Satellite Technology Trends

- A perspective from Intelsat

Gonzalo de Dios

ITU International Satellite Symposium 2017
May 29, 2017

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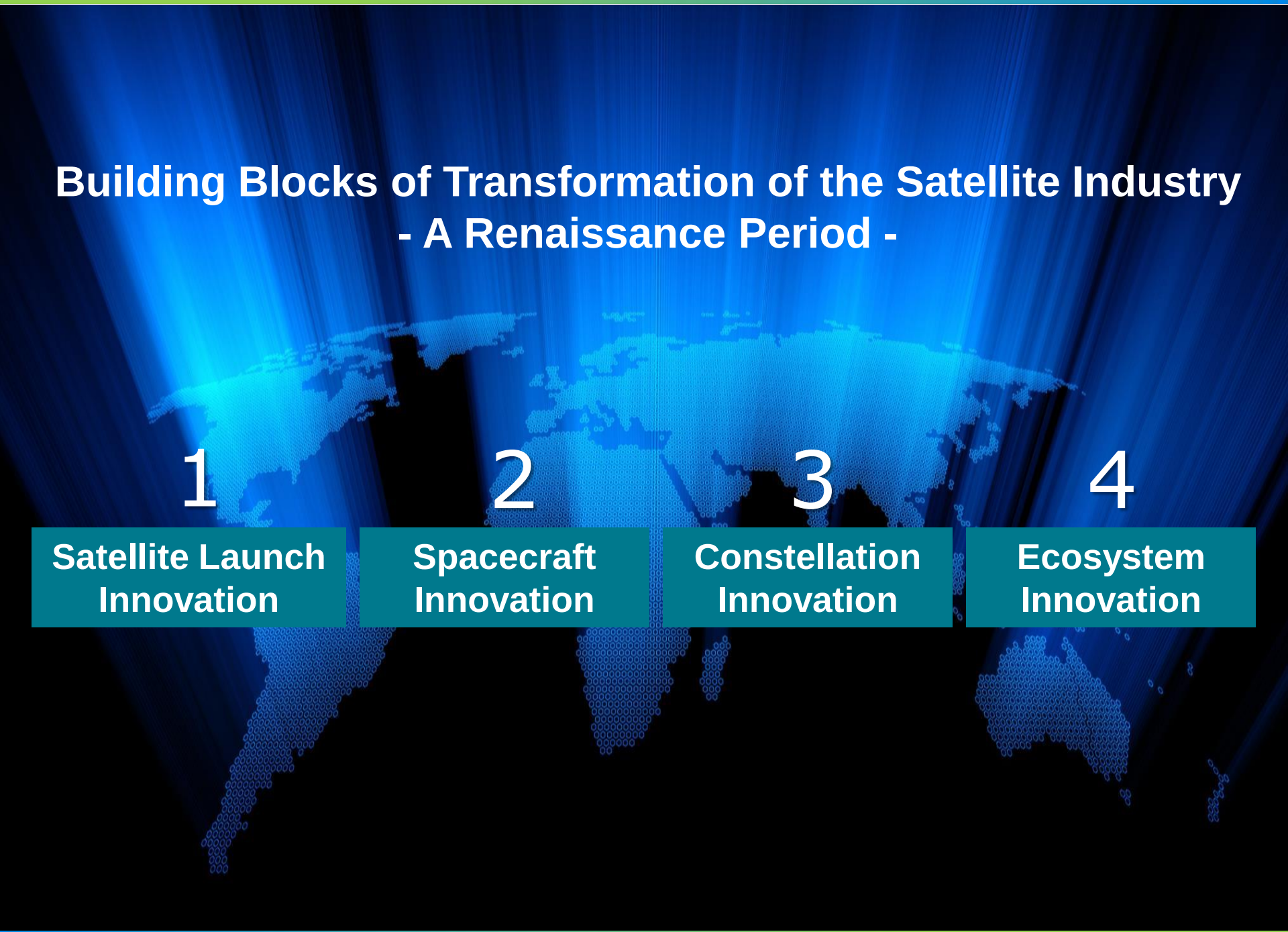
Envision. Connect. Transform.

Building Blocks of Transformation of the Satellite Industry
- A Renaissance Period -



The Technology CEO Space Race Is Heating Up

Investments split between satellite and stratospheric balloon connectivity, and earth observation data

