

## Free Space Optical Communication



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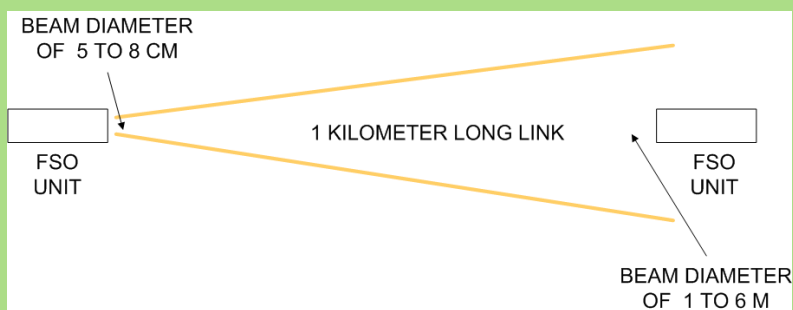
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# Introduction

- In **Free Space Optics (FSO)** Infrared frequencies, those just above visible light, is used to create a laser based wireless link, instead of using a radio frequency.



## Introduction

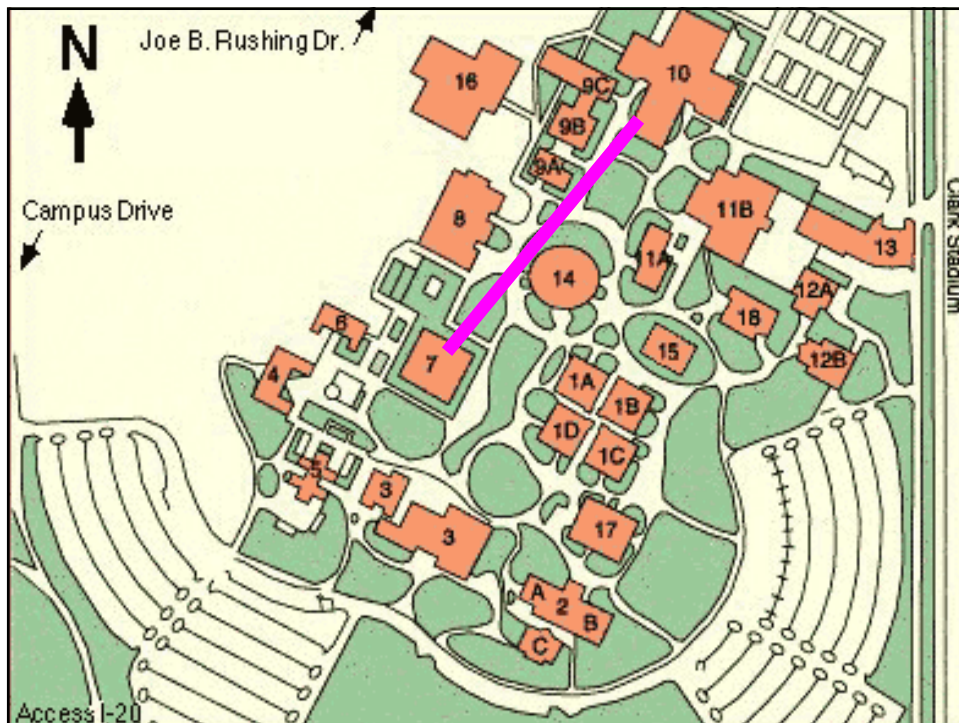
- Advantages FSO Systems
  - **No need for a license** to use these wavelengths
  - **No right of way issues**, since for the most part you may shoot a signal across anyone's property at any time
  - **High throughput** levels these systems can achieve
  - **No interference** from radio frequency signals
  - **Better security** than a radio frequency signal

