Satellite Systems and 5G ecosystem
Integration of Satellite Systems into Next Generation Access Technologies

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Overview

• General View of the Brazilian Telecommunications Sector
• Report – Integration of Satellite Systems into NGAT
• Coexistence of IMT and Satellite Systems – Brazil’s C-band case
• Final Comments – Regulatory Aspects
**General View of the Brazilian Telecommunications Sector**

**Numbers of Telecommunications in Brazil**

- 5th biggest geographic area of the world
- Population ≈ 200 million

![Map of Brazil with telecommunications data](https://www.anatel.gov.br/dados/2015-02-04-18-43-59)

<table>
<thead>
<tr>
<th>Service</th>
<th>Prepaid</th>
<th>Postpaid</th>
<th>Mobile Telephone</th>
<th>228,8 mi</th>
</tr>
</thead>
<tbody>
<tr>
<td>Authorized</td>
<td>55.3%</td>
<td>44.7%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concessions</td>
<td>44.6%</td>
<td>55.4%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metallic Cable</td>
<td>40.3%</td>
<td>30.5%</td>
<td>20.6%</td>
<td>31.4 mi</td>
</tr>
<tr>
<td>Coaxial Cable</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fiber</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fixed Telephone</td>
<td></td>
<td></td>
<td></td>
<td>36.6 mi</td>
</tr>
<tr>
<td>Fixed Broadband</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pay TV</td>
<td>52.4%</td>
<td>41.3%</td>
<td></td>
<td>17.4 mi</td>
</tr>
<tr>
<td>DTH</td>
<td>52.4%</td>
<td>41.3%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

General View of the Brazilian Telecommunications Sector

Satellite Market in Brazil

GSO satellites authorized in Brazil:
• 16 Brazilian satellites – Brazilian satellite networks;
• 43 Foreign satellites – Foreign satellite networks;
  4 NGSO satellite systems authorized.

Brazilian satellites in operation

82 Brazilian satellite networks:
• 51 networks – in coordination
• 31 networks – notified

Future?
• NGSO Constellations
• Q/V bands
• Increased demand for broadband

Some services supported by satellite capacity

- Broadband
  ≈ 200,000 of subscribers
  Increase 250% in 5 years

- DTH
  ≈ 8 million of subscribers

Source: https://www.anatel.gov.br/dados

Information of July 2019

92°W C
94°W C / Ku / Ka
75°W C / Ku / Ka
74°W Ku
70°W C / Ku
65°W C / Ku / Ka
63°W C / Ku
61°W C / Ku / Ka
47.5°W C / Ku / Ka
20°W Ka

Source: ITU Satellite Communications Symposium 2019
Integration of Satellite Systems into NGAT

Key elements for Integration of satellite systems into Next Generation Access Technologies (NGAT)

- Discussed in WP 4B
- Approved by Study Group 4

Proposed by the Brazilian Administration.

Objective: reaffirm the importance of integrating satellite systems with new access technologies. Satellite communication is essential for the telecommunications development.
Integration of Satellite Systems into NGAT

Report ITU-R M.2460-0 – Key elements for integration

Integration of satellite systems into Next Generation Access Technologies

5G is more than just cellular, it is wireless - a combination of technologies

- Background assumptions (As stated in Recommendation ITU-R M.2083) – in 5G:
  
  • User should be able to access services anywhere, anytime;
  
  • Combination of different fixed, terrestrial and satellite networks;
  
  • Heterogeneous networks with interoperability capacity to provide ubiquitous seamless coverage.

Why should satellites be considered in this context?
Large, important and reliable communications structure.

This Report focuses on how satellites can support the various scenarios, providing envisaged use cases and key technical elements for careful consideration to enable integration of satellite solutions into NGAT.
Integration of Satellite Systems into NGAT

Satellite use cases

It’s critical to ensure that satellite solutions be accommodated where that makes sense (e.g. use cases that do not require “very low latency”).