Building and launching reusable rockets for space tourism and satellite delivery

Designs, manufactures and launches advanced rockets and spacecraft

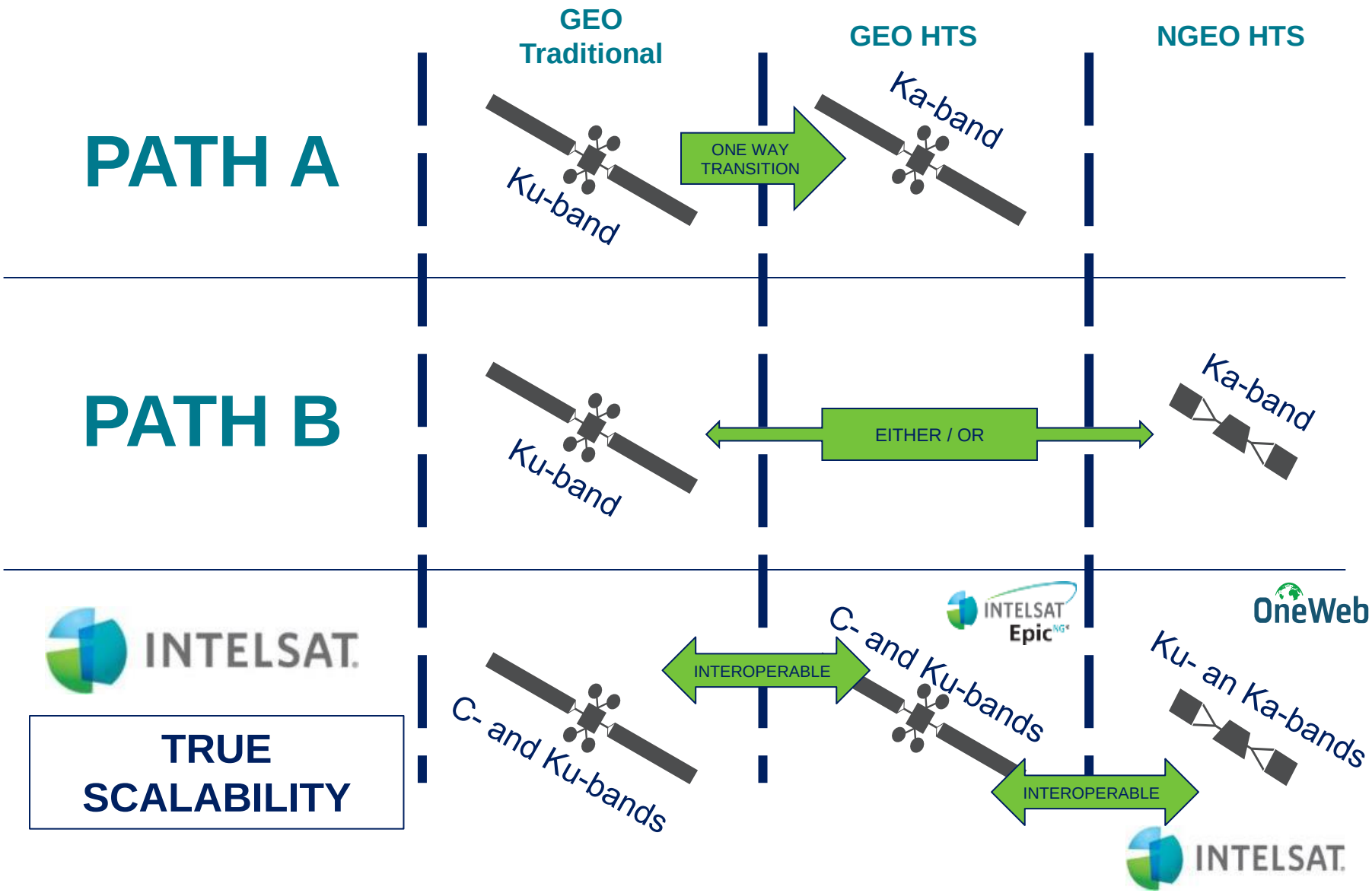
Plans to launch over 4,000 satellites starting in 2019

Looking to drones, lasers and satellites for Internet access

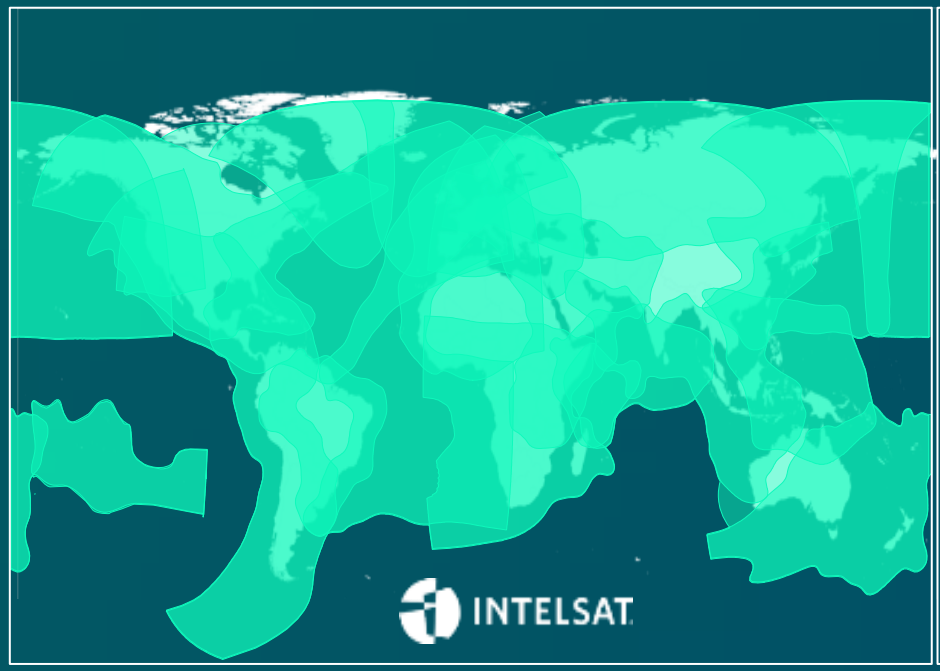
OneWeb investor

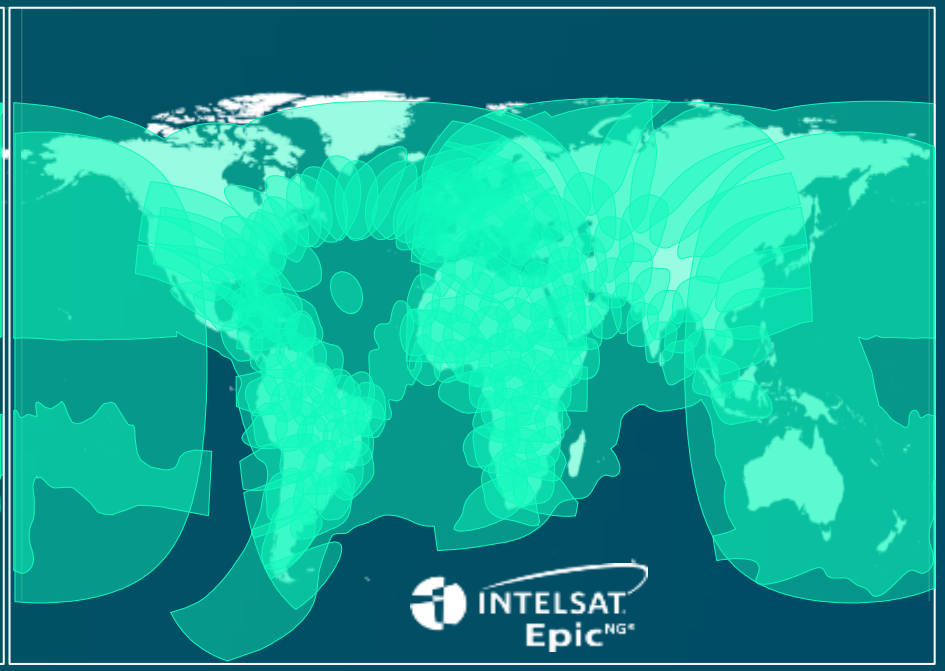
Developing commercial spacecraft, and aims to provide suborbital spaceflights

