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SatCom next steps

New Space Economy

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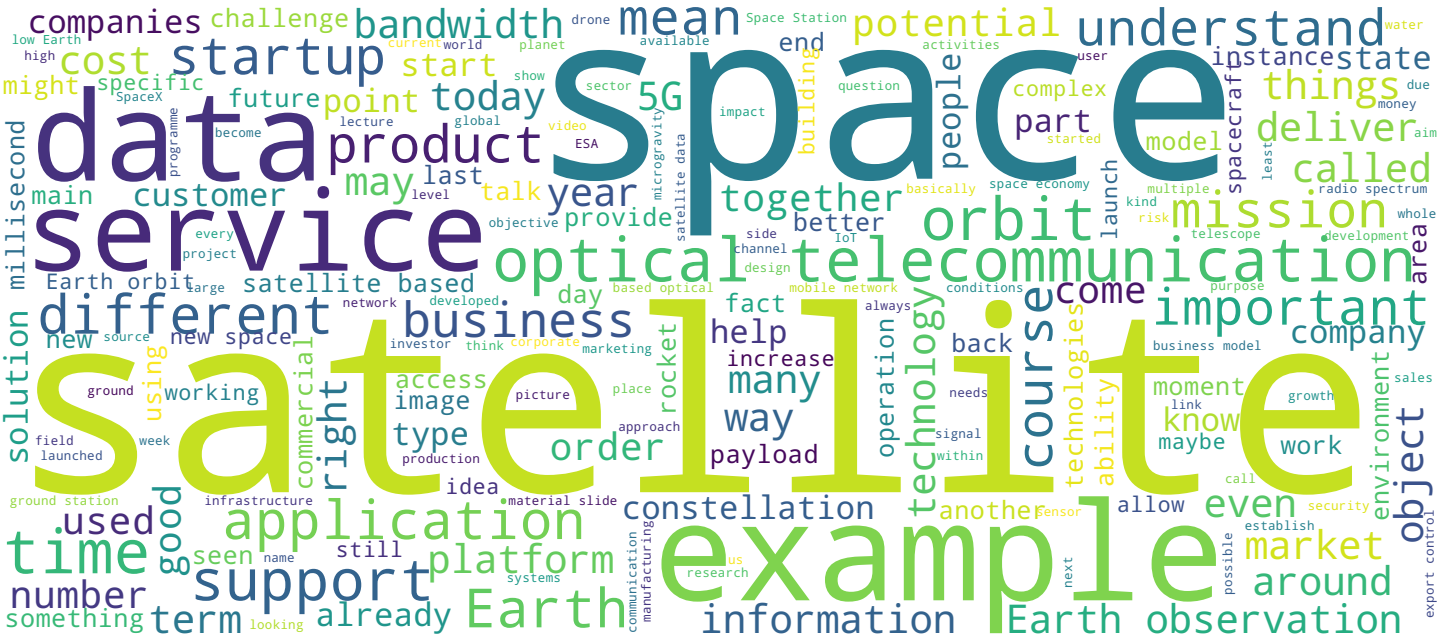


Search MOOC

Video

EPFL

SatCom: What is Next

- Internet of Thing (IoT)
- 5G
- Fiber from the Sky
- Quantum Key Distribution (QKD)

Now, we look into the future together and we try to understand the declination and future developments of satellite-based telecommunications. The 5G, the Fiber from the Sky or LaserCom, and the Quantum Key Distribution. Concerning satellite-based Internet of Things, there will be a dedicated lecture from a great expert for you.

