



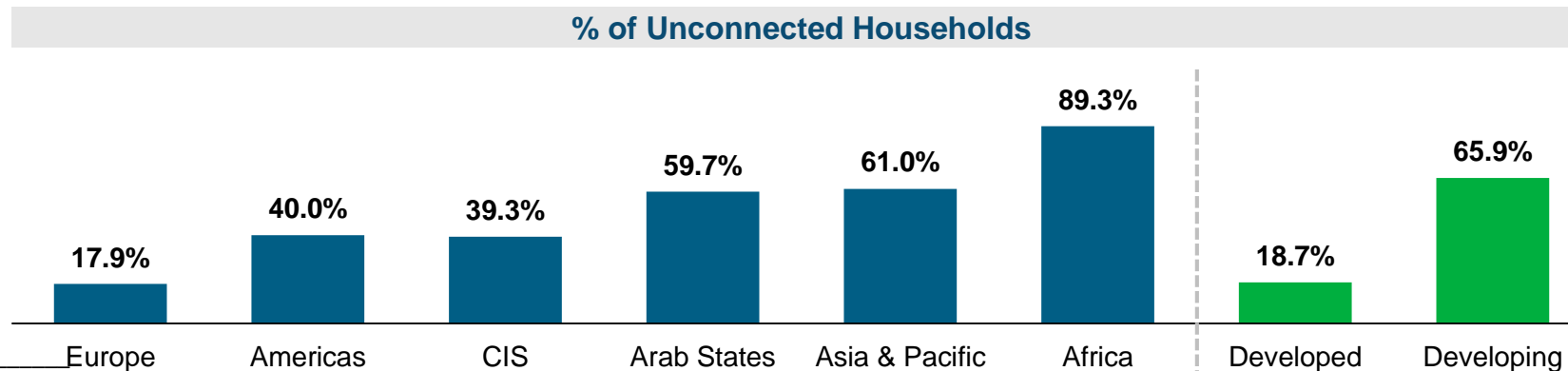
## OneWeb's Approach to Space Debris Mitigation

UN/UAE High Level Forum, 8 Nov 2017

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# Enable Affordable Internet Access for Everyone

- The ITU <sup>1</sup> estimates over **4 billion people** without internet access globally
- 55 million people lack access to advanced broadband in the U.S. alone
- OneWeb's market entry objectives align with public initiatives and international governments' goals



Source: ITU - ICT Facts & Figures, 2015; FCC 2015 Broadband Progress Report.

(1) International Telecommunication Union, an agency for information and communication technologies within the United Nations (UN).

# History

1990s



## First Fiber to the Home In Africa

OneWeb Founder, Greg Wyler, builds the first fiber to the home network in Africa following the events of the Rwandan Genocide. There, he realized satellites were the solution to bridging the digital divide.

2012



## OneWeb Founded

OneWeb is founded in 2012 with the mission to enable affordable access for everyone and connect every school on Earth.

2015



## Joint Venture with Airbus

OneWeb and Airbus form joint venture to manufacture OneWeb's constellation. A contract for an initial run of 900 satellites is signed.

2015



## \$500 Million Series A Funding

OneWeb announces 500 Million in Series A funding with a group of leading international companies. Wyler announces "we have spectrum, funding, chip technology, satellite manufacturing, launch, and markets."

2016



## First High Volume Satellite Manufacturing Facility

OneWeb and Airbus Joint Venture, OneWeb Satellites, unveil plans for the world's first high volume satellite manufacturing facility to be built in Exploration Park, Florida.