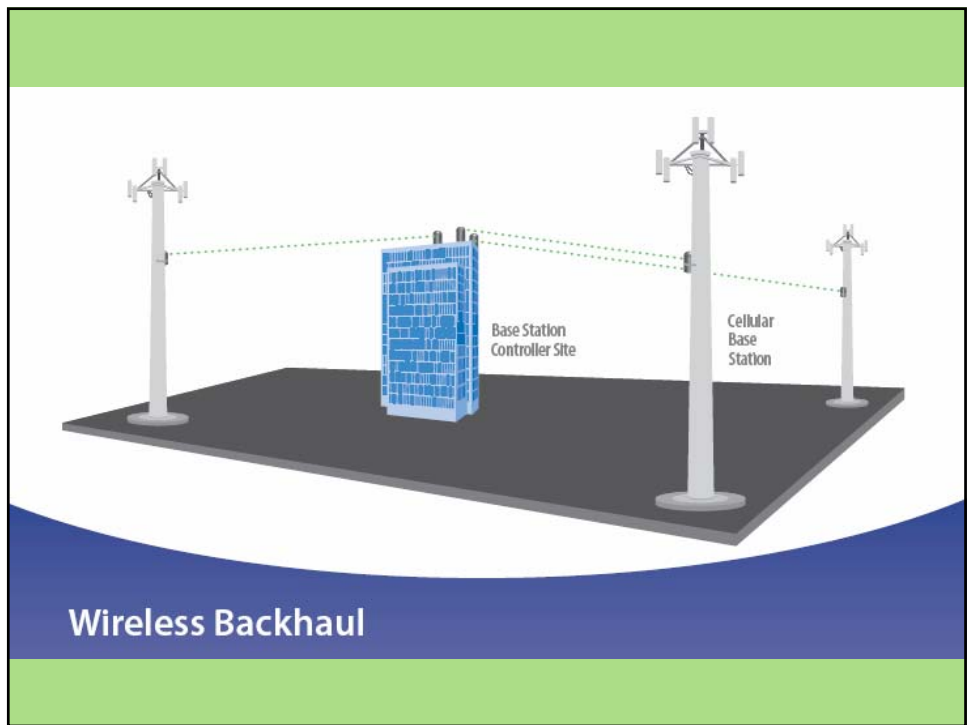
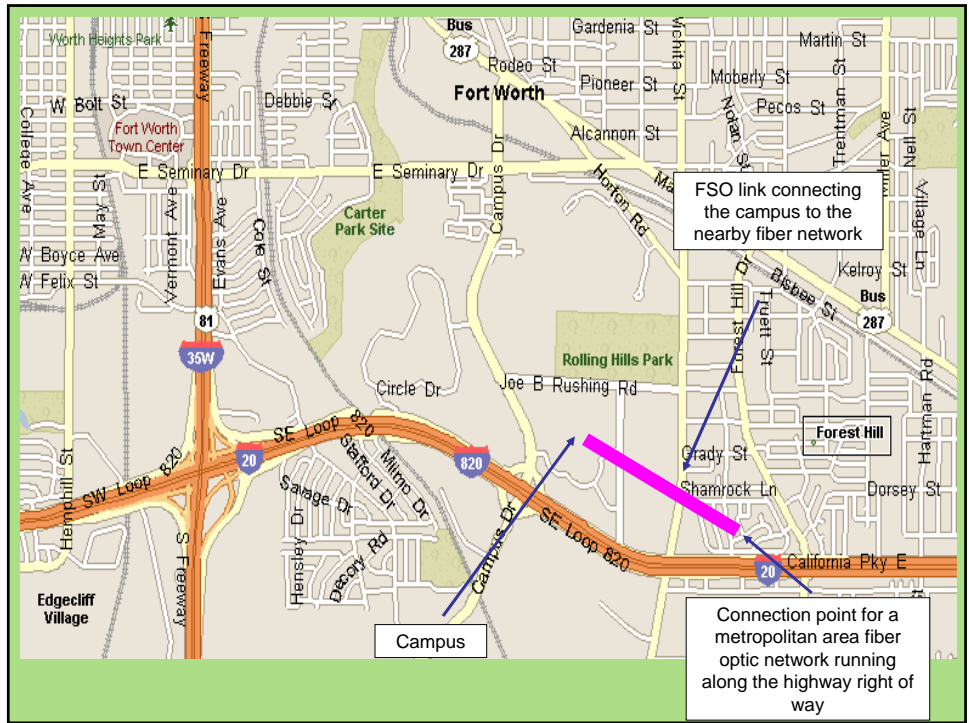
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# Applications

- Typical applications for FSO include
  - [Connecting sites in a campus setting](#)
  - [Extending a fiber optic cable network to nearby buildings](#)
  - Local loop bypass (for companies doesn't have copper or fiber)
  - [Backhaul](#)
  - [Disaster recovery](#)
  - Last Mile







**20Mbps  
or  
200Mbps**

**Disaster Recovery Kit**

**PRODUCT DESCRIPTION**  
The Dominion Lasercom, Inc. (DLI) family of products includes industry standard 802.3 wireless Ethernet systems that operate at 10Mbps, 100Mbps, and 1000Mbps Full Duplex at distances of 100 - 2000m. When there are prohibitive factors such as time and economic constraints or where there are communication-cabling infrastructure right-of-way obstructions or failures, this is the preferred solution. These products wirelessly extend fiber-like connectivity among buildings.

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## Companies in the FSO Market

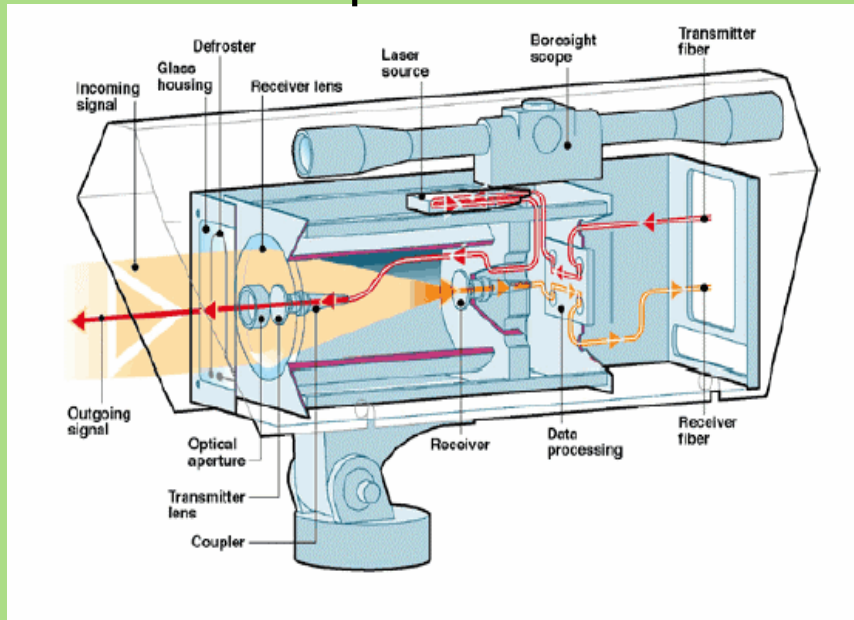
- Canobeam
- Dominion Lasercom
- fSONA
- Lightpointe
- MRV
- Omnilux
- PAV Data
- Terabeam