Notes

Summary

0m 05s

5G: Basic Concepts

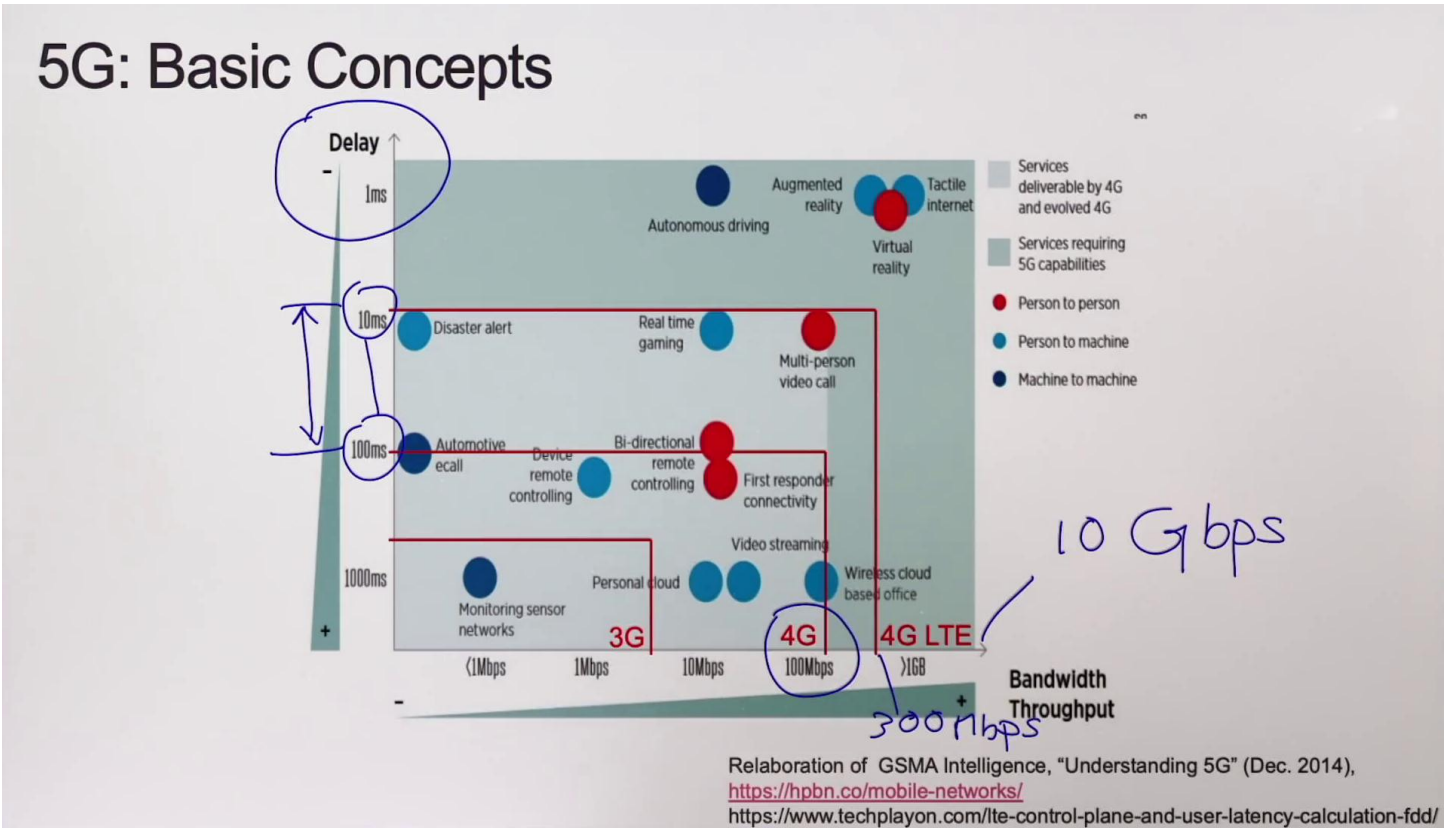
- 5G is the new mobile network technology
- A real integration of different communication systems
  - Not a simple evolution of mobile broadband networks
- State of the Art performance
  - Resources efficiency
  - Latency
  - Bandwidth

We should all have heard about the rolling out of the new mobile network, the 5G, at least because advertisement is trying to propose us new subscriptions for our mobile phones. Well, 5G represents a radical improvement in mobile network connectivity because it aims at delivering us state-of-the-art performances in terms of resource efficiency, latency, and bandwidth. Let's talk briefly about resource efficiency. There is a lot of debate about the radiated power of 5G, but the fact is that 5G is upfront targeting the ability to support low power, independent, and self-standing applications. The capability to support power minimization in communication is fundamental to achieve this result.

