,139,599 | $36,043,227 | $35,510,770 | $34,516,469 | $33,033,539 | $31,034,141 |
| **EBITDA** | | **$45,360,000** | **$46,267,200** | **$47,192,544** | **$48,136,395** | **$49,099,123** | **$50,081,105** | **$51,082,727** | **$52,104,382** | **$53,146,470** | **$54,209,399** | **$54,064,841** | **$53,266,155** | **$51,774,703** | **$49,550,308** | **$46,551,211** |
| | | | | | | | | | | | | | | | | |
| Capital expenditures | **$350,000,000** | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| | | | | | | | | | | | | | | | | |
| **Free cash flow to equity and debt** | **($350,000,000)** | **$45,360,000** | **$46,267,200** | **$47,192,544** | **$48,136,395** | **$49,099,123** | **$50,081,105** | **$51,082,727** | **$52,104,382** | **$53,146,470** | **$54,209,399** | **$54,064,841** | **$53,266,155** | **$51,774,703** | **$49,550,308** | **$46,551,211** |
| | | | | | | | | | | | | | | | | |
| Discount rate | 9.0% | 9.0% | 9.0% | 9.0% | 9.0% | 9.0% | 9.0% | 9.0% | 9.0% | 9.0% | 9.0% | 9.0% | 9.0% | 9.0% | 9.0% | 9.0% |
| | | | | | | | | | | | | | | | | |
| Discounted FCF | ($350,000,000) | $41,614,679 | $38,942,177 | $36,441,303 | $34,101,036 | $31,911,061 | $29,861,727 | $27,944,001 | $26,149,432 | $24,470,111 | $22,898,636 | $20,951,902 | $18,937,968 | $16,887,803 | $14,827,755 | $12,780,078 |
| **Sum of discounted cash flows** | **$48,719,667** | | | | | | | | | | | | | | | |
| NPV | $48,719,667 | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| Share of revenues | | | | | | | | | | | | | | | | |
| C-band | 43% | | | | | | | | | | | | | | | |
| Ku-band | 57% | | | | | | | | | | | | | | | |
| Ka-band | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| Allocation NPV by band | | | | | | | | | | | | | | | | |
| C-band | $20,879,857 | | | | | | | | | | | | | | | |
| Ku-band | $27,839,810 | | | | | | | | | | | | | | | |
| Ka-band | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| Total delivery bandw idth in use (MHz) | | | | | | | | | | | | | | | | |
| C-band | 1000 | | | | | | | | | | | | | | | |
| Ku-band | 1000 | | | | | | | | | | | | | | | |
| Ka-band | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| Value per MHz | | | | | | | | | | | | | | | | |
| C-band | $20,880 | | | | | | | | | | | | | | | |
| Ku-band | $27,840 | | | | | | | | | | | | | | | |
| Ka-band | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| **Annualized value per MHz** | | | Straight-line basis | | | | | | | | | | | | | |
| **C-band** | **$2,304** | | $1,392 | | | | | | | | | | | | | |
| **Ku-band** | **$3,073** | | $1,856 | | | | | | | | | | | | | |
| Ka-band | | | | | | | | | | | | | | | | |

## Table 59 Anik F2 - income approach valuation calculations

| Year | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | |
| C-band transponders | | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 |
| Frequency per transponder (MHz) | | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 |
| Modulation rate (Mbps) | | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 |
| Mbps per transponder | | 43.2 | 43.2 | 43.2 | 43.2 | 43.2 | 43.2 | 43.2 | 43.2 | 43.2 | 43.2 | 43.2 | 43.2 | 43.2 | 43.2 | 43.2 |
