OneWeb

ACCESS FOR EVERYONE

Overview

2/15/2016

We All Need Access

World Summit on the Information Society

In 2005 WSIS outlined 10 targets for 10 years.

Target #1 – Connect all villages with ICT's and community access points.

Target #2 – Connect all Secondary and Primary Schools with ICT's

10 Years Later

"In terms of internet access and use, Target 1 is unlikely to be achieved by 2015 and currently available data suggests a pronounced rural-urban divide. Access to the Internet in any form is extremely low for rural households in developing countries…"

Broader Mission

- Create a system which can affordably and profitably connect every school, health center and community location in the world

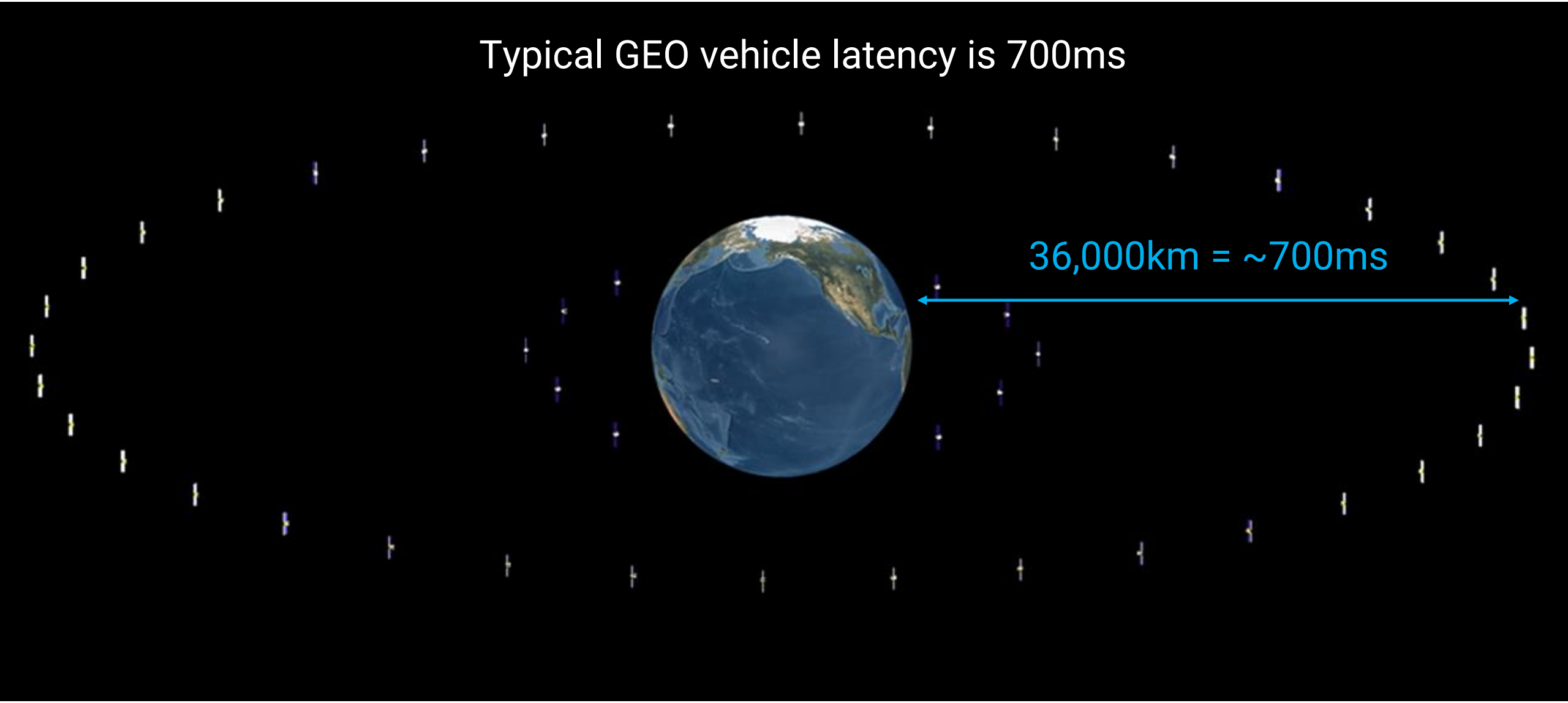
Key:

- Each access point must be easy to install with no tools/minimal training
  - Create a local income for the owners/installer
- Each access point must provide internet quality similar to any modern city:
  - 50mbps @ 50ms latency
- Solar Powered
- Free Basic Service should be available to everyone
- Onboard cache for government/school data - educational videos

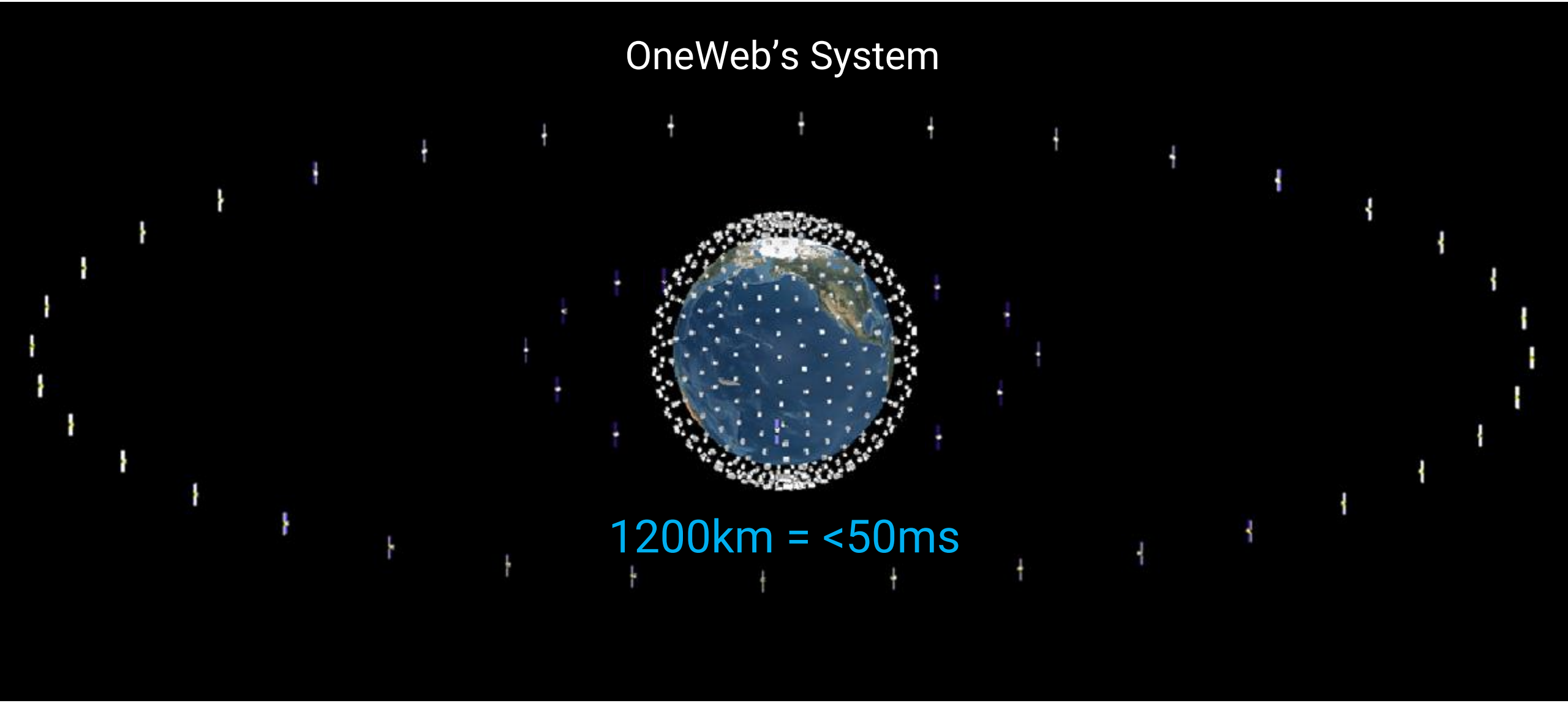
WiFi/LTE/3G and 2G access

- Neutral network – be a small cell extension for every participating mobile operator and ISP