<table>
<thead>
<tr>
<th>Use cases</th>
<th>Examples</th>
<th>Number of sites</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trunking and head-end feed</td>
<td>Service to remote areas; special events</td>
<td>Limited to unserved areas in a carrier’s network</td>
</tr>
<tr>
<td>Backhauling and Multicasting tower feed</td>
<td>Surge capacity to overloaded cells, plus content delivery (e.g. video) to local caches; efficient broadcast service to end users</td>
<td>Thousands</td>
</tr>
</tbody>
</table>

Representative diagram of the Trunking and Head-end Feed use case

Representative diagram of the Backhauling and Multicasting Tower Feed use case
Integration of Satellite Systems into NGAT

**Satellite use cases**

Different scenarios have different requirements for coverage, latency and bandwidth.

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<th>Number of sites</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communications on move</td>
<td>In Flight Connectivity for Aircraft; connectivity directly to land vehicles; broadband to ships and trains</td>
<td>Potentially millions</td>
</tr>
<tr>
<td>Hybrid multiplay</td>
<td>Video and broadband connectivity directly to home or multi-tenant building with NGAT distribution in building</td>
<td>Potentially millions</td>
</tr>
</tbody>
</table>

Representative diagram of the Communications on the Move use case

Representative diagram of the Hybrid Multiplay use case
Integration of Satellite Systems into NGAT

Key elements of satellite as a technical solution

- Wide coverage
- Rapid deployment
- High throughput
- Flexibility for use in different applications
- Innovation in satellite sector (HTS, new technologies for ground segment...)

Both geostationary and non-geostationary satellite systems have a role to play in 5G scenario, and should be accommodated where it makes sense.

Satellite systems integrated with NGAT are expected to provide scalable and efficient network solutions.
Coexistence of IMT and Satellite Systems

3.5 GHz Frequency Band in Brazil

**Scenario:** licensed earth stations – professional systems / unlicensed earth stations – consumer TVRO low cost system (free-to-air)

**Objective:** enable the use of the 3.5 GHz band for 5G (IMT-2020)

**Challenge:** coexistence with satellite systems operating in the adjacent band

**Spectrum scenario under analysis**

- IMT
- Extended C-band satellite downlink
- Standard

**Important elements in this discussions**

- Significant number of TVRO consumers;
- Importance of 3.5GHz frequency band for 5G development;
- Importance of 5G for the Brazilian economy.
Coexistence of IMT and Satellite Systems

3.5 GHz Frequency Band in Brazil

**Challenge:** coexistence between 5G and satellite systems operating in the adjacent band

**Main challenges:**
- LNBF do not have filter before low noise amplifier (LNA);
- LNBF are wideband “receivers” intended to be cheap and low complexity.

**Test results:**
- Main problem: no filtering before LNA;
- LNBF blocking due to overloading (saturation);
- Professional reception: can be solved with coordination between 5G and FSS stations.
Coexistence of IMT and Satellite Systems

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**Conclusions:**

- Coexistence between the two systems is possible only under certain conditions;
- Receivers must be selective (important for the efficient use of spectrum);
- Systems should protect themselves before requiring protection;
- Different solutions involve different costs.
Coexistence of IMT and Satellite Systems

3.5 GHz Frequency Band in Brazil

Possible solutions:

• LNBF re-design to insert filtration needed?
  Considered technical solution
  Anatel should assess the feasibility of setting minimum quality requirements for current C-Band TVRO systems;
  Need to use larger antennas to compensate filter in-band insertion loss;
  No manufacturer has yet been able to introduce filtering prior to LNA;
  Need to increase 40 MHz in the guard band.

• Limiting the power of 5G?
  Shouldn’t be considered
  It’s not desirable to impose technical restrictions that limit technological innovation;
  Such a solution would limit some possible applications of 5G.

• Migration of consumer TVRO systems to Ku band?
  Considered possibility
  Pros: Lower Ku systems cost, alignment with Europe and USA.
  Cons: need to change all installed plant.
Final Comments – Regulatory Aspects

Shaping the Future of Communications – Regulatory aspects:

• Stable and clear regulatory framework;
• Promote efficient use of spectrum;
• Accommodate future needs;
• Consider the perspective of all players.

Anatel’s Regulatory Agenda - Satellite Exploitation Issues

✔️ Price Reduction for Satellite Exploitation Right

✔️ Updating and simplifying the regulatory framework for satellite exploitation and operation
Thank you!

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