Notes

Summary

0m 35s



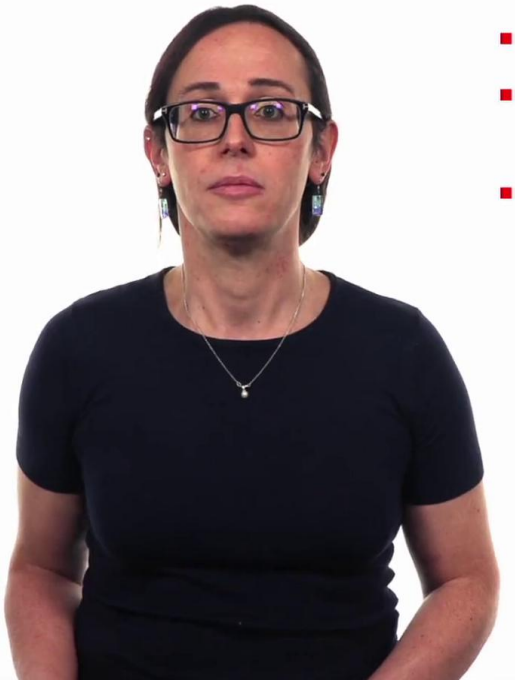
So let's look together at the targeted latency and bandwidth of 5G. The existing network, 4G, operates with latencies between 10 milliseconds and 100 milliseconds and delivers bandwidth between 100 megabytes per second to about 300 megabytes per second. 5G instead aims to deliver to the final users latencies of one millisecond and bandwidth capability up to 10 gigabit per second.

