



# Free Space Optics Communications

By:

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# Free Space Optics (FSO)

- is a telecommunication technology that uses light propagating in free space to transmit data between two points.
- The technology is useful where the physical connection of the transmit and receive locations is difficult, for example in cities where the laying of fiber optic cables is expensive.
- Free Space Optics is also used to communicate between space-craft, since outside of the atmosphere there is little to distort the signal. The optical links usually use infrared laser light, although low-data-rate communication over short distances is possible using LEDs.
- IrDA is a very simple form of free-space optical communications.
- Distances up to the order of 10 km are possible, but the distance and data rate of connection is highly dependent on atmospheric conditions.

# Free Space Optics (FSO)

- Free space optics (FSO) is a line- of- site technology that uses lasers to provide optical bandwidth connections.
- Is capable of 2.5 Gbps of data, voice and video communications.
- The use of lasers is a simple concept similar to optical transmissions using fiber-optic cables; the only difference is the medium.

# Free Space Optics (FSO)

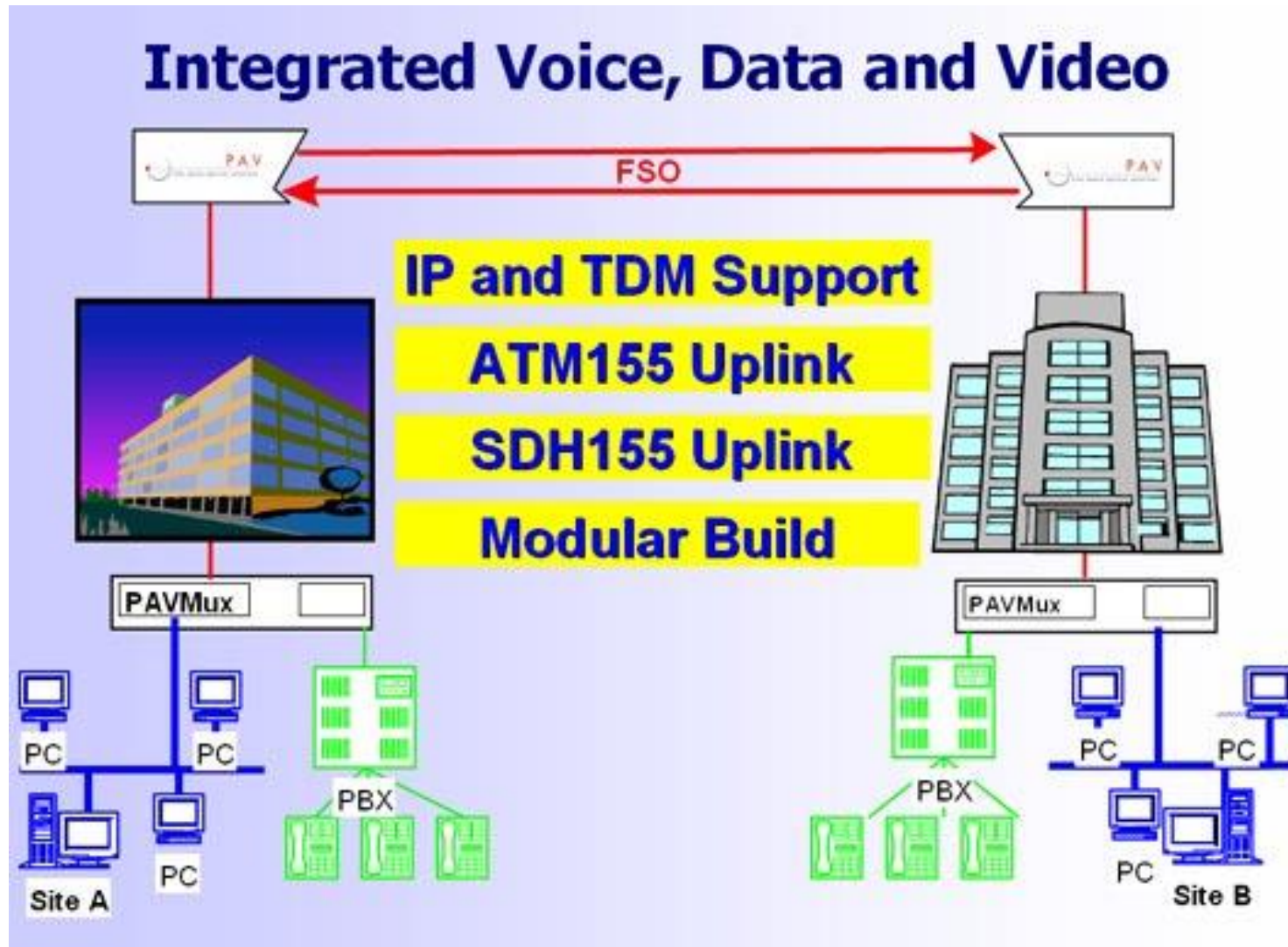


FSO transmitter and receiver.