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## Method of Operation

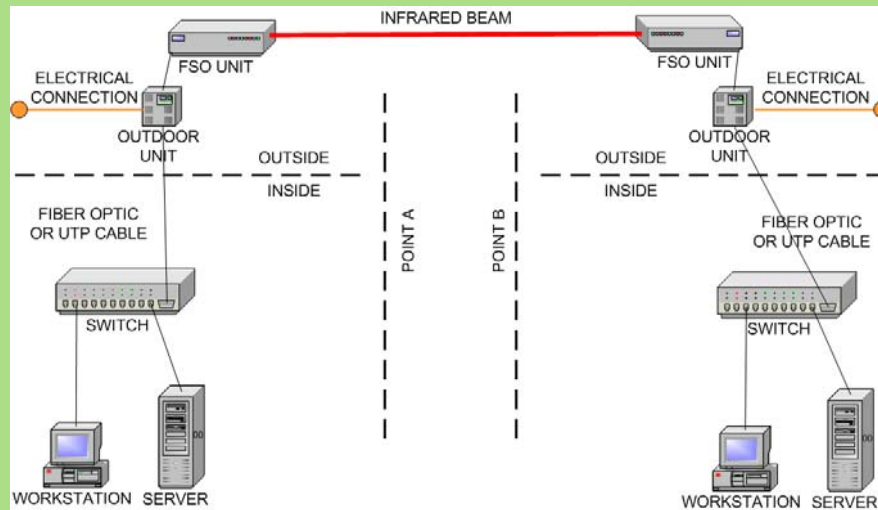


## Method of Operation

- FSO systems operate very much like a fiber optic connection using a cable
- The main difference being the **attenuation** in a cable is **known and controllable**
- Whereas in a FSO link that uses the atmosphere as the media, the exact attenuation of the link can vary by the second and is **unpredictable**
- To make this type of system work a device known as a **laser diode** is used to produce a signal in the first part of the near infrared range, which is just above visible light at 700 nm
- The most common wavelengths used are 780 nm to 900 nm and 1500 to 1600 nm
- The device on the other end that receives the signal is a **photodiode**
- A **transceiver** has both devices so that the units can send and receive



## Method of Operation



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## System Design

- The important design considerations include
  - Transmitter type  
LED, VCSEL ...
  - Transmitting power  
Higher the power the longer and more stable the link
  - Beam divergence  
A more focused beam is desired. But, larger the diameter the better the receiving ...
  - Receiver diode type and characteristics  
PD, PIN PD, APD, PTr ...

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## Issues with Laser Based Systems

- The specific limitations of these systems are the result of
  - Safety restrictions on laser intensity  
780 nm (Cheap) & 1550 nm (50 times strong) lasers
  - Building movement  
Heat, wind, Earthquakes
  - Weather and other light-blocking atmospheric conditions

## Issues with Laser Based Systems

- The specific limitations of these systems are the result of
  - Weather and other light-blocking atmospheric conditions  
Rain & snow are not issues,  
Fog, which does block light, is the major problem
    - Absorption
    - Scattering
    - Turbulence
    - Beam Wander
    - Beam Spreading

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## Speed and Distance

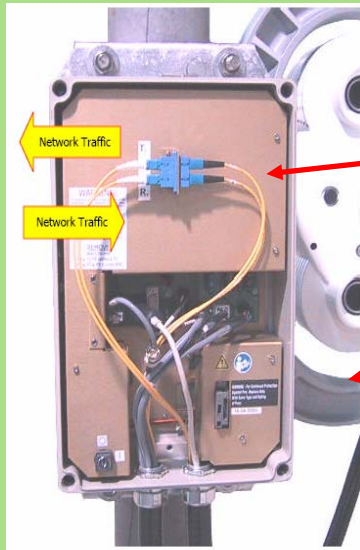
- Speeds for FSO systems typically run from 1.5 Mbps to 2.5 Gbps
- Most commercially available FSO systems are rated for operation from 50 to 10,000 m, but under 1000 m is more realistic
- For the longer distances automatic tracking systems that keep the beams at each end pointing at each other can be used to create a link, but as the weather conditions affect the quality of the link

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## Equipment Mounting





Fiber Optic  
Data Connection

Electrical  
Power  
Connection

**END**