

Role of satellite communications in expanding the reach of telecom connectivity to rural and remote areas

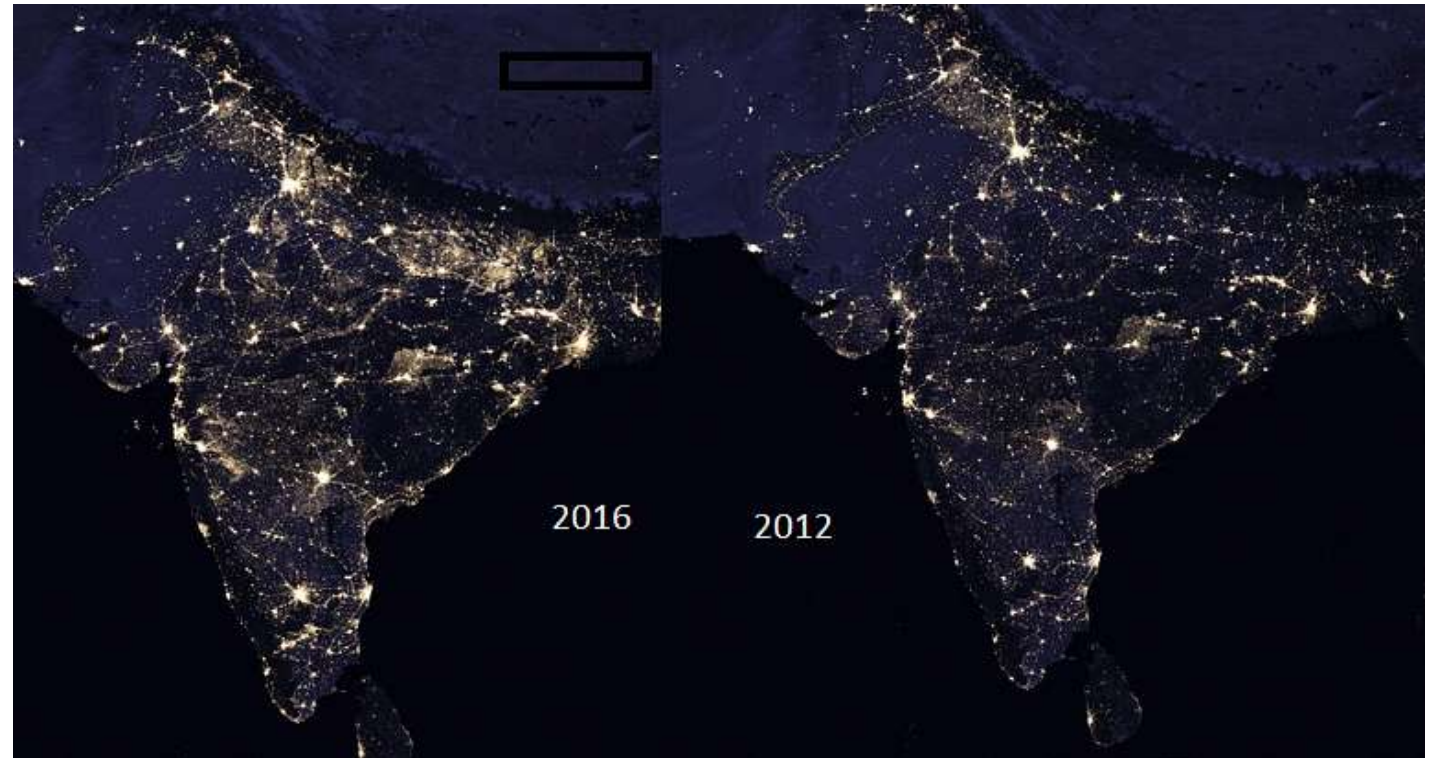
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Sparsely populated areas in India

- Central Indian forests, Thar desert, W Ghats, NE India,...
- Cellular coverage patchy
 - Population density makes it unviable
 - Foliage and / or terrain hampers radio propagation
- Space-based connectivity provides a solution for such areas
 - GeO satellites
 - LEO satellites
 - HAPS
- Assigned spectrum must not be attenuated much by rain/fog/cloud cover



courtesy: Swarajya



Advances in Space-based Platforms

- Payload and power availability increasing with time
- Sophisticated multi-antenna deployments feasible
 - Narrow beam-forming
- LEO satellite launch becoming significantly cheaper
 - Many startups emerging
- HAPS is an emerging technology
 - Progress / cost reduction linked to advances in drone, battery and solar-energy technologies
 - “geostationary” at 20 km elevation
 - above weather disturbances
 - Can fly 24x7 for several months between maintenance touch-downs



GeO vs LEO vs HAPS

- GeO
 - latency ~ 500 ms,
 - uplink Tx requirements not suitable for handsets
 - capacity limited by size of footprint
 - despite advances such as SDR, MIMO, etc, etc
- LEO
 - latency low, though URLLC type connection still difficult
 - Handset operation possible
 - Many satellites needed that necessary cover the earth
 - How to utilize satellites when their orbit leaves Indian airspace (>90% of time)
 - Inter-satellite transfer of data possible



GeO vs LEO vs HAPS (contd.)

- HAPS
 - Latency comparable to terrestrial mobile
 - Handset link budget also similar
 - Each platform can serve 1000's of sq. km (or less)
 - 24x7, like GeO satellites
 - Capacity highest among three choices
 - Platform still not mature
 - Cost will determine timeline for scaling



LEO satellites and their duty cycle

- If we wish to continue with current telecom operational regime, satellite traffic has to terminate within country
 - At some core network of a national TSP
- So, LEO satellites have to enter (and depart from) national TSP networks periodically
 - i.e., we will have “mobile” base stations
- In order to monetise them rest of the time
 - They have to similarly enter (and depart from) other national networks
 - Satellite operator must provide base stations to multiple TSPs globally
 - Standards must support such “attachment” and “detachment” of base stations
- Else we have to change national policy to permit international Service Providers to switch/terminate traffic
 - which cannot be lawfully intercepted within national boundaries



Ensuring 100% saturation coverage in India

- Even as optical fiber goes to every village and terrestrial wireless coverage improves
 - We will continue to have coverage holes
 - Forests, deserts, mountains,...
- Space-based wireless umbrella coverage a must
 - Standards being developed to handle seamless handovers from terrestrial to / from space-based base stations
- LEO satellites will play an important role
 - India's launch capabilities including emerging space launch startups are great enablers
- Global players must provide LEO base stations to TSPs (in many countries)
 - Spectrum bands for operation must be standardized globally
 - Could be an "infrastructure provider" instead of a TSP

In the meantime,....watch out for HAPS!

Thank you