| Price per Mbps per month | | $3,000 | $3,000 | $3,000 | $3,000 | $3,000 | $3,000 | $3,000 | $3,000 | $3,000 | $3,000 | $3,000 | $3,000 | $3,000 | $3,000 | $3,000 |
| Revenue per transponder per month | | $129,600 | $129,600 | $129,600 | $129,600 | $129,600 | $129,600 | $129,600 | $129,600 | $129,600 | $129,600 | $129,600 | $129,600 | $129,600 | $129,600 | $129,600 |
| Annual revenue per transponder | | $1,500,000 | $1,530,000 | $1,560,600 | $1,591,812 | $1,623,648 | $1,656,121 | $1,689,244 | $1,723,029 | $1,757,489 | $1,792,639 | $1,828,492 | $1,865,061 | $1,902,363 | $1,940,410 | $1,979,218 |
| Capacity utilization | | 90% | 90% | 90% | 90% | 90% | 90% | 90% | 90% | 90% | 90% | 88% | 85% | 81% | 76% | 70% |
| Total satellite revenue per annum | 0 | $32,400,000 | $33,048,000 | $33,708,960 | $34,383,139 | $35,070,802 | $35,772,218 | $36,487,662 | $37,217,416 | $37,961,764 | $38,720,999 | $38,617,743 | $38,047,254 | $36,981,931 | $35,393,077 | $33,250,865 |
| | | | | | | | | | | | | | | | | |
| Ku-band transponders | | 32 | 32 | 32 | 32 | 32 | 32 | 32 | 32 | 32 | 32 | 32 | 32 | 32 | 32 | 32 |
| Frequency per transponder (MHz) | | 27 | 27 | 27 | 27 | 27 | 27 | 27 | 27 | 27 | 27 | 27 | 27 | 27 | 27 | 27 |
| Modulation rate (Mbps) | | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 |
| Mbps per transponder | | 32.4 | 32.4 | 32.4 | 32.4 | 32.4 | 32.4 | 32.4 | 32.4 | 32.4 | 32.4 | 32.4 | 32.4 | 32.4 | 32.4 | 32.4 |
| Price per Mbps per month | | $4,000 | $4,000 | $4,000 | $4,000 | $4,000 | $4,000 | $4,000 | $4,000 | $4,000 | $4,000 | $4,000 | $4,000 | $4,000 | $4,000 | $4,000 |
| Revenue per transponder per month | | $129,600 | $129,600 | $129,600 | $129,600 | $129,600 | $129,600 | $129,600 | $129,600 | $129,600 | $129,600 | $129,600 | $129,600 | $129,600 | $129,600 | $129,600 |
| Annual revenue per transponder | | $1,500,000 | $1,530,000 | $1,560,600 | $1,591,812 | $1,623,648 | $1,656,121 | $1,689,244 | $1,723,029 | $1,757,489 | $1,792,639 | $1,828,492 | $1,865,061 | $1,902,363 | $1,940,410 | $1,979,218 |
| Capacity utilization | | 90% | 90% | 90% | 90% | 90% | 90% | 90% | 90% | 90% | 90% | 88% | 85% | 81% | 76% | 70% |
| Total satellite revenue per annum | 0 | $43,200,000 | $44,064,000 | $44,945,280 | $45,844,186 | $46,761,069 | $47,696,291 | $48,650,217 | $49,623,221 | $50,615,685 | $51,627,999 | $51,490,324 | $50,729,672 | $49,309,241 | $47,190,770 | $44,334,486 |
| | | | | | | | | | | | | | | | | |
| Ka-band transponders | | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 |
| Frequency per transponder (MHz) | | 56 | 56 | 56 | 56 | 56 | 56 | 56 | 56 | 56 | 56 | 56 | 56 | 56 | 56 | 56 |
| Modulation rate (Mbps) | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Mbps per transponder | | 56 | 56 | 56 | 56 | 56 | 56 | 56 | 56 | 56 | 56 | 56 | 56 | 56 | 56 | 56 |
| Price per Mbps per month | | $5,000 | $5,000 | $5,000 | $5,000 | $5,000 | $5,000 | $5,000 | $5,000 | $5,000 | $5,000 | $5,000 | $5,000 | $5,000 | $5,000 | $5,000 |
