



[When Fibre Isn't an Option:
Multi-Gigabit FSO Solutions for Service Providers](#)
(Q&A from the February 10th CRRBC Webinar)

1. Is there a budgetary price for the system that could be shared?

Pricing will be determined by the design of the equipment needed to meet the requirements of the specific use case. Please contact us with requirements and we will provide a quote.

2. Is there a path analysis software available?

To calculate the strength of a link, Attochron has a link availability tool that uses the latitude, longitude, and height of a given pair of transceivers to find the expected availability, taking regional weather history into account. **Please go to Attochron.com and find our Contact form to get the link to the Path Analysis tool.**

3. Is there a specific design/planning tool used to design these links?

For the equipment design, Attochron uses an assortment of computer-aided design software, like SolidWorks, in combination with the expertise of our partners and collaborating vendors to select components along with other hardware and software. To assist in the actual link design, we use the link availability tool and mapping software. A site visit is required for the installation of each link.

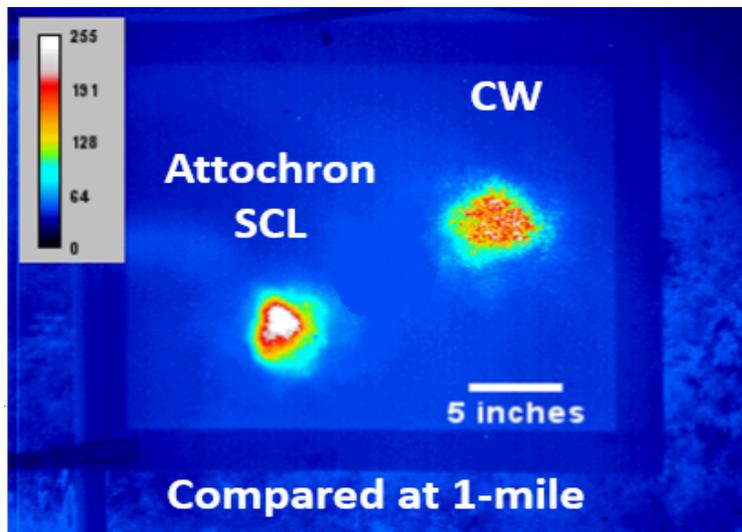
4. What's the maximum twist (degrees) of the site/tower to avoid loss of the signal?

Attochron's pointing, acquisition and tracking (PAT) solution is designed to compensate for maximum allowable tower movement described in the TIA-222 industry standard for cell tower twist and sway tolerances.

5. Is there any wavefront distortion effect during transmission for this femtosecond transmitter? Do you need adaptive optics to compensate for this distortion?

Any beam traveling in the atmosphere will experience wavefront distortion because of air turbulence. However, the ultrashort pulse lasers (USPLs) and the other light sources Attochron uses will be significantly more immune to coherent interference due to the short coherence

length of the signal. The lack of 'speckle' in Attochron's light sources versus continuous wave (CW) is evidence of this benefit. CW lasers appear "speckled" which is the result of constructive and destructive interference. Attochron has not used adaptive optics (AO) yet but currently uses Fast Steering Mirrors (FSMs) and position data from the Position Sensitive Detectors (PSDs) to control the beam.



6. Would it be correct to assume that obstructions (i.e., birds) will cause loss of signal or bursts of errors?

Yes, it would be correct to assume that obstructions (such as birds) will cause loss of signal or bursts of errors, though it is important to note that they do not cause the system to go down permanently. Our pointing-and-tracking capabilities are able to handle obstructions such as these and reacquire the beam. Additionally, we have a camera on each transceiver that will take a picture at the moment that the signal is lost. This will help determine if the link is down due to a temporary condition or whether a truck roll is required. Of course, the best-case scenario is to avoid obstructions as much as possible, which is why it is important that installation is high enough that most potential obstructions are out of harm's way.

7. Latency and max bi-directional throughput? Also, can you talk a bit more about security?

The latency can be variable but is generally anywhere from 200 microseconds to just over a millisecond in round trip time without optimizing the network card. The maximum bi-directional throughput that we have tested is a 10Gbps system. As far as security, the wavelength used is outside of the visible spectrum of ~400 nm to 700nm in the infrared (1550 nm). We have tested the near-on axis visibility of the beam in fog and at night: it was not visible. Also, the link sends a

narrow beam, so spillover of the far end transceiver is minimal. The military considers this low probability of interception (LPI) and low probability of detection (LPD).

8. What kind of modulation does the system rely on, is it a simple on/off keying or anything more exotic? And can bit rate improvement later be obtained by using other modulation schemes?

Attochron's system uses On-off Keying (OOK) modulation and is protocol-agnostic. To the network, the link appears just as if it were a normal fiber connection, so options like forward error correction can be used.

9. Can you share any case studies from North America or deployments in regions with similar weather patterns? I've worked with LightPointe and FSON in the past. How is this product different from those older FSO technologies?

Attochron's patented breakthroughs are the use of short coherence length light sources and advanced, high link-margin pointing-and-tracking solutions. These short coherence lasers help mitigate the signal quality issues with FSO, which is scintillation which can occur in any weather but reaches some of its highest levels in the most common weather condition: clear air.

While we do not currently have case studies to share, Attochron is building datasets to demonstrate the advantages of ultrashort pulse lasers **and other short coherence sources for FSOC** as opposed to continuous wave lasers, which have been used in the majority of projects preceding our revolutionary product.

10. How does weather condition attenuation, including clouds, affect the link range of 1 mile? Attochron features a minimum link margin of ~ 55 decibels (dB) and is able to perform through most weather conditions. While we are still working toward quantifying the exact impact of various weather events, our system has performed through various levels of fog, precipitation, scintillation, and other atmospheric conditions.

11. Extreme cold - has it been tested in conditions persistent -20°C?

Attochron's FSOC technology can be designed to operate at the full range of any telecommunications equipment that is mounted outdoors. The beam has worked fine through air temperatures to -20°C when beamed through windows at distances to 1 mile / 1.6 km. Contact Attochron via our website if you have proof of concept you want to propose.

12. Are the optical components (transmitters/receivers) rated for freezing rain and ice buildup?

The Attochron production unit's outdoor unit (ODU) will operate from -40°C up to 55°C. The transmit beam is infrared and naturally heats the transmit lenses. Additionally, the ODU has a heater integrated to counteract exceedingly cold temperatures.

13. In snowy/icy conditions, what is the typical link uptime percentage over winter months? Do you need a backup microwave link for 99.99% availability?

This will depend on the climate the links are expected to operate in. Generally, Attochron projects 99.99% availability annually at 1 kilometer and 99.95% availability annually at 1.6 km/1 mile. Using Attochron's link margin analysis tool, conservative figures for link availability can be projected using the ITU data referenced in the tool. We do not currently have any plans to implement a microwave backup.

14. What is the impact of blowing snow or drifting snow on link stability?

Attochron's FSOC has remained operative through various snowfalls. Attochron's link availability tool should be referenced as it averages the weather for a particular GPS location to arrive at projected availability figures.