Different Paths to High Throughput Satellites (HTS)

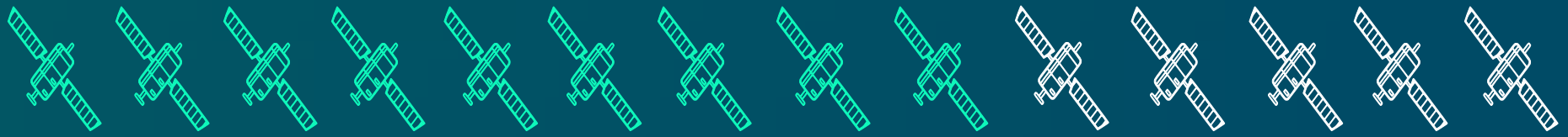


Building a Global C- and Ku-band Network





Up through 2015 | **2016-2017** | **2018 onwards**



IS-21 IS-23 IS-30 IS-34 IS-29e IS-31 IS-33e IS-36 IS-32e IS-35e IS-37e IS-38 H-3e IS-39

Open Architecture

- Backward compatibility with existing equipment
- Freedom to choose ground technology

Epic^{NG} Ecosystem Partners

COMTECH EF DATA

Gilat

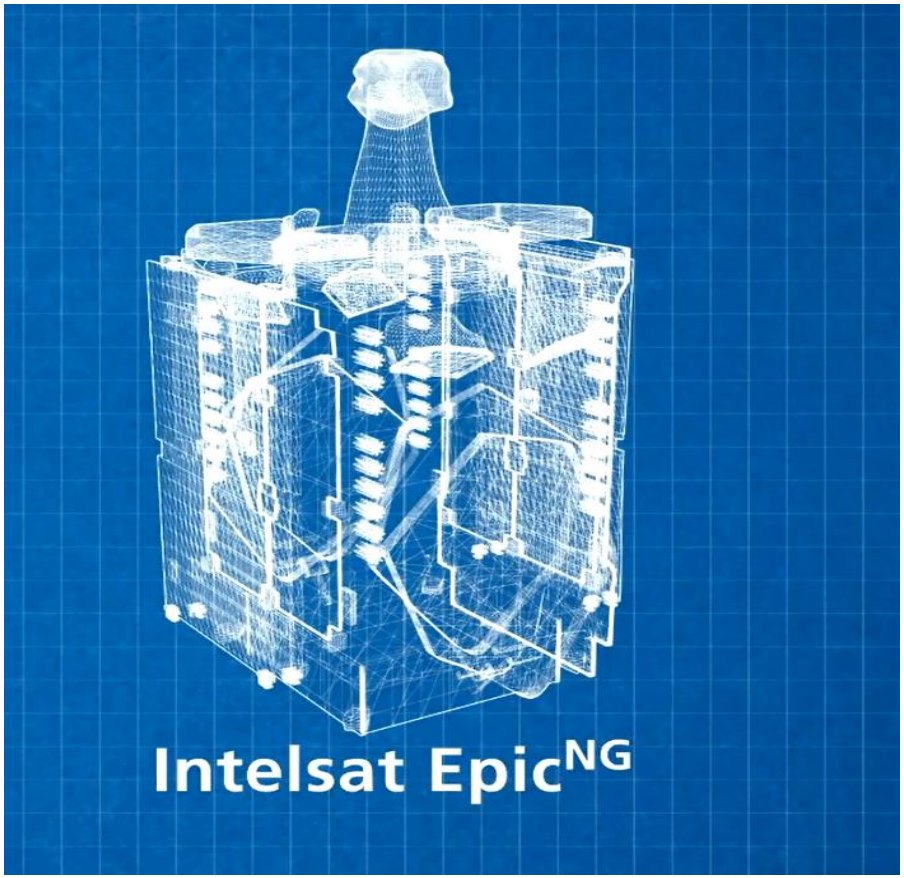
Newtec

iDIRECT

HUGHES

romantis Satellite communications

NovelSat Making Space in Space



- Increased spectral efficiency
- Flexibility
- Security
- Adaptable and scalable connectivity

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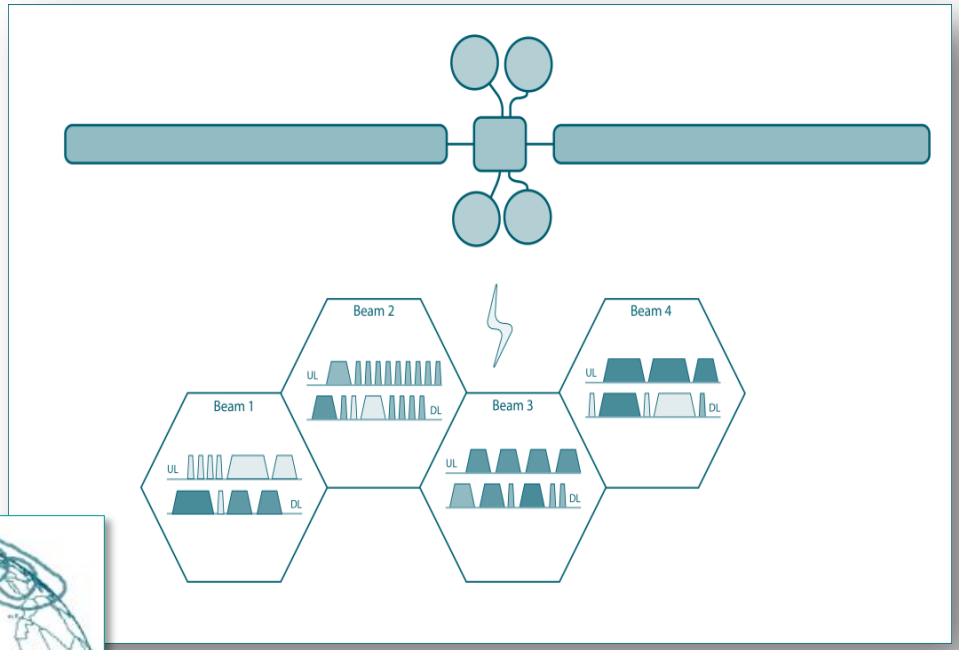
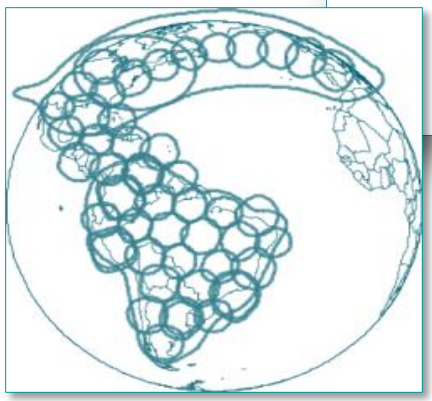
Intelsat Epic^{NG} Features