Notes

Summary

1m 35s

5G: Key Objectives



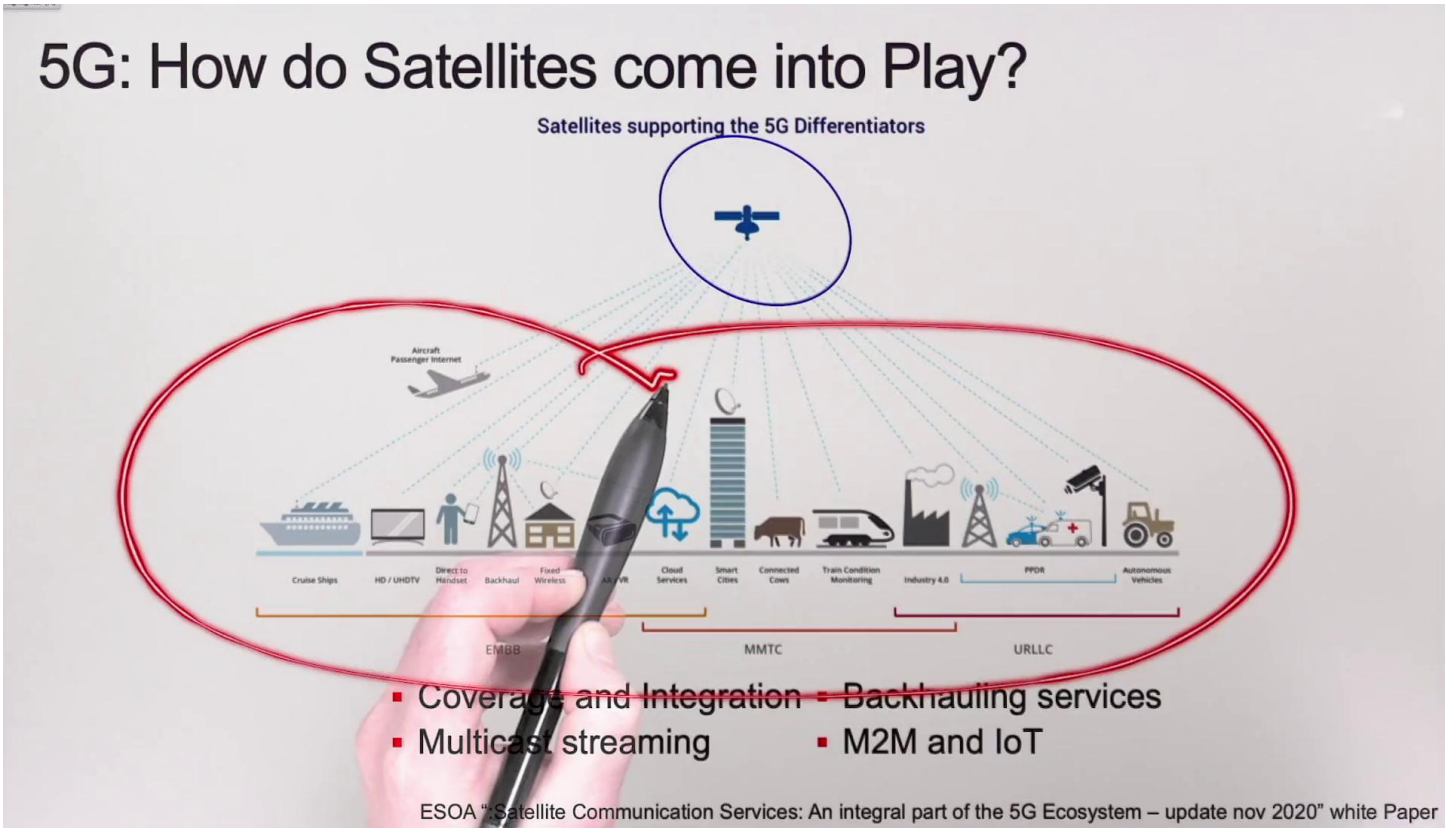
- To support the projected mobile growth
- To support and enable emerging services: eMBB, mMTC, URLLC, IoT
- To bring agility in network characteristics through network slicing: SDN, NFV

Why is the whole 5G industry undertaking such an effort? From a technical standpoint, the objective is to support the projected growth of the mobile network usage and not only our mobile phones, but a whole new range of applications and services. This is because 5G intends to support emerging services and applications like the enhanced mobile broadband, the massive machine type communications, ultra-reliable, low latency communications. Do not forget Internet of Things. This whole set of new emerging services, products, and applications heavily rely on the architecture of 5G to deliver the agility and the massive connectivity. For example, through network slicing techniques like the software-defined networking or the network functions virtualization.

Notes

Summary

2m 26s



Satellites are going to support 5G with a whole set of functionalities. First of all, satellites are going to support 5G by delivering the network beyond the usual terrestrial applications like on aircraft, on ships, or in rural areas. Satellites will provide backhaul capability in order to support the network in the moments of highest demand. Finally, the 5G will be supported by satellites in the whole range of services and applications, and in particular for the machine-to-machine and IoT applications and services. Satellites, in fact, will ensure service continuity and ability to connect and support updates for autonomous vehicles, for non-connected devices, or moving platforms.

