Understanding High Throughput Satellite (HTS) Technology

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What is a High Throughput Satellite?

A high throughput satellite (HTS) is a satellite that has many times the throughput of a traditional FSS satellite for the same amount of allocated frequency on orbit.

These satellites take advantage of frequency reuse and multiple spot beams to increase throughput and reduce the cost per bit delivered, regardless of spectrum choice.
What are the Components of High Throughput Satellite Design Decisions?

All of these components impact the business model for satellite design and are driven by go-to-market business criteria.
Technical Element #1: Throughput

- Throughput is the speed of information delivery (bits/sec), driven by:
  - **Bandwidth** (MHz) = The “size of the pipe”, increased by frequency reuse
  - **Efficiency** (Bits/sec per MHz) = Amount of error-free content in the pipe

- Maximizing aggregate satellite bandwidth or maximizing individual user throughput are often conflicting technical goals.
  - There is a trade-off, and the right answer depends on the business applications
Why Does Throughput Matter?

- **Rapid Growth in Demand**
  - Consumer-driven demand for broadband anywhere on any devise
  - Broadband-centric business and government applications in all regions of the globe

- **Service providers need to deliver solutions to address this demand**

- **HTS platforms will change satellite’s role in the telecoms infrastructure:**
  - Expand addressable geographic markets by delivering broadband everywhere
  - Serve application segments with terrestrial-like economics
  - Leverage satellite inherent strengths

![Global IP Traffic – EB per Month](image)
Technical Element #2: Efficiency

• Efficiency is the amount of error-free information to the user (bits/Hz)
  – Spot beams drive efficiency **up** (more power) but close proximity of same frequency spot beams increases interference and brings efficiency **down**.

• Greater distance between same frequency spot beams will increase efficiency but reduce frequency reuse and total satellite throughput. So what is best?
  – This is a trade-off: Serving more users with **consumer-grade quality** (lower efficiency) or fewer users with **carrier-grade quality** (CIR, higher efficiency). This is a decision that will depend on the operator's business plan.
Why Does Efficiency Matter?

• Optimal satellite efficiency depends on the target business application
  – A lower efficiency design will optimize shared network services for the most number of users at the lowest possible cost per user
  – A high efficiency design will enable carrier-grade services, maximizing throughput delivered to specific end users for mission-critical applications

• Greater efficiency lowers end-user terminal costs for consumer and enterprise applications
Technical Element #3: Coverage

- The size of beams formed by a standard satellite antenna size depends on frequency.

  and

- The number of beams is constrained by satellite resources (power, mass, space).

- The size of the targeted coverage is a major driver of frequency selection.

<table>
<thead>
<tr>
<th>Distance</th>
<th>Ka-band</th>
<th>Ku-band</th>
<th>C-band</th>
</tr>
</thead>
<tbody>
<tr>
<td>200 miles</td>
<td></td>
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<tr>
<td>600 miles</td>
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<tr>
<td>1000 miles</td>
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- The size of the targeted coverage is a major driver of frequency selection

Beams shown are for illustration only
Why Does Coverage Matter?

• Coverage decisions are driven by:
  – Target applications and geography
  – Density and distribution of existing end-user locations or traffic patterns
  – Anticipated global/regional expansion of customer networks
  – Consistent service levels expectation
  – Flexibility needed for varying beam and coverage requirements
Technical Element #4: Architecture

HTS designs may allow for closed or open network architectures. **Open architectures** are compatible with many network topologies:

- **Star**
  - Gateway
  - User beam

- **Mesh**
  - User or gateway beam

- **Loopback**
  - User or gateway beam

...and with a variety of network technologies:
## Why Does Architecture Matter?

<table>
<thead>
<tr>
<th></th>
<th>Closed</th>
<th>Open</th>
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</thead>
<tbody>
<tr>
<td><strong>Network Topology</strong></td>
<td>Typically Star configuration with defined gateway locations</td>
<td>Star or mesh configuration, flexible gateway locations</td>
</tr>
<tr>
<td><strong>Ground Technology</strong></td>
<td>Specified by satellite network operator</td>
<td>Determined by customer network operator, can be backward compatible</td>
</tr>
<tr>
<td><strong>Service Availability</strong></td>
<td>Typically defined by satellite network operator on a “best effort” basis</td>
<td>Defined by customer network operator on a “CIR” basis</td>
</tr>
<tr>
<td><strong>Throughput</strong></td>
<td>Typically high aggregate satellite throughput shared by large number of users</td>
<td>High throughput to individual sites shared by a defined number of users</td>
</tr>
<tr>
<td><strong>Primary Applications Served</strong></td>
<td>Consumer broadband, mobility, trunking</td>
<td>Enterprise/corporate networks, government/military networks, mobility applications, cellular backhaul, media distribution</td>
</tr>
</tbody>
</table>
Technical Element #5: Spectrum

- HTS can be developed in any frequency band
- The frequency selection is driven by many considerations:
  - Coverage and beam size
  - Atmospheric conditions in the region that is being served
  - Availability of a robust ecosystem of ground technologies
Why Does Spectrum Matter?

- Business considerations for spectrum selection decisions:
  - End-user applications
  - Geographic location of services to be provided
  - Network performance/cost
  - Availability of back-up capacity
  - Current investments in gateways, terminals, systems and training
  - Available frequency rights
Business Applications Drive High Throughput Satellite Design Decisions
High Performance Satellite Platform

- High Capacity
- High Efficiency
- High Throughput
- High Performance
- Flexible
- Multi-band
- Open Platform
- Backward Compatible
- All-region Coverage
- Complementary Overlay
- Resilient and Secure
- Lower Cost of Ownership
Question and Answer