| Revenue per transponder per month | | $280,000 | $280,000 | $280,000 | $280,000 | $280,000 | $280,000 | $280,000 | $280,000 | $280,000 | $280,000 | $280,000 | $280,000 | $280,000 | $280,000 | $280,000 |
| Annual revenue per transponder | | $1,000,000 | $1,020,000 | $1,040,400 | $1,061,208 | $1,082,432 | $1,104,081 | $1,126,162 | $1,148,686 | $1,171,659 | $1,195,093 | $1,218,994 | $1,243,374 | $1,268,242 | $1,293,607 | $1,319,479 |
| Capacity utilization | | 90% | 90% | 90% | 90% | 90% | 90% | 90% | 90% | 90% | 90% | 88% | 85% | 81% | 76% | 70% |
| Total satellite revenue per annum | 0 | $40,500,000 | $41,310,000 | $42,136,200 | $42,978,924 | $43,838,502 | $44,715,273 | $45,609,578 | $46,521,770 | $47,452,205 | $48,401,249 | $48,272,179 | $47,559,067 | $46,227,413 | $44,241,347 | $41,563,581 |
| | | | | | | | | | | | | | | | | |
| **Total satellite revenue** | **$0** | **$116,100,000** | **$118,422,000** | **$120,790,440** | **$123,206,249** | **$125,670,374** | **$128,183,781** | **$130,747,457** | **$133,362,406** | **$136,029,654** | **$138,750,247** | **$138,380,247** | **$136,335,993** | **$132,518,585** | **$126,825,194** | **$119,148,932** |
| | | | | | | | | | | | | | | | | |
| EBITDA margin | 60.0% | 60.0% | 60.0% | 60.0% | 60.0% | 60.0% | 60.0% | 60.0% | 60.0% | 60.0% | 60.0% | 60.0% | 60.0% | 60.0% | 60.0% | 60.0% |
| | | | | | | | | | | | | | | | | |
| Operating expenses | | $46,440,000 | $47,368,800 | $48,316,176 | $49,282,500 | $50,268,150 | $51,273,513 | $52,298,983 | $53,344,962 | $54,411,862 | $55,500,099 | $55,352,099 | $54,534,397 | $53,007,434 | $50,730,078 | $47,659,573 |
| **EBITDA** | | **$69,660,000** | **$71,053,200** | **$72,474,264** | **$73,923,749** | **$75,402,224** | **$76,910,269** | **$78,448,474** | **$80,017,444** | **$81,617,792** | **$83,250,148** | **$83,028,148** | **$81,801,596** | **$79,511,151** | **$76,095,116** | **$71,489,359** |
| | | | | | | | | | | | | | | | | |
| Capital expenditures | **$499,788,822** | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| | | | | | | | | | | | | | | | | |
| **Free cash flow to equity and debt** | **($499,788,822)** | **$69,660,000** | **$71,053,200** | **$72,474,264** | **$73,923,749** | **$75,402,224** | **$76,910,269** | **$78,448,474** | **$80,017,444** | **$81,617,792** | **$83,250,148** | **$83,028,148** | **$81,801,596** | **$79,511,151** | **$76,095,116** | **$71,489,359** |
| | | | | | | | | | | | | | | | | |
| Discount rate | 9.0% | 9.0% | 9.0% | 9.0% | 9.0% | 9.0% | 9.0% | 9.0% | 9.0% | 9.0% | 9.0% | 9.0% | 9.0% | 9.0% | 9.0% | 9.0% |
| | | | | | | | | | | | | | | | | |
| Discounted FCF | ($499,788,822) | $63,908,257 | $59,804,057 | $55,963,429 | $52,369,448 | $49,006,272 | $45,859,080 | $42,914,002 | $40,158,057 | $37,579,099 | $35,165,762 | $32,176,135 | $29,083,308 | $25,934,840 | $22,771,195 | $19,626,549 |
| **Sum of discounted cash flows** | **$112,530,667** | | | | | | | | | | | | | | | |
| NPV | $112,530,667 | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| Share of revenues | | | | | | | | | | | | | | | | |
| C-band | 28% | | | | | | | | | | | | | | | |
| Ku-band | 37% | | | | | | | | | | | | | | | |