Notes

Summary

3m 31s

Ever increasing demand for bandwidth, so what?

http://www.visualcapitalist.com/wp-content/uploads/2018/07/us-frequency-allocations.jpg

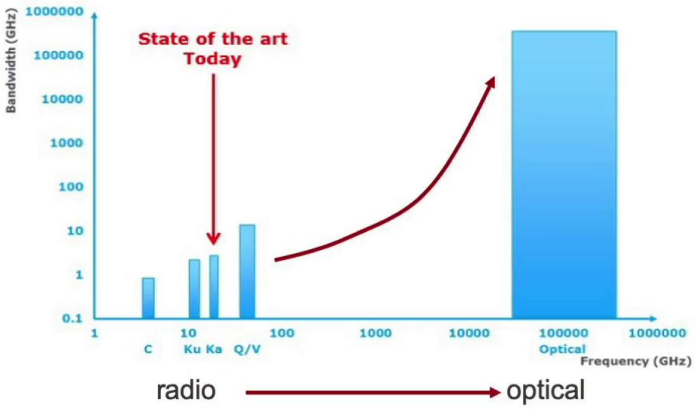
The increase in satellite bandwidth, usage and consumption is satisfied at the moment by high throughput satellites. We have seen how these satellites are responding to the increased demands by adapting and tuning the technology in order to better serve the users. In addition, the complex regulation and the congestion of the radio spectrum, as we saw it in the first module together, is making it complex, if not impossible to support the ever-growing demand of bandwidth only through radio frequencies.

Notes

Summary

4m 34s

Ever increasing demand for bandwidth, so what?



ESA Scylight Roadmap Plan - 2017

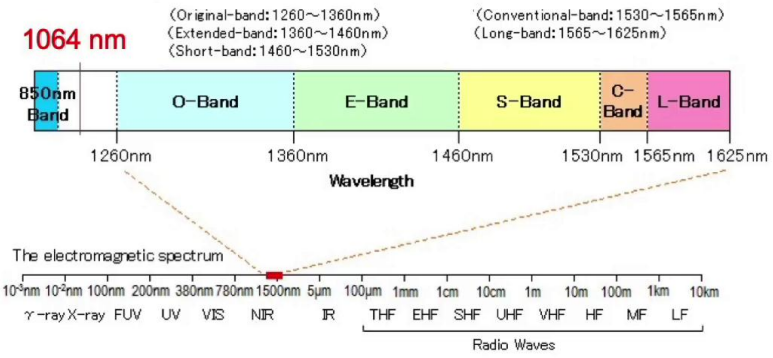
A response to the limitation of radio spectrum, both in terms of regulation and in terms of complexity. To support the growth in demand of bandwidth is the adoption of optical communications or LaserCom or Fiber from the Sky. Optical telecommunications can support and complement the radio-based telecommunications in the quest for bandwidth.

Notes

Summary

5m 13s

LaserCom or Fiber From the Sky



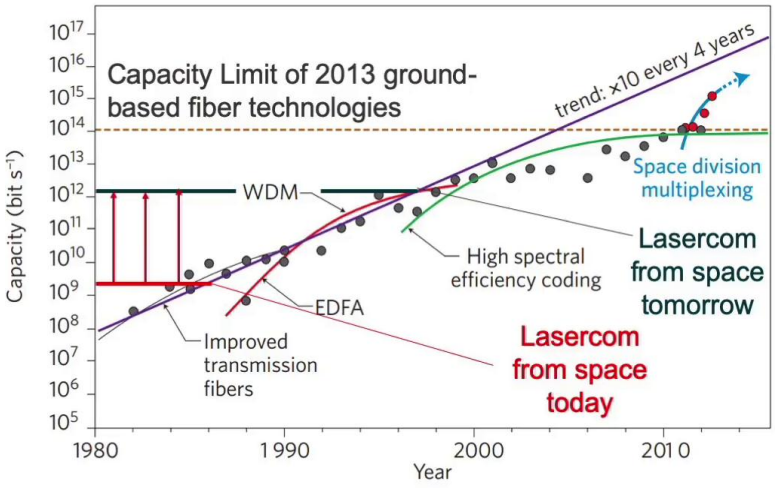
First of all, satellite-based optical telecommunication operates between 850 and 1600 nanometres. These are infrared wavelengths invisible to the eye. This spectral range is substantially unregulated from a telecommunication standpoint.