Latency



Latency



Extending Cellular And Broadband Coverage

Broadband

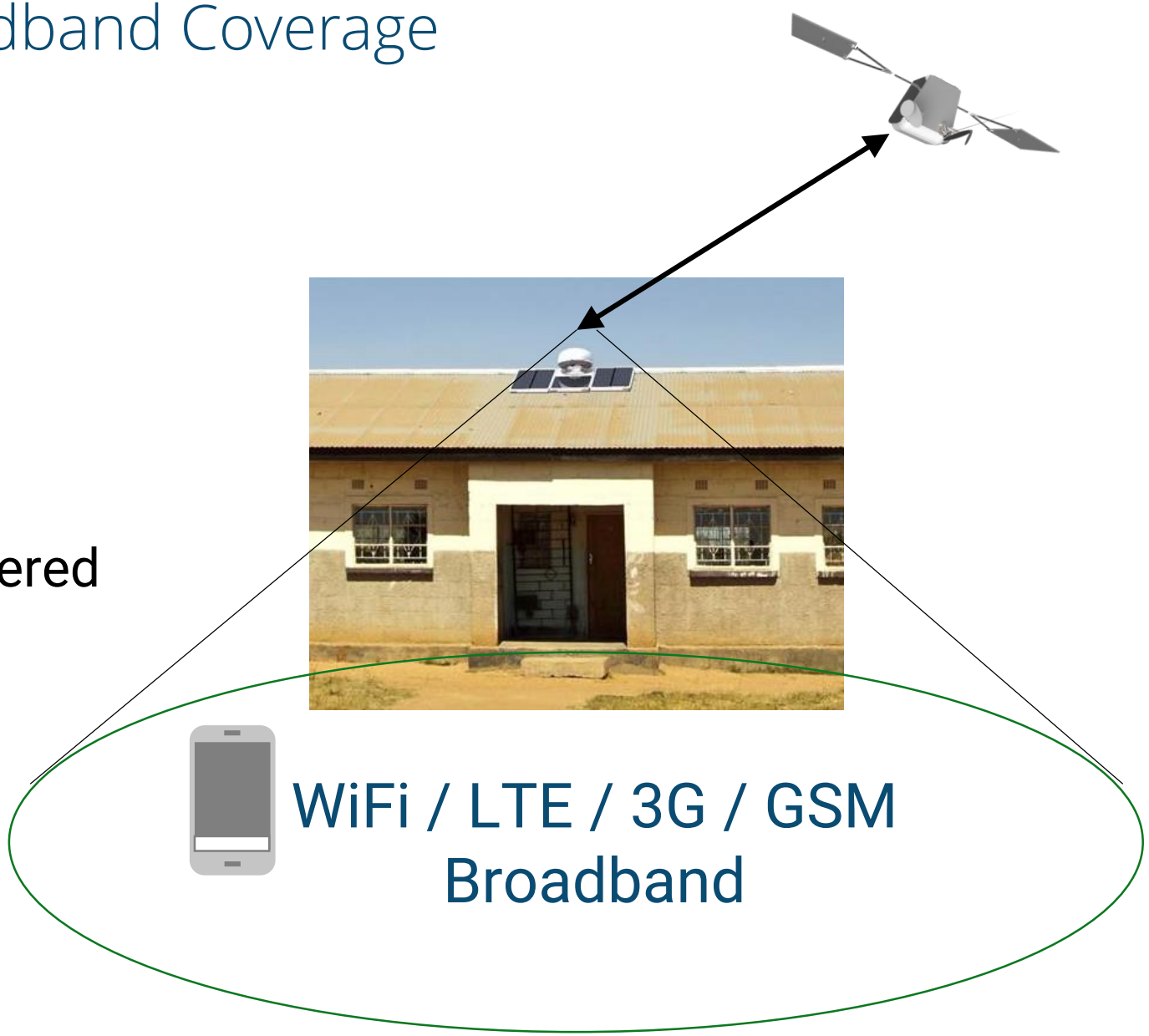
- Ethernet up to 50 Mbps

OneWeb Backhaul

- Low latency (two-way) < 50 ms
- Battery, Solar and Ethernet powered

200m Cellular Cell

- LTE/3G/WiFi
- Any Cellular Carrier (roaming)