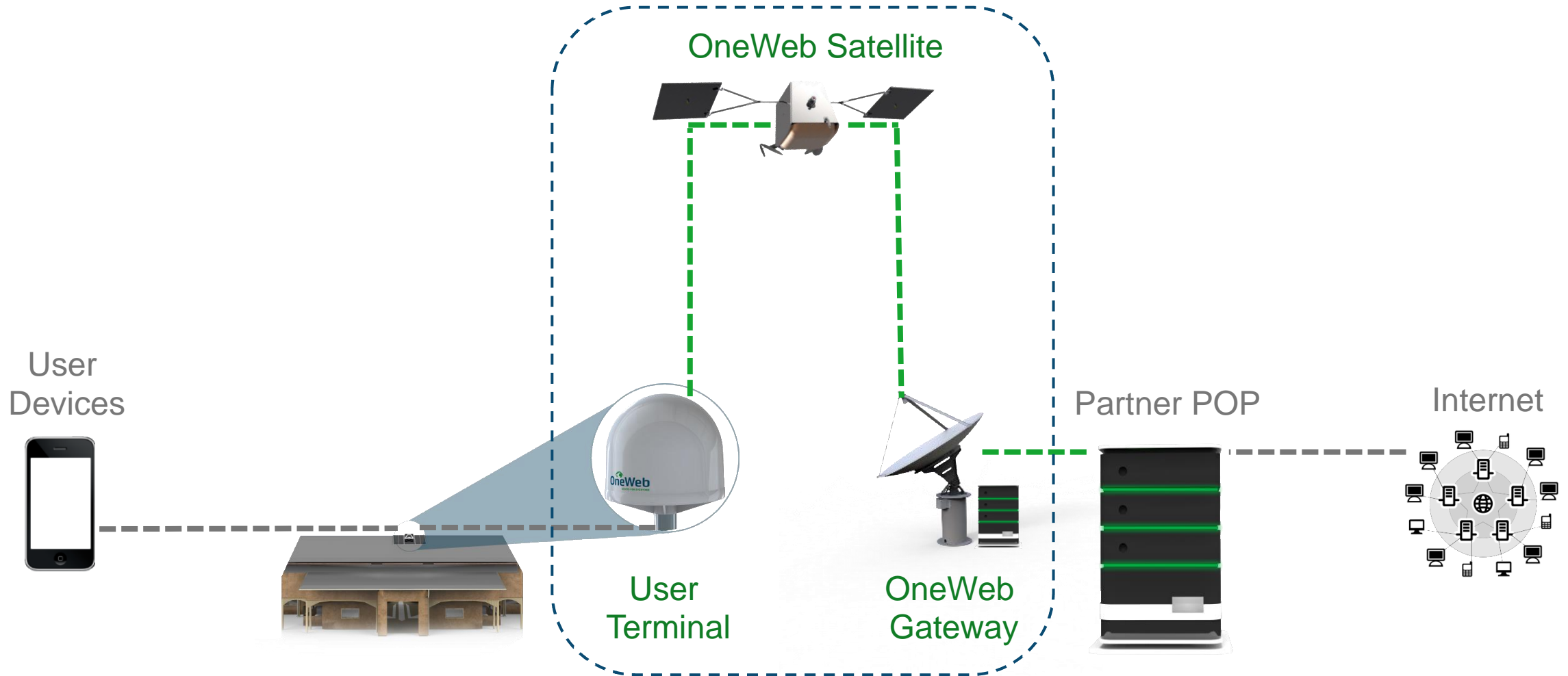
2016



## \$1.2 Billion Series B Funding

OneWeb announces 1.2 Billion funding round led by SoftBank Group. Wyler announces, "these new capabilities will support both our 2022 goal of connecting every unconnected school and our 2027 goal of bridging the digital divide."

# OneWeb System Architecture





# Constellation Overview

## Constellation

- 720 satellite initial deployment by 2020
- 18 orbital planes of 40 satellites each
- 1,200 km operational altitude
- 87.9° inclination
- Scalable to accommodate demand
- > 50 Gateway sites worldwide

## Satellites

- 150 kg class, electric ion propulsion
- 1,080 x 1,080 km footprint
- Ku/Ka band service/feeder links

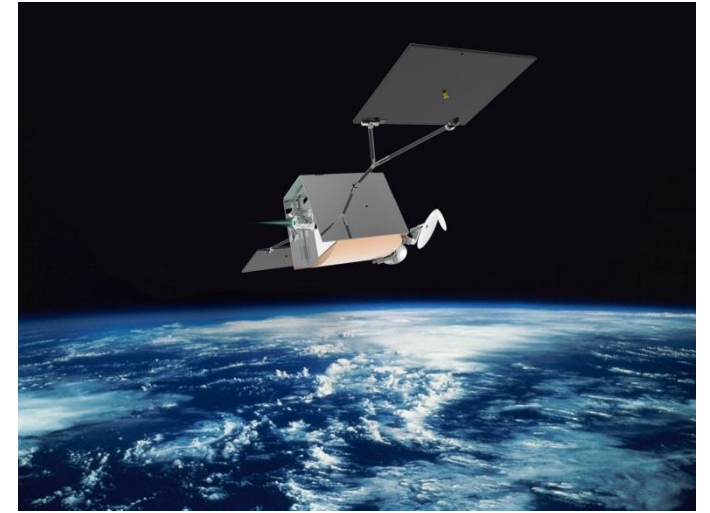
## Service

- Remote small cell networks
- Mobile broadband
- Leverages LTE technology
- High look angles



# Satellite Production

- OneWeb Satellites is a joint venture between OneWeb and Airbus Defense and Space
  - Responsible for design and fabrication of OneWeb satellites
  - First 10 are being built in Toulouse to validate design and manufacturing
- Satellite factory being built in Melbourne, Florida
  - \$85M facility
  - More than 100,000 square feet
  - Scheduled to open in 2017
  - State-of-the-art assembly and I&T
- Production contract
  - 900-satellite initial production run
  - Peak production rate of 1-2 satellites per day



# Launch Services

OneWeb has mix of launch vehicles and exploring additional options



## Soyuz (Arianespace)

- 21 firm launches with 5 options
- 3 Ariane-6 options
- 32 satellites on each launch
- 3 launch sites: Baikonur, Kourou (French Guiana) and Vostochny
- Launch to 450km from Baikonur / Vostochny and 475km from Kourou
- 1,800+ launches; industry leading 97% success rate



## Launcher One (Virgin Galactic)

- 4 firm launches
- Additional launches based on deployment needs
- 1-2 satellites per launch vehicle
- 747 airplane launch from Mojave, CA
- Launch to 500km for 2 satellites, up to 1,200km with 1 satellite



# Mission Profile

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- Launch to 450-500 km altitude
- Preliminary IOT and drifting to adjacent planes as necessary
- 20-week ascent to 1,200 km altitude operational orbit
- Five-year nominal operational mission
- Decommissioning and extraction to 1,100 km circular
- One-year deorbit campaign to lower perigee below 200 km for rapid re-entry
- Complete structural demise in upper atmosphere (preliminary analysis)



# Good Stewardship is Good Business

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- OneWeb believes space is a shared, natural resource that must be protected like any other
- Our goal is to operate cleanly and responsibly for the benefit of the orbital environment as well as for the sustainability of our business
- OneWeb believes current mitigation regulations may be insufficient environmental safeguards
- OneWeb is advocating for safer design and operating practices
- OneWeb is committed to unparalleled standards for environmental stewardship

# Responsible Design and Operations

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- OneWeb's Orbit Selection
  - LV insertion at 450-475, above ISS and below existing high-value assets
  - Operational altitude at 1,200 km, above high-density LEO regions
- Positional Knowledge
  - Redundant GPS receivers on every spacecraft
  - Automated, high-accuracy orbit determination process
  - Strong radar signature facilitates independent tracking
- Data Sharing
  - Data sharing agreements already in place with JSpOC
  - Ephemeris will be shared with other operators directly and/or through other data coordination entities (e.g., Space Data Association, ComSpOC)

# Responsible Design and Operations (cont'd)

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- Collision Avoidance
  - Active conjunction monitoring and maneuvering from launch to re-entry
  - High-efficiency, electric propulsion system provides maneuverability
  - Nearly global TT&C visibility provides collision avoidance agility
- Disposal
  - Deorbit system is required to be the highest-reliability function on the satellite
  - Atmospheric re-entry within five years of decommissioning
- Design for Demise During Re-entry
  - Preliminary DAS assessment indicates entire satellite will disintegrate prior to reaching the ground
  - Pursuing contract with NASA to confirm with detailed ORSAT modeling
- Active Retrieval Facilitation
  - Considering design accommodations to facilitate uncooperative capture and active removal

# OneWeb's Debris Mitigation Activities

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- JSpOC coordination and joint CONOPS development
- Risk assessment and covariance analyses with SpaceNav
- Re-entry survivability and impact vulnerability assessment with NASA (pending)
- Long-term environmental impact assessment with Univ. of Southampton (pending)
- Development of conjunction assessment tools and maneuvering criteria
- Evaluation of commercial tracking data sources
- Development of decommissioning criteria
- Evaluation of satellite accommodations to facilitate ADR
- Outreach to government agencies and regulators to inform policy reform