Notes

Summary

5m 41s

LaserCom or Fiber From the Sky



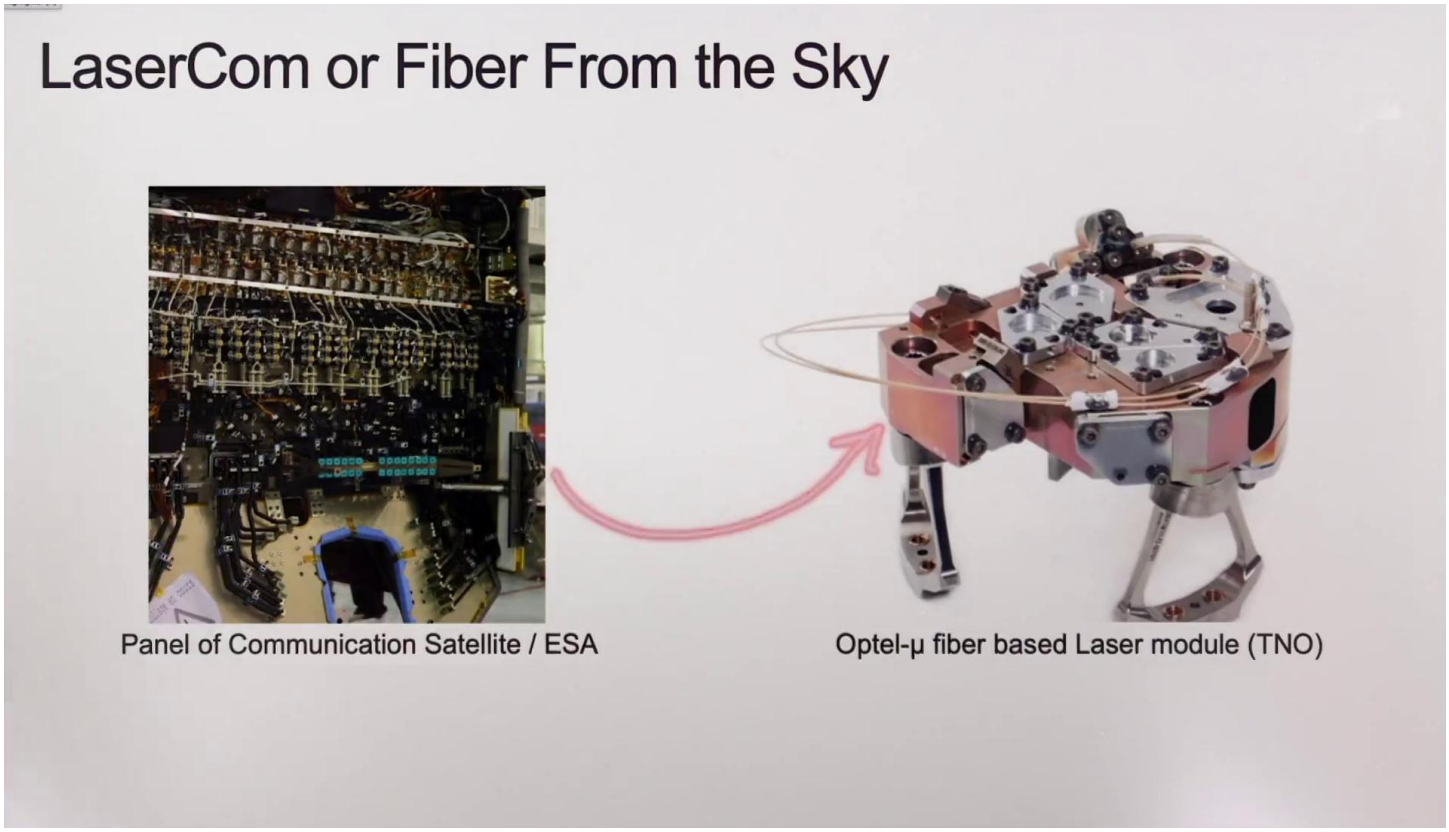
Richardson, D. J., Fini, J. M., & Nelson, L. E. (2013). *Space-division multiplexing in optical fibres. Nature Photonics, 7(5), 354–362.* doi:10.1038/nphoton.2013.94