# FSO Applications

1. LAN-to-LAN connections on campuses at Fast Ethernet or Gigabit Ethernet speeds.
2. LAN-to-LAN connections in a city. *example, Metropolitan area network.*
3. To cross a public road or other barriers which the sender and receiver do not own.
4. Speedy service delivery of high bandwidth access to fiber networks.
5. Converged Voice-Data-Connection.
6. Two solar-powered satellites communicating optically in space via lasers.
7. Temporary network installation (for events or other purposes).
8. Reestablish high-speed connection quickly (disaster recovery).
9. As an alternative or upgrade add-on to existing wireless technologies.
10. As a safety add-on for important fiber connections (redundancy).
11. For communications between spacecraft, including elements of a satellite constellation.
12. For interstellar communication.

# FSO Networks

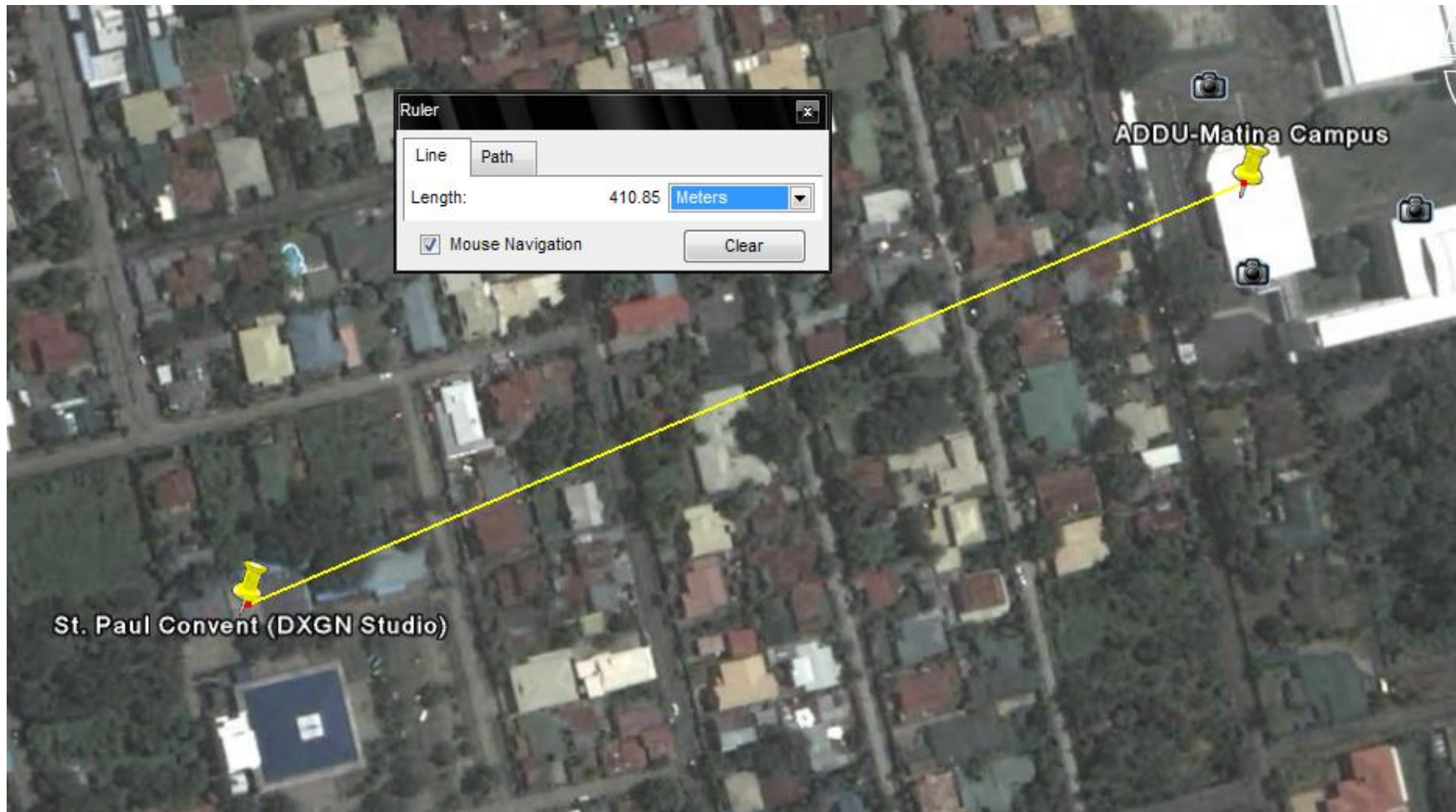


# Free Space Optics (FSO) Links



FSO transmitter and receiver links

# FSO Topographic Links

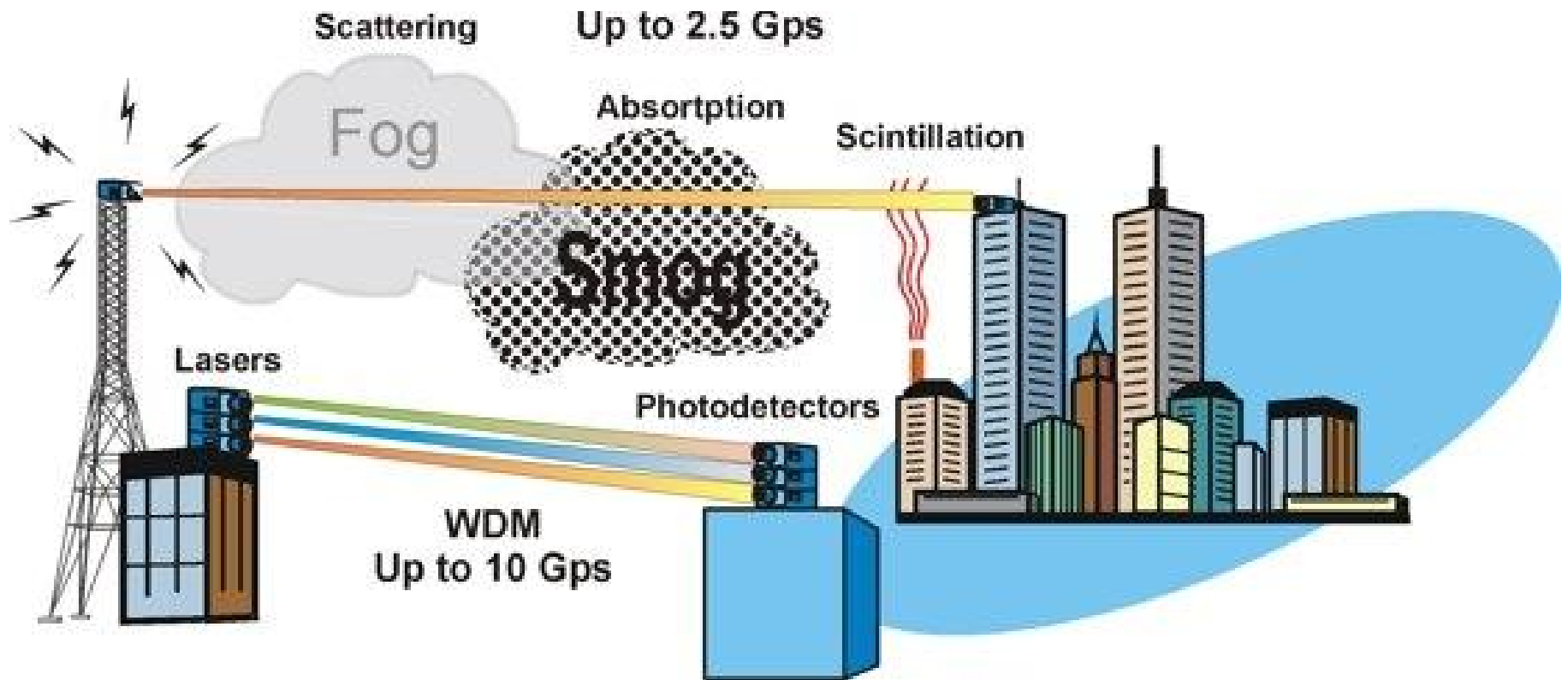


# Optical Intersatellite Link



# Technology disadvantages and behavior

1. Beam dispersion
2. Atmospheric absorption
3. Rain (lower attenuation)
4. Fog (10.~100 dB/km attenuation)
5. Snow (lower attenuation)
6. Scintillation (lower attenuation) although to a lesser degree in LED Systems
7. Background light
8. Shadowing
9. Pointing stability in wind
10. Pollution / smog
11. If the sun goes exactly behind the transmitter, it can swamp the signal.



# Advantages of FSO

1. Quick link setup
2. License-free operation
3. High transmission security
4. High bit rates
5. Low bit error rate
6. No Fresnel zone necessary
7. Low snow and rain impact
8. Full duplex transmission
9. Protocol transparency
10. No interference
11. Great EMI behavior
12. In some devices, the beam can be visible, facilitating aiming and detection of failures.

# Challenges of FSO

1. FSO is also a line-of-site technology and interconnecting points must be free from physical obstruction and able to "see" each other.
2. Rain and snow have little effect on FSO:
  - The major challenge to FSO communication is fog.
  - The primary way to counter fog when deploying FSO is through a network design that shortens FSO link distances and adds network redundancies.

# Safety

- With FSO, safety is often a concern because the technology uses lasers for transmission.
- The two major concerns:
  - Human exposure to laser beams (which present much more danger to the eyes than any other part of the human body).
  - High voltages within the laser systems and their power supplies.
- Standards have been set for laser safety and performance.
- FSO systems comply with these standards.



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