Don't Let Contamination Affect 5G Reliability

By adopting fiber cleaning best practices, wireless operators ensure they can deliver quality 5G wireless services to consumers and businesses.

By Liam Taylor / *MicroCare*

With its high speeds and great capacity, 5G opens the potential for new, innovative services in every area of life. Technology in autonomous vehicles and connected appliances enhances accessibility, and remote medical monitoring improves health and safety. The increased bandwidth