- Satellites utilize small multi-spot uplink and downlink beams covering the desired area
- Why?
  - Frequency reuse – more bandwidth
  - Better G/T – better performance
  - Higher EIRP
  - Higher throughput





Throughput is 25-60 Gbps, or 10X that of traditional bent pipe payloads

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OneWeb
ACCESS FOR EVERYONE

First Fully Global, Pole-to-Pole HTS System

Total throughput of the system:

5 terabits per second

The OneWeb satellite constellation:

- 650 satellites (18 planes of 36 satellites)
- Low latency (<30ms round trip delay)
- Look angles > 57◦

Credit: Airbus Defence and Space

DESIGN PHASE

LEO HTS

- Pole-to-pole coverage
- Small terminals, low latency

HTS 2.0

- Software defined payloads with flexible coverage, power and connectivity

- 4 HTS satellites already contracted
- OneWeb

LAUNCH PHASE

HTS 1.0

- HTS spots positioned in high traffic areas
- Complementing first layer, not replacing it
- Provides depth of coverage

- 3 HTS satellites

COMPLETED

WIDEBEAM SATELLITES

- Uniform quasi global coverage
- Base layer of the network
- Provides breadth of coverage

- 50 satellites
- 7 wide beam mobility satellites
- 100% complete

Up through 2015 → 2016-2017 → 2018 onwards

GEO

- Wide beams
- HTS overlay for high density areas
- Global coverage

Ku-band

Flexible, high-performance Interoperable user terminals

- Additional capacity
- High look angle
- Low latency
- Pole-to-pole coverage

LEO

Designed with Interoperability in Mind

Interoperability triggered by:

Remote Situation

Shifting to the stronger signal based on geographic location or remote attitude

Capacity Availability

Shifting depending on local capacity availability

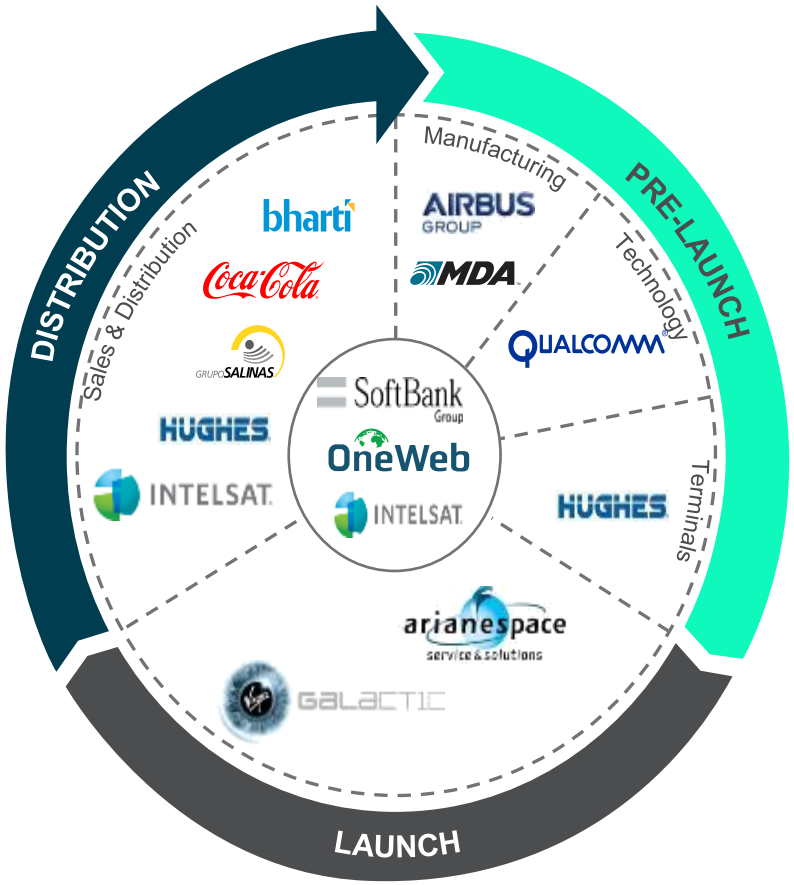
Application-based

Ability to route IP traffic depending on application

Well-Established Partnership Ecosystem Fostering Innovation

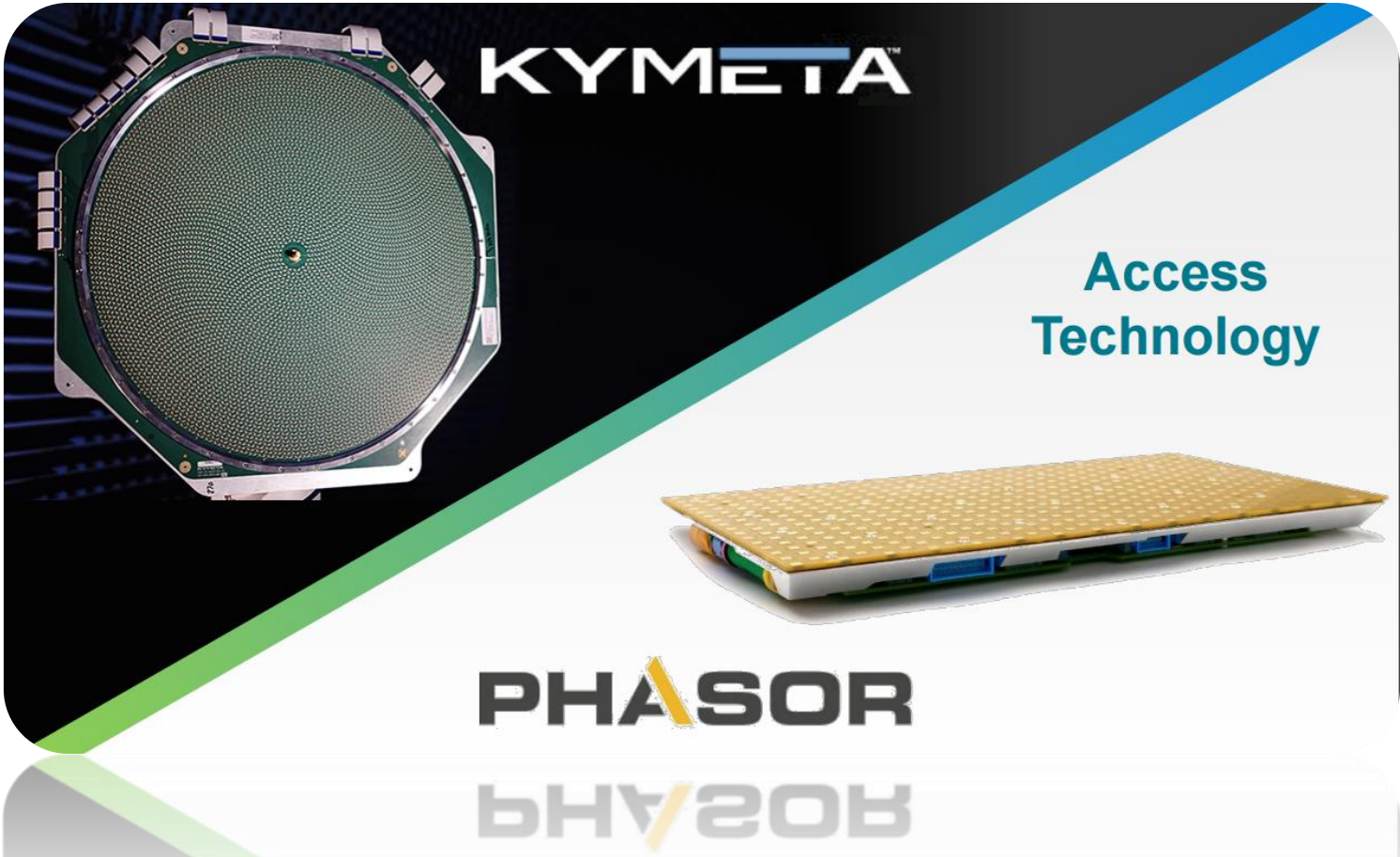
Key strategic and commercial partners	**Synergy across all OneWeb's business operations**
Strong technology partnerships	**Rapid development of the satellite, user terminal and ground systems**
Key distribution partnerships	**Effective initial go-to-market strategy**

Will continue to partner with new industry leaders to support deployment and market access



Innovation in Ground Technology

- Business and small jets
- Vehicles
- Hand-held devices
- IoT applications
- Sensors



Advancements in ground segment technology are enabling access to new and previously unserved segments

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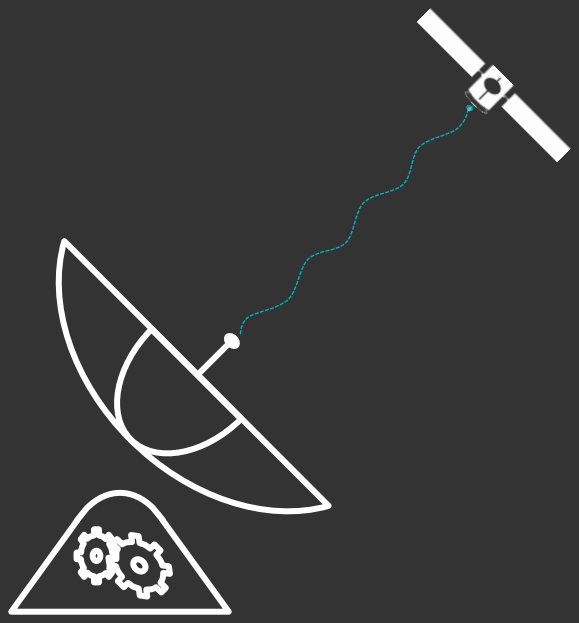
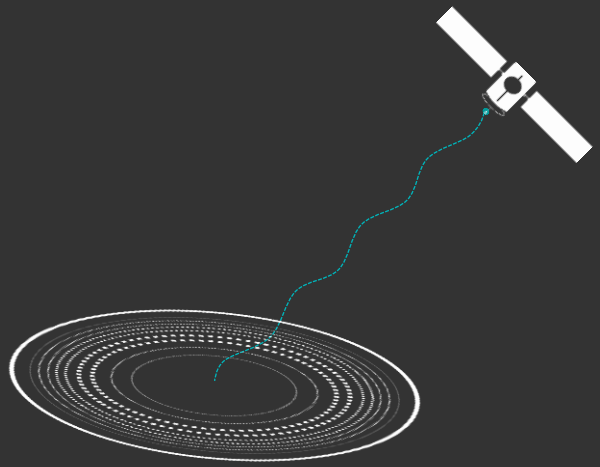
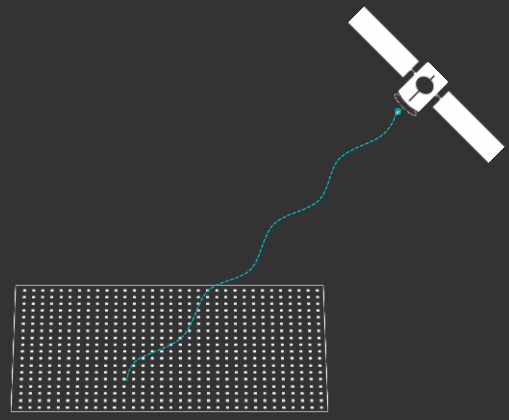
Redefining the Satellite Antenna