Secondly, optical telecommunication from satellites are based on technologies that leverage on ground-based optical fiber telecommunications. These give an outlook for a huge scalability. Today, satellite-based optical telecommunications achieve few gigabytes per second per channel. That is equivalent to the state-of-the-art of ground infrastructure of 20 years ago. But ongoing studies target to achieve terabyte per second for each channel.

Notes

Summary

6m 01s



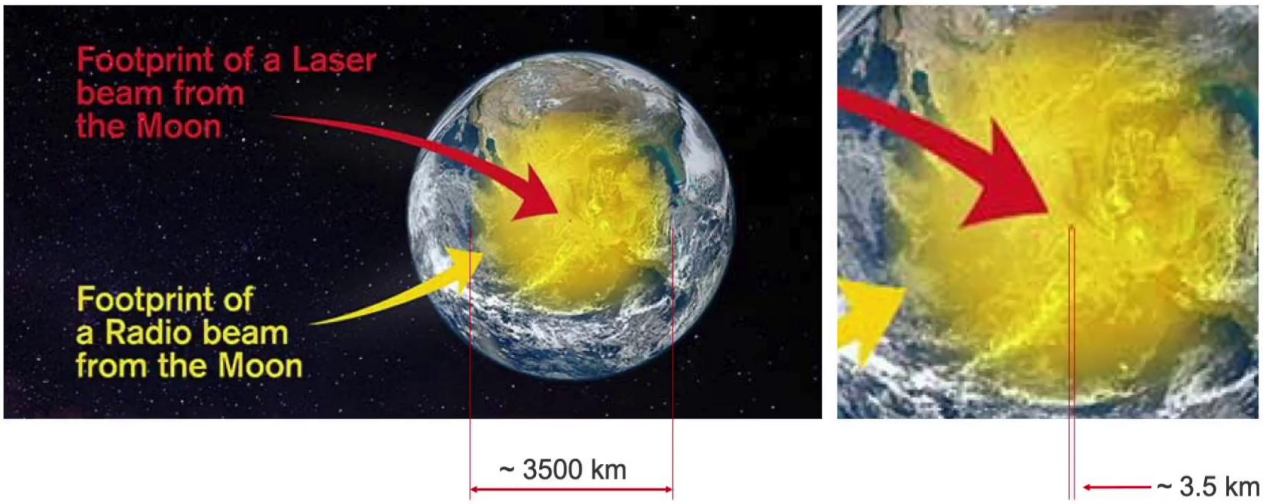
Optical telecommunications aim at delivering different characteristics than those of radio telecommunications, thanks or due to the implicit beam characteristics. For example, we are targeting very high bandwidth and data rates by using rather small antennas and telescopes. We aim to achieve frequency management and bandwidth management through lighter and more compact systems.

Notes

Summary

6m 35s

LaserCom or Fiber From the Sky



http://www.parabolicarc.com/2020/10/02/the-most-sensitive-optical-receivers-yet-for-space-communications/

Based on the expected smaller beam divergence, optical telecommunications are expected to be less susceptible to interception, jamming, interference, and privacy.