| Ka-band | 35% | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| Allocation NPV by band | | | | | | | | | | | | | | | | |
| C-band | $31,403,907 | | | | | | | | | | | | | | | |
| Ku-band | $41,871,876 | | | | | | | | | | | | | | | |
| Ka-band | $39,254,884 | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| Total delivery bandwidth in use (MHz) | | | | | | | | | | | | | | | | |
| C-band | 1000 | | | | | | | | | | | | | | | |
| Ku-band | 1000 | | | | | | | | | | | | | | | |
| Ka-band | 2000 | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| Value per MHz | | | | | | | | | | | | | | | | |
| C-band | $31,404 | | | | | | | | | | | | | | | |
| Ku-band | $41,872 | | | | | | | | | | | | | | | |
| Ka-band | $19,627 | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| **Annualised value per MHz** | | | Straight-line basis | | | | | | | | | | | | | |
| **C-band** | **$3,466** | | $2,094 | | | | | | | | | | | | | |
| **Ku-band** | **$4,621** | | $2,791 | | | | | | | | | | | | | |
| **Ka-band** | **$2,166** | | $1,308 | | | | | | | | | | | | | |

**Table 60 Income approach modelling assumptions**

| Modelling Assumptions | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Transponder lease rates ($)** | | | | | | | | | | | | | | | |
| Generic C | 1,500,000 | | | | | | | | | | | | | | |
| Generic Ku | 1,500,000 | | | | | | | | | | | | | | |
| Ka` | 1,000,000 | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| **Bandwidth modulation rates (Mbps per MHz)** | | | | | | | | | | | | | | | |
| C-band | 1.2 | | | | | | | | | | | | | | |
| Ku-band | 1.2 | | | | | | | | | | | | | | |
| Ka-band | 1.0 | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| Generic | 350,000,000 | | | | | | | | | | | | | | |
| Anik F2 (2004) | 408,000,000 | - reported cost of USD408 million or C$640 million; derived cost of $510 million from financial statements | | | | | | | | | | | | | |
| Anik F2 satellite | 326,400,000 | | | | | | | | | | | | | | |
| Anik F2 launch and insurance | 81,600,000 | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| EBITDA margin | 60.0% | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| Weighted average cost of capital | 9.0% | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| **Capacity ultilization** | | | | | | | | | | | | | | | |
| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| Utilization rate | 90% | 90% | 90% | 90% | 90% | 90% | 90% | 90% | 90% | 90% | 88% | 85% | 81% | 76% | 70% |
| | | | | | | | | | | | | | | | |
| **Inflation** | | | | | | | | | | | | | | | |
| Annual price inflation | 2.0% | | | | | | | | | | | | | | |
| Year | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | | | |
| CPI | 91.3 | 92.9 | 95.4 | 97.8 | 100.0 | 102.8 | 104.7 | 107.0 | 109.1 | 111.5 | 114.1 | 114.4 | | | |
| Satellite cost adjustment factor | 1.2530 | 1.2314 | 1.1992 | 1.1697 | 1.1440 | 1.1128 | 1.0926 | 1.0692 | 1.0486 | 1.0260 | 1.0026 | 1.0000 | | | |
| | | | | | | | | | | | | | | | |
| **Exchange rates** | | | | | | | | | | | | | | | |
| Year | 1998 | | | | | | | | | | | | | | |
| Anik F2 current | 1.040 | | | | | | | | | | | | | | |

End of report