- Electronically Steered Antennas (ESA)
- No moving parts
- Ultrathin and light





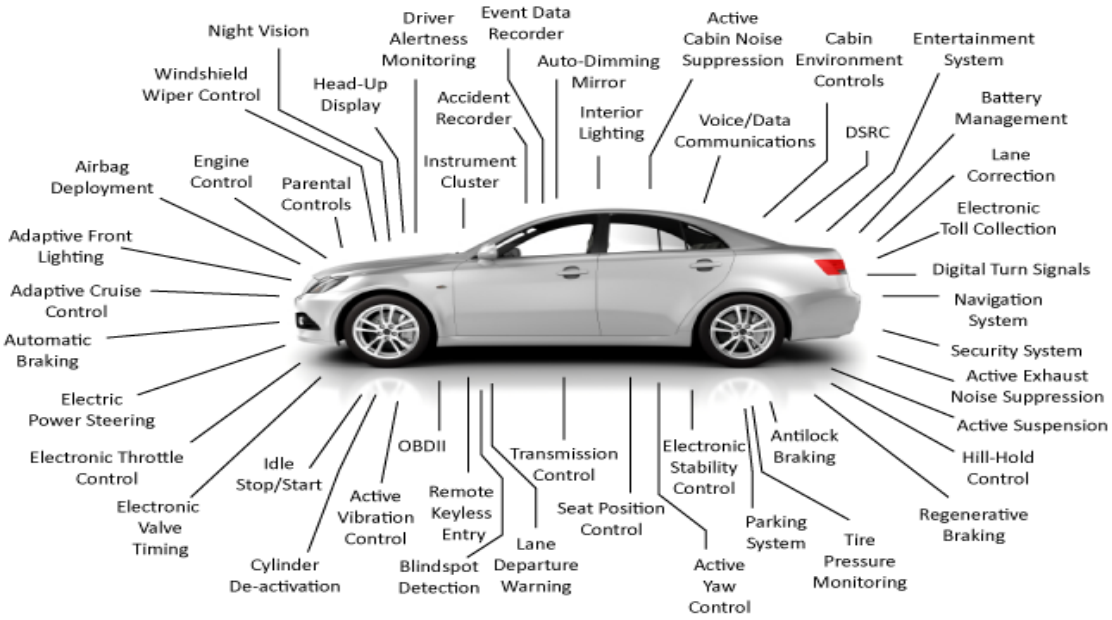
- Metamaterials
- Passive array



- Active phased array
- Panels may be laid conformably

About Connected and Autonomous Vehicles

- Connected and autonomous vehicles incorporate a range of different technologies, facilitating the safe, efficient movement of people and goods
- Vehicles with increasing levels of automation will use information from on-board sensors and data banks to understand their position and local environment
- This enables them to require regular firmware and software updates and operated with little or no human input



The Connected Car

Consumer Demand

250 Hours Time a typical American commuter spends per year inside their car.

~50% Of all the car buyers wish to access their mobile applications when they are inside their cars.

Source: *"The Internet on Wheels and Hitachi, Ltd." by Hitachi*

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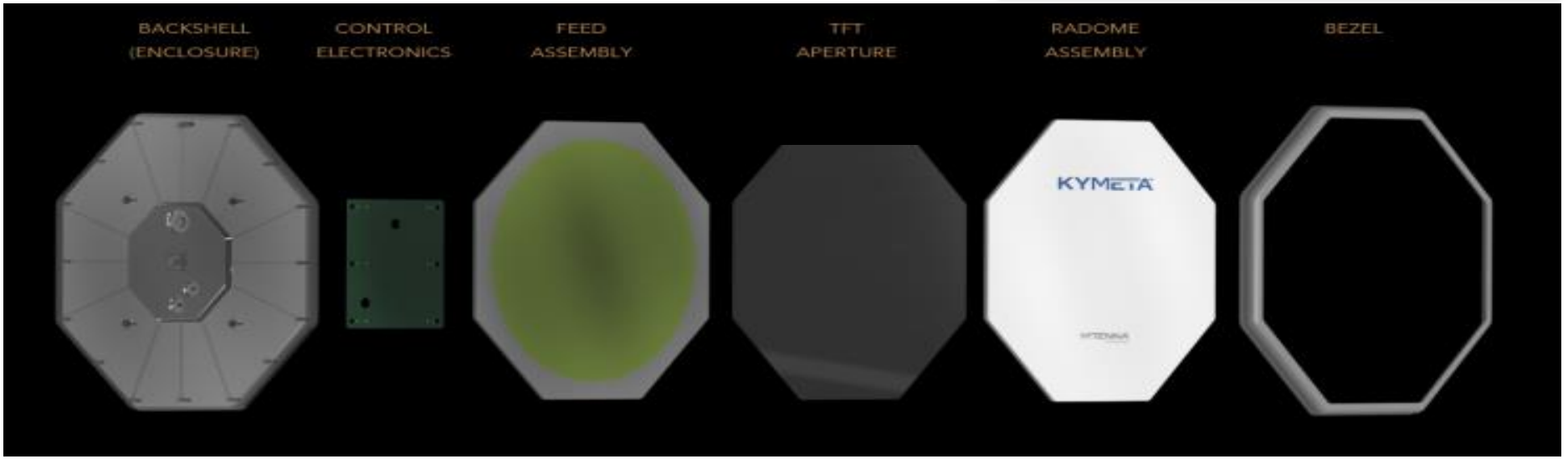
Kymeta
Ground Segment Advancements

Intelsat Acquires Equity Stake in Kymeta, Announces Service for Satellite Purchases

mTenna^{u7}
The world's first, electronically scanned satellite antenna that can be used extensively across mobile and fixed platforms will begin commercial trials in May 2017



Kymeta and Intelsat solution is being designed to deliver 1TB of data per month to each car

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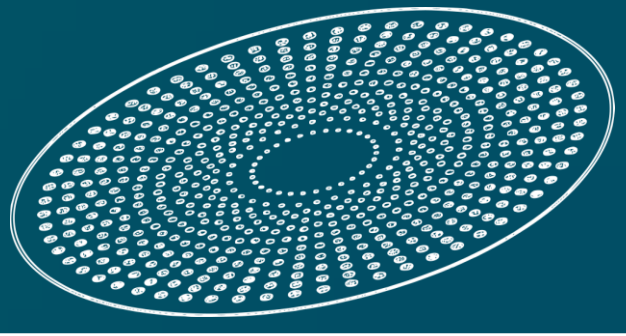
Intelsat and the Connected Car