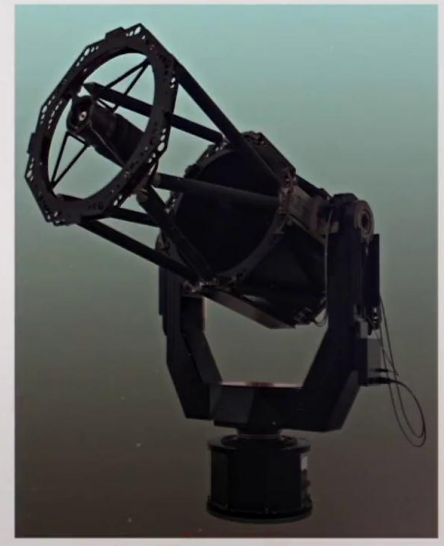
Notes

Summary

7m 11s

LaserCom or Fiber From the Sky

Starlink Antenna
500 mm
100 Mbps downlink



Officina Stellare Telescope for LaserCom
500 mm
10 Gbps downlink

Keeping constant the ground receiver diameter. We are expecting ground stations to become more complex, but on the other side, we are also expecting to grow in the communicated bandwidth.

Notes

Summary

7m 23s

LaserCom or Fiber From the Sky

- Cloud Coverage
- Atmospheric Turbulence
- Daylight
- Ground Stations Location

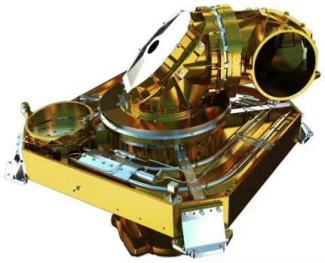
One of the crucial elements for an effective and reliable space-to-ground optical telecommunication is the interaction with the atmosphere. Radio communications are substantially resilient to weather conditions or, for example, to day and night time operations. Optical telecommunications instead experience cloud coverage as a disruptive event. Depending on the angle of elevation of your telescope that is receiving the signal, atmospheric turbulence can deteriorate the quality of your link. Therefore, the choice of the ground station location and the backup plan approach for this is crucial.

Notes

Summary

7m 41s

LaserCom: GEO-to ground operational example



TESAT / ESA

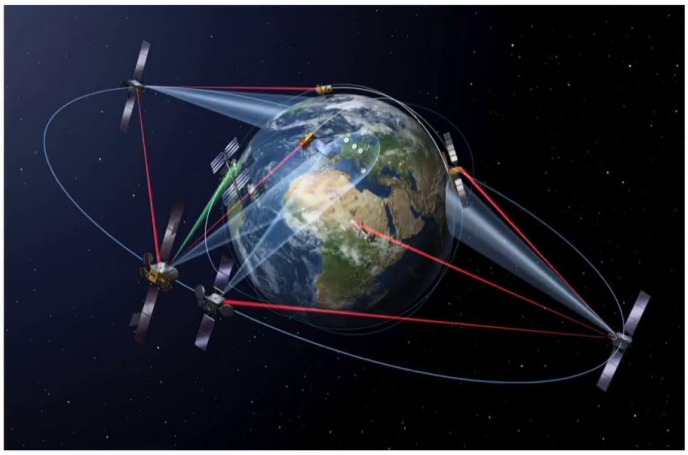
We have operational cases of optical telecommunications, for example, as it is the case of the European data relay satellites. These are three geostationary satellites that have been launched between 2016 to 2019 and allow a down-link capability of 1.8 gigabyte per second each. They support the down-link of the data generated by the Sentinel constellation.

Notes

Summary

8m 31s

LaserCom: Intersatellite Links



Intersatellite Optical Laser Terminals

Thales

Mynaric

Optical communications are also being adopted for inter-satellite links. Some examples known of constellations that adopt optical telecommunications or intend to are, for example, Starlink, Galileo's second generation, and the Chinese BeiDou. LaserCom is having an increased amount of demonstrators, prototypes, and institutional-based operations. There are several operators, also with the support of institutions, that are aiming at establishing an operational network of satellites to serve ground applications. Nevertheless, as of today, such a commercial offering is not yet existing. As said before, optical telecommunications will not replace radio telecommunications from space, but it is a fundamental cornerstone to support the growth in bandwidth offering and to establish a space-based digital highway.

Notes

Summary

9m 02s