O3b – A different approach to Ka-band satellite system design and spectrum sharing

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O3b’s Non-Geostationary Satellite/Constellation Design

- Circular equatorial orbit at 8,062 km altitude
- 288 minute orbit period
- 8 satellites in initial launch in early 2013
- Launch 4 more satellites soon after
- Inherent in-orbit redundancy
- 10 years minimum life time
- 12 steerable spot beam antennas on each satellite
Comparison of the O3b Orbit with the GSO

• 4.8 times closer to Earth than the GSO (8,062 km orbit altitude)
  • lower launch costs, multiple satellites per launch vehicle

• 13dB Path Loss reduction relative to GSO
  • link budget improvement

• 20 times lower power requirement than GSO based on reduced Path Loss
  • smaller satellites, less weight for solar panels, batteries, etc.

• Less than 150 ms latency (round-trip)
  • more communications services and applications are possible

• Uses tracking earth stations
  • Suited to certain types of fixed applications and all mobile ones
  • Electronically steerable antennas under development
O3b’s Communications Concept

- Steerable Ka-band spot beams
- Seamless handover between satellites
- Bent-pipe connecting gateways with customers for internet access
- 2 beams per satellite for gateways
- 10 beams per satellite for customers
- Customers use:
  - medium/large ES only for high capacity fixed links
  - Medium/small ES for mobile applications
- Beam coverage: ~700 km diameter
- Channel bandwidth: 216 MHz
- Coverage ~45 N° N/S latitude
Coverage Capability of the O3b Orbit (showing planned O3b Gateways)

Global Coverage anywhere 45° North/South of the equator
Some gateway locations still being evaluated.
Inherent Angular Separation of O3b Orbit from GSO

- Interference potential exists with GSO only in narrow range of equatorial latitudes (e.g., within approx. 5° of the equator)
O3b Frequency Plan

Ka-band Downlink 17.70 – 20.20 GHz

17.7 – 20.20 GHz

EPFD↓ limits apply

No EPFD↓ limits Coordinate with GSO

EPFD↓ limits apply

Ka-band Uplink 27.50 – 30.00 GHz

27.5 – 30.00 GHz

EPFD↑ limits apply

No EPFD↑ limits Coordinate with GSO

EPFD↑ limits apply

Key:

- **03b frequencies for Communications**
- **03b Telemetry and Command Bands**
O3b Spectral Efficiency

• **Dual polarization:**
  • Full frequency re-use achieved by dual orthogonal polarization for both gateway beams and customer beams

• **Spatial frequency re-use:**
  • Additional spatial frequency re-use between gateway beams and customer beams

• **Total frequency re-use factor is therefore 4 times**
• O3b does not use the following portions of Ka-band:
  • 200 MHz bands of 18.6-18.8 GHz down and 28.4-28.6 GHz up
    (downlink not available to O3b type orbit – see 5.522B)
  • 400 MHz bands of 19.3-19.7 GHz down and 29.1-29.5 GHz up
    (MSS/NGSO feeder link allocation – see 5.523B and 5.535A)

• In the parts of Ka-band where EPFD limits apply and in situations where interference could occur with respect to GSO satellite networks, O3b will not use the spectrum
  • e.g., for service to geographic locations close to the equator
  • consists of 1,400 MHz of spectrum on uplink and same on downlink

• O3b only needs to coordinate with GSOs based on ITU date priority in the 500 MHz segments of Ka-band that are allocated by the ITU with equal rights to GSO and non-GSO (i.e., 18.8-19.3 GHz down and 28.6-29.1 GHz)
O3b coordination with GSOs is limited to 20% of the normal “commercial” Ka-band spectrum available to GSOs
  - or 14.3% if the GSO has access to the “government” portion of Ka-band (20.2-21.2 GHz down and 30.0-31.0 GHz up)

All real-world broadband Ka-band satellites require a relatively large amount of spectrum for Gateway links
  - e.g., KA-SAT uses 2,000 MHz of spectrum for Gateways and 500 MHz for Users to limit the number of Gateway locations

Regional broadband Ka-band satellite networks are less likely to use Gateways in equatorial regions because of rain-fade and fibre interconnectivity reasons

Conclusion:
  - O3b shares well with GSOs that use the 18.8-19.3 GHz and 28.6-29.1 GHz bands not located in equatorial regions, such as for Gateways
O3b Sharing with NGSOs

- O3b shares well with certain other types of NGSO satellite systems where angular separation between the orbits can be maintained.

- Russian Molniya is a perfect example:
  - O3b orbit appears in a different part of the sky from the active arc of the Molniya orbit.

- Similar compatibility exists with other HEO (Highly Elliptical Orbit) systems, as studied by the Working Parties of the ITU.
O3b’s Progress and Launch/Operation Schedule

- O3b Founded by Greg Wyler (Oct)
- Launch services contract signed with Arianespace
- O3b selects ViaSat to supply Teleports and IP Trunking terminals
- First teleport installed and operational in Greece
- Allen & Company invests with O3b (Feb)
- SES invests US$75 million with O3b (Nov)
- O3b OHQ opens in The Hague (Sept)
- First 4 satellites launched

2007
- Q3
- Q4

2008
- Q1
- Q2
- Q3
- Q4

2009
- Q1
- Q2
- Q3
- Q4

2010
- Q1
- Q2
- Q3
- Q4

2011
- Q1
- Q2
- Q3
- Q4

2012
- Q1
- Q2
- Q3
- Q4

2013
- Q1
- Q2
- Q3
- Q4

Satellite Supply contract signed with Thales (Aug)
HUGE step forward, investments in O3b from Liberty, Google & HSBC (July)

O3b secures funding for an additional 4 satellites bringing the total number to 12
Tier 2 Terminal vendors selected, GD Satcom, Comtech and Gilat

O3bTrunk launched
O3bMaritime launched
Second 4 satellites launched
Network Operations Centre ready
All Teleports Installed and Operational
3b Networks
Fiber Speed. Satellite Reach.