Working to provide secure connectivity solutions

20cm Flat Panel Antenna

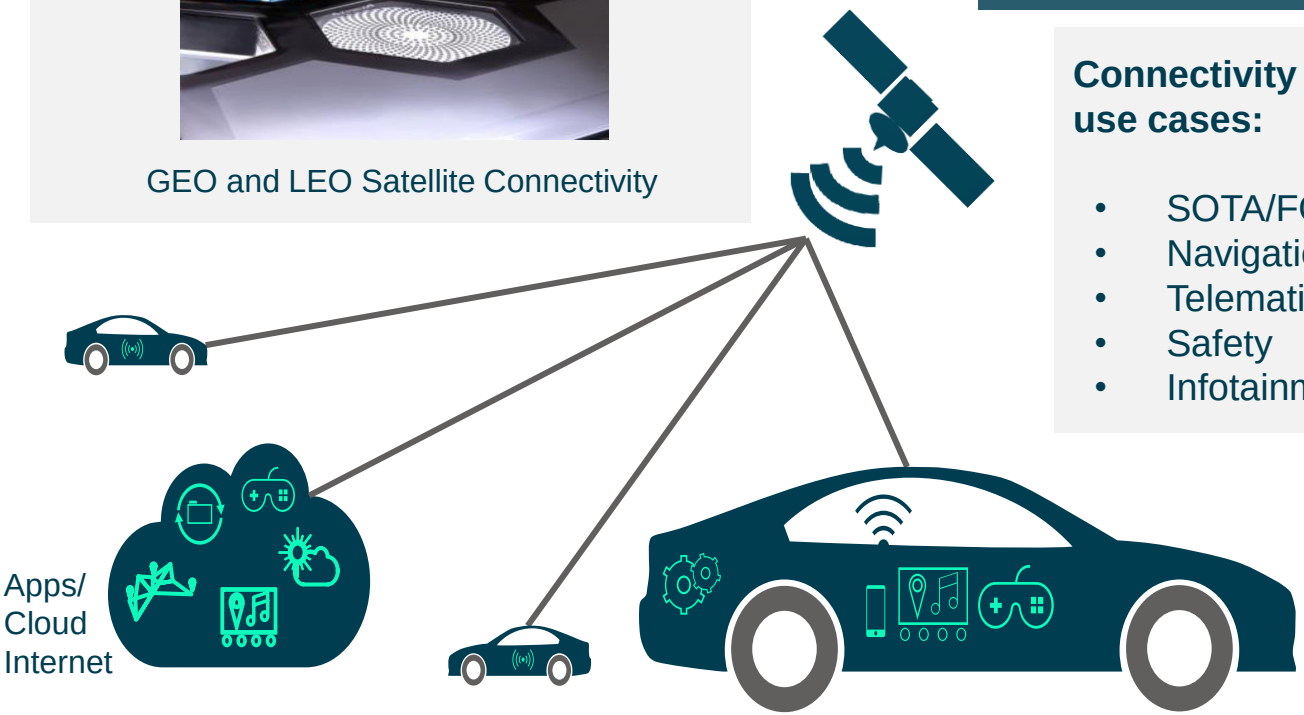
GEO and LEO Satellite Connectivity

Offerings:

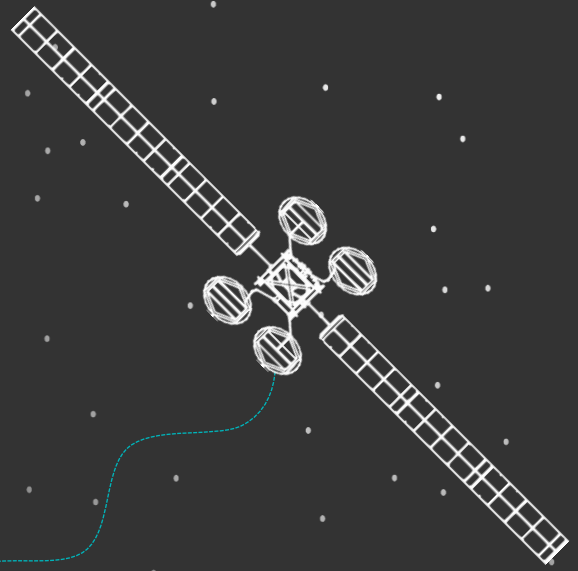
- Multicast & Broadcast solutions
- Services to millions of vehicles world wide
- Innovative services – not just connectivity

Connectivity and services for a variety of use cases:

- SOTA/FOTA downloads
- Navigation
- Telematics
- Safety
- Infotainment



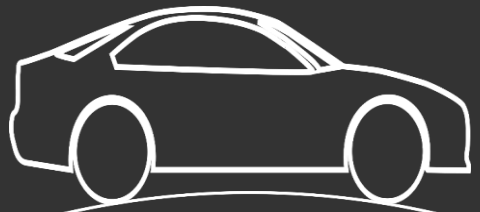
- Satellite infrastructure is designed for security
- The converged carrier-class network supports and extends to all data/media applications
- All service procedures are fully Integrated with our Information Assurance Program



Intelsat adheres to and assesses against the following:

- ISO 27001/27002 – Information and data security
- DoD 8005.2 MAC II – Mission Assurance Controls
- HIPAA HITECH – Full compliance securing patient data

And employs relevant and layered countermeasures to reduce risk and effectively counter cyber-threats



