Emerging Commercial Satellite Communications

Telemedicine Takeaways

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• Telemedicine Needs and Limitations
• Communication System Fundamentals
• Basics of Satellite Communications
• Advancements in SatCom & 5G
• Looking Forward Toward the Future
Ubiquitous Coverage

• Rural and Remote Patients have limited access to broadband communications

High Data Rates

• Few wireless solutions offer cost effective options for large amounts of data

Secure

• Healthcare information is private and protected

SATCOM has long standing history supporting telemedicine
Communication systems in general:
- **Transmitter/Receiver**: Devices that send and receive a communication signal
- **Channel**: the physical medium to transmit the signal (cable, EM wave, air, water)
- **Noise**: Something that interferes with the communication signal

**Design Considerations**
- Data Rates
- Power Needs
- Antenna Pointing
- RF Propagation
- Interference
Geosynchronous/Geostationary Orbit (GEO)
• Altitude: 35,786 km
• Orbit Period: 24 hours
• Examples: Weather and Data Relay Satellites

Medium Earth Orbit (MEO)
• Altitude: 2,000km – 35,000km
• Orbit Period: 2-24hrs
• Examples: GPS

Low Earth Orbit (LEO)
• Altitude: <2,000km
• Orbit Period: <2hrs
• Examples: ISS, CubeSats
Commercial Service Providers

- Globalstar
- eutelsat
- INTELSAT
- Viasat
- iridium
- inmarsat
- SES
- Telesat
- ASTRANIS
- SSC
- 3b Networks
- OneWeb
- Google
- facebook
- Amazon
- Hughes
- Thuraya
- SpaceX
- Speedcast
Commercial SatCom - GEO

Globalstar

eutelsat

INTELSAT

Viasat

iridium

inmarsat

SES

Telesat

ASTRANIS

SSC

3b Networks

OneWeb

Google

facebook

amazon

Hughes

THURAYA

speedcast
Commercial SatCom - LEO

Globalstar · eutelsat · INTELSAT
Viasat · iridium · inmarsat
ASTRANIS · SSC
3b Networks · OneWeb · SPACEX
Google · facebook · amazon
HUGHES · THURAYA · speedcast
• Require larger constellations  
  • 1000s of satellite needed for full earth coverage  
  • Smaller, Less expensive satellites

• Constant Satellite Refreshes  
  • Satellites deorbit due to atmospheric drag

• Complex inter-satellite networking  
  • Short Orbit Requires constant handoffs  
  • Significant Doppler Effects to compensate

• Small size limits transmit power
LEO Constellation Drivers

- Building and launching satellites is getting cheaper
  - Most gains seen with SmallSats in LEO
  - >$500M → <$5M and decreasing
- Leverage 5G investment in silicon based phased arrays
  - High frequency signals offer high data rates over short distances
  - Arrays change basic communication model
  - Ka-Band propagation means multiple beams needed for each user
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<tr>
<th>Goals</th>
<th>Challenges</th>
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<tr>
<td>• Roam across WiFi, 5G, Satellites Seamlessly</td>
<td>• Early Days of dramatic changes to Terrestrial and Satellite Networks</td>
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<td>• Connectivity anywhere</td>
<td>• Standards still being established</td>
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<td>• Easy to off load capacity to alternative networks</td>
<td>• Too many companies</td>
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<tr>
<td>• Flexibility and robustness to support variety of users</td>
<td>• Significant increase in complexity</td>
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<tr>
<td>• Constant High Data Rates</td>
<td>• Actual capability not well understood</td>
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<td>• Dramatic increases in IoT</td>
<td>• High Frequencies are good for data and bad for propagation</td>
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<td>• Lots of vertical integration</td>
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<td>• Interoperability very challenging</td>
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Questions?