Direct to Home, Schools, Hospitals, Farms

Instant and Constant Infrastructure

End user devices (e.g. smartphones, laptops, tablets, etc.) Operating on LTE, WiFi, 3G, 2G communicate via the OneWeb mobile stations to satellites.

First Responder cells created through OneWeb's solution combine to create larger coverage areas

In-Transit Connectivity

OneWeb Architecture

Satellite Constellation

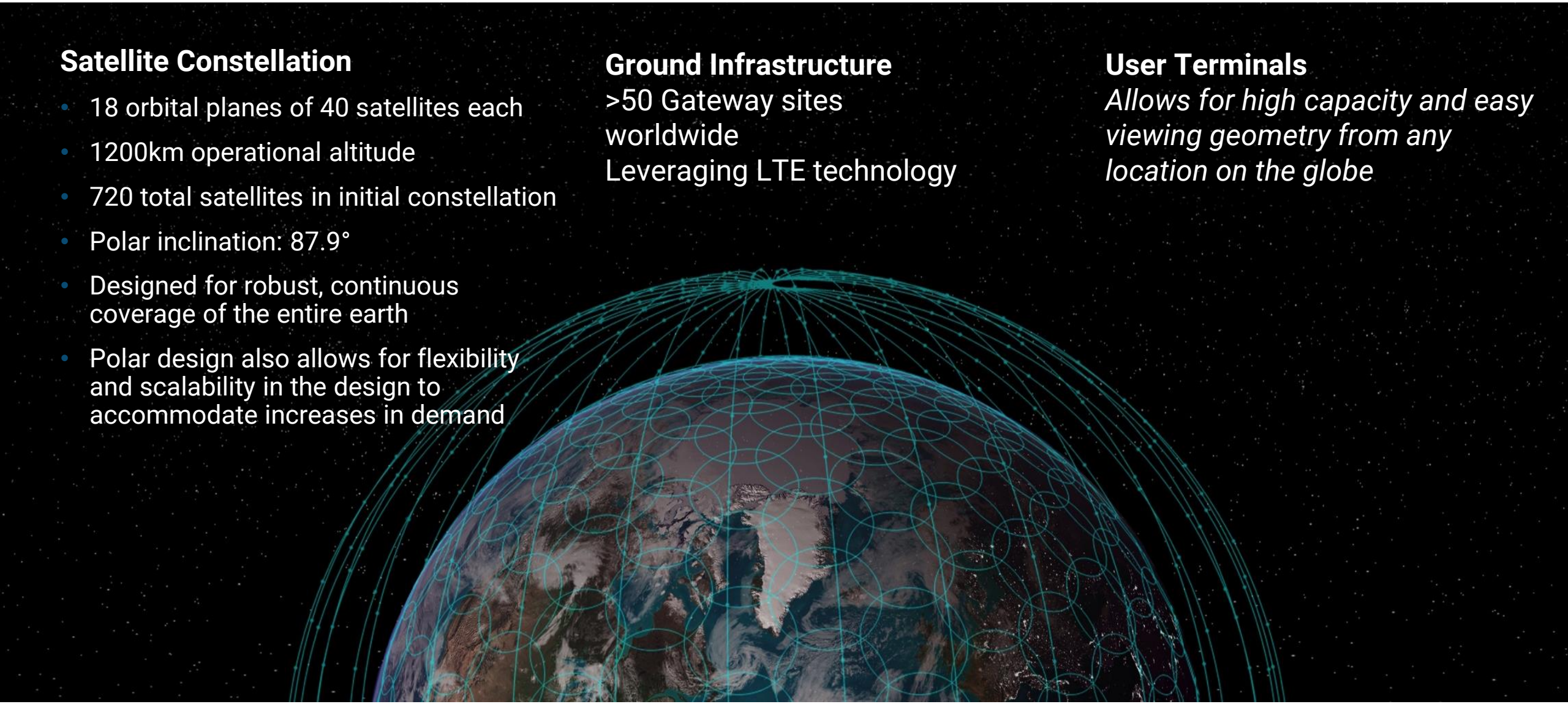
- 18 orbital planes of 40 satellites each
- 1200km operational altitude
- 720 total satellites in initial constellation
- Polar inclination: 87.9°
- Designed for robust, continuous coverage of the entire earth
- Polar design also allows for flexibility and scalability in the design to accommodate increases in demand

Ground Infrastructure

>50 Gateway sites worldwide
Leveraging LTE technology

User Terminals

Allows for high capacity and easy viewing geometry from any location on the globe



Launch Campaign

- Largest commercial launch acquisition in history
- 21 Launches from Arianespace using Soyuz and Ariane 6
- 39 Launches from Virgin Galactic
- Options for 100 additional launches
- Utilizing launch pads from Guiana Space Center, Baikonur, and additional pads in Russia
- Ensures the timely deployment of OneWeb's full constellation

Raising the Orbit

- Satellites will be deployed from the launch vehicle into a 475 km circular orbit
- System tests/checkouts performed over the following few days
- Upon approval, satellites will raise altitude from 475 km to 1200 km using electric propulsion
- The continuous, low-thrust trajectories are constantly screened for conjunctions
- Ascent phase is 60-70 days long

With launches every 20–30 days, this means we could have nearly 100 satellites orbit raising at the same time for several months

Being Good Stewards of Space

OneWeb understands space is a shared, natural resource that must be protected like any other. We are passionate about preventing debris creation, respecting existing space assets, and ensuring a safe and sustainable space (and Earth!) environment for the future.

Our goal is operate cleaner and more responsibly than expected

OneWeb Design is Taking Responsible Measures

- Trackability
  - Large Radar Cross Section
  - Onboard GPS for precise OD, ephemerides sharing
- Maneuverability
  - Budgeting sufficient fuel for collision avoidance agility
  - Planning for <5 year disposal orbit (ideally with active control until reentry)
- Reliability
  - High deorbit reliability, >90%
  - Designed for removal in worst case: s/c have mechanical fixture for uncooperative capture
- Design for demise: limit materials that may survive atmospheric reentry
- Proactive with JSpOC interaction
    - High number of spacecraft is expected to be a burden on current operations
    - Low-thrust trajectories require ephemerides exchange
    - Currently working to establish mutual CONOPS years before launch

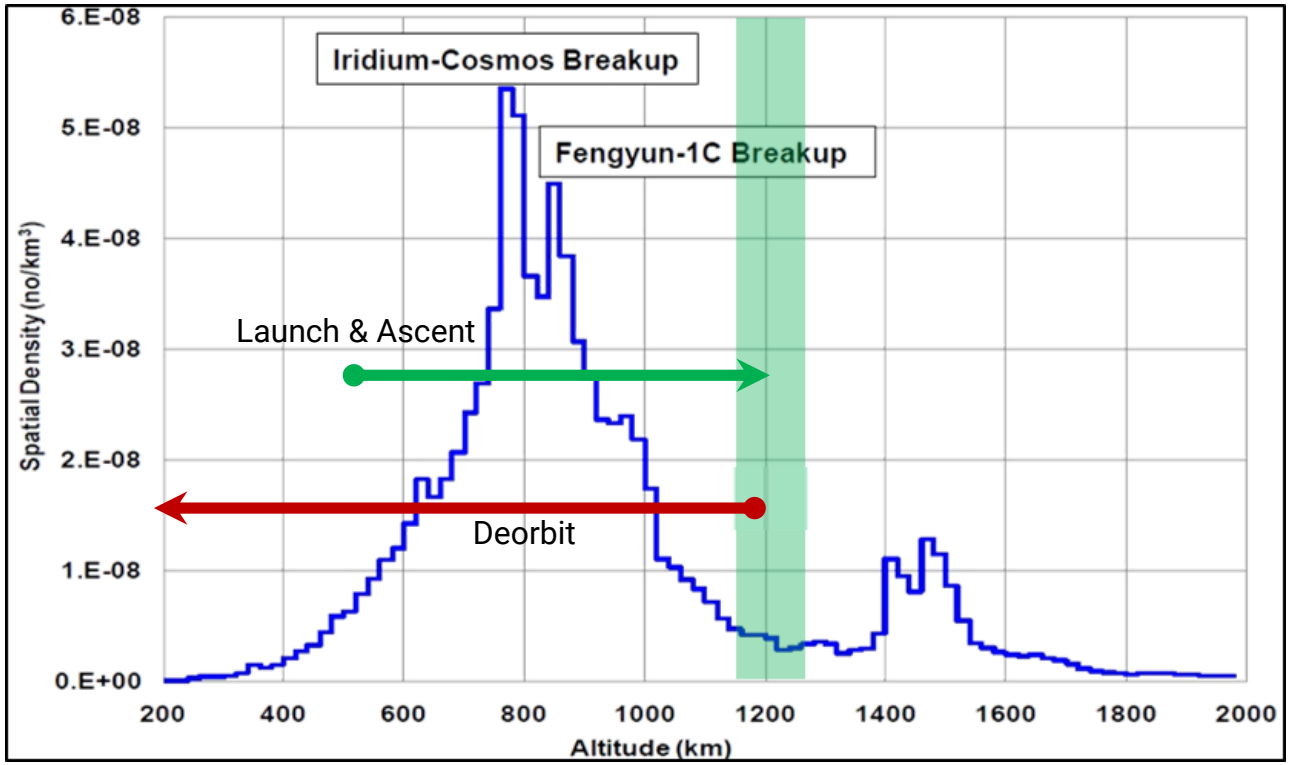
Orbit Choice and Collision Avoidance

Operating in a safe orbital regime

- 1200km orbit chosen, in part, for its low density of space objects: minimal risk of conjunctions
- Most conjunction warnings will occur during orbit transfer through the 700-900km region: avoidance strategy is simply turning the thruster off
- Assessing the expected number of High Interest Events that will require action during other phases → fuel budget and CONOPS

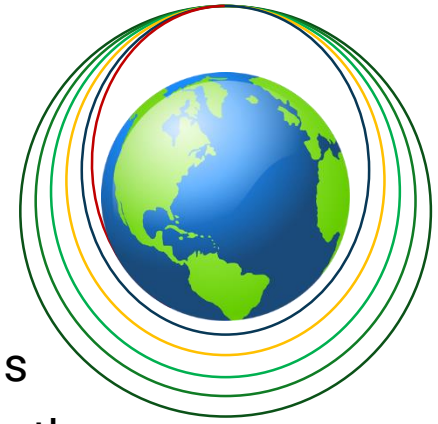
Decrease uncertainty, decrease # maneuvers

- Space Fence to come online in a few years, other commercial radar efforts are currently in development
- Space data sharing agreements already in place with USSTRATCOM/JSpOC
- The increase of quantity, quality, and frequency of data collection and analysis will allow us to further minimize the maneuvers needed during constellation lifetime



Low Earth Orbit Objects Need to be Carefully Considered

Minimizing Impacts to LEO Environment



OneWeb plans to limit the increase of object population density in LEO

- **Short term effects:** determined by satellite deorbit time
- **Long term effects:** determined by system reliability

- Following the 25 year deorbit requirement is not enough for large constellations
  - Satellite design lifetime means we'll be decommissioning satellites frequently
  - <5 year deorbit time will keep LEO from getting cluttered
  - Apogee only burns to place satellites into eccentric disposal orbit with apogee below the constellation operational altitude: 1100x240km

- Deorbit reliability is paramount to keeping our own orbits clean, as well as the rest of LEO
  - Satellites left in orbit would stay there for centuries
  - OneWeb requires the deorbit system to be the most reliable part of the spacecraft
  - Satellite design includes a fixture to enable uncooperative capture by future systems

Thank you