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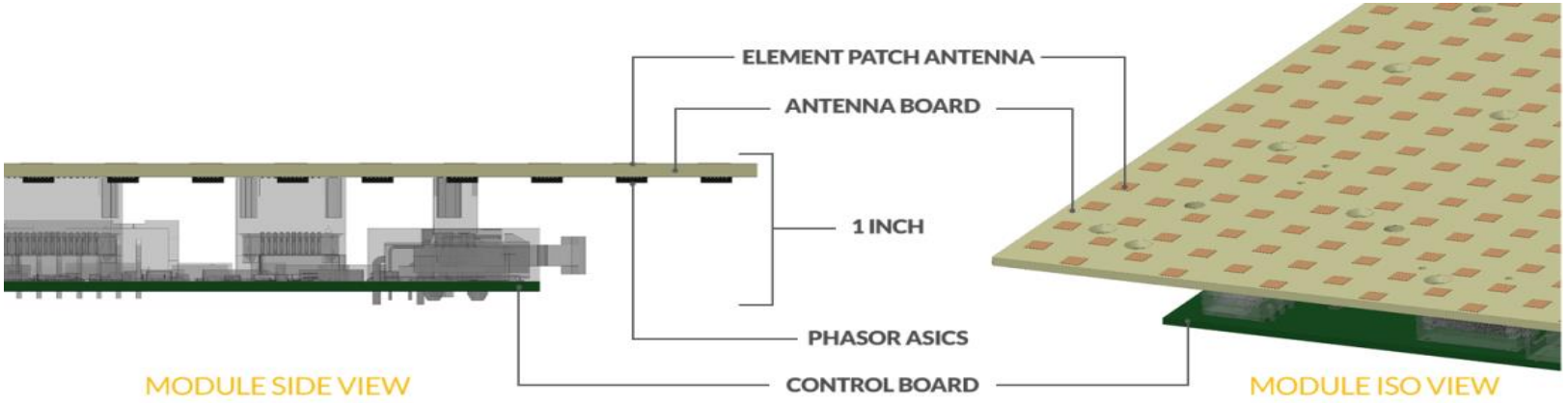
Phasor for the Connected Jet



Source: Phasor

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GEO and NGEO

Phased Array Antenna Technology

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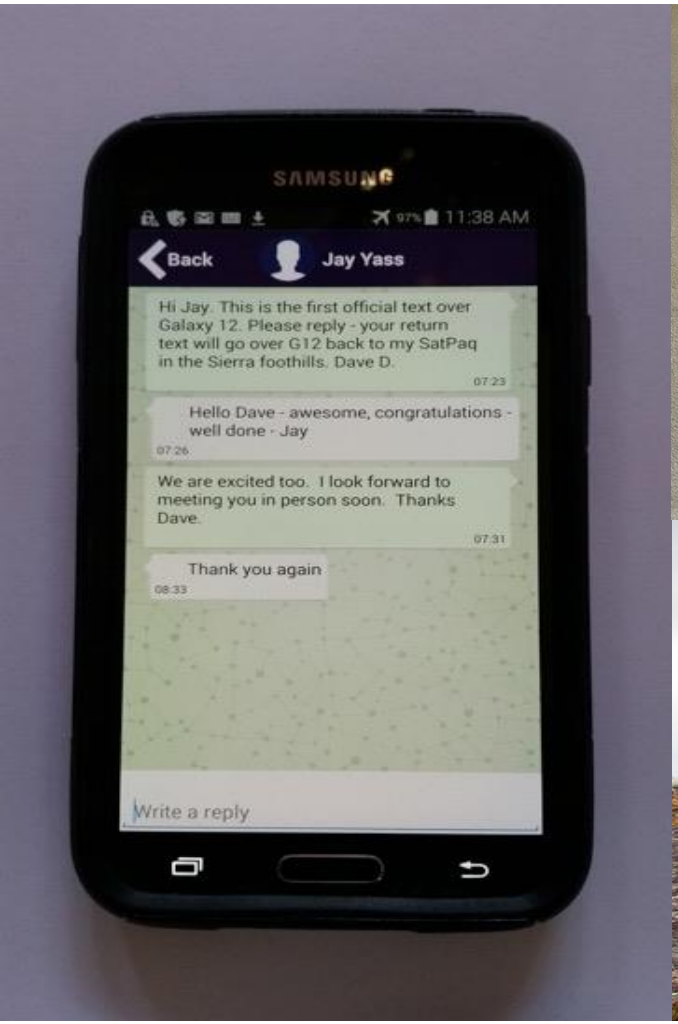
Higher Ground

Smartphone-sized Antenna for Text Messaging, IoT Applications



June 3, 2015

- First ever text messaging exchanged directly over FSS satellite (Galaxy 12) with a SatPaq smart phone sized terminal

January 18, 2017

- FCC grant of blanket earth station license to operate up to 50,000 SatPaq earth station terminals

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Connecting the Unconnected

The ability to seamlessly communicate with anyone, anywhere is an expectation

Yet, the physical and financial constraints of traditional networks have left more than 60% of the world's population unconnected

The promise of ubiquitous, affordable access to all requires a new approach which the satellite industry is addressing

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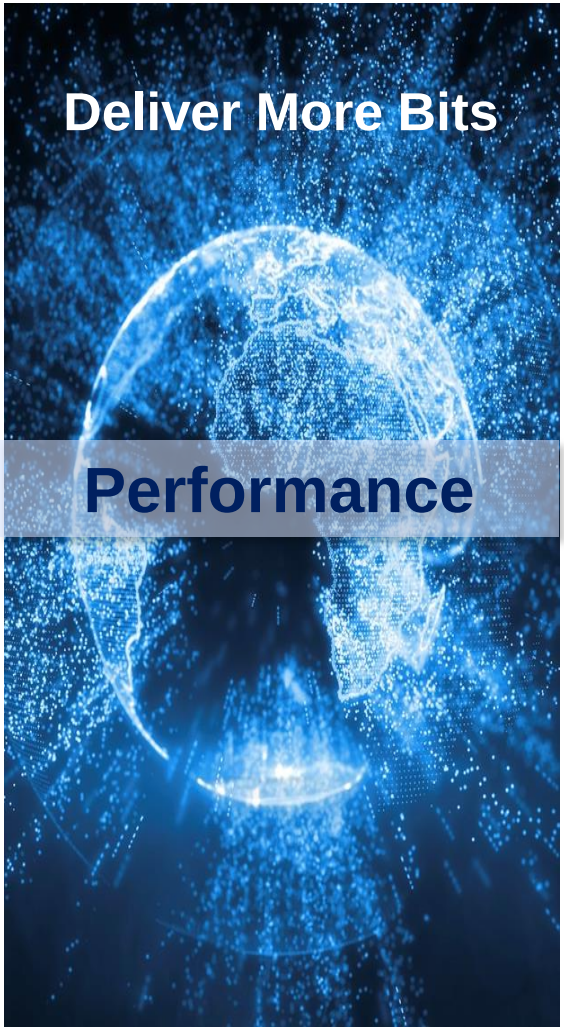
The Way Forward

Accessible and Efficient High Speed Connectivity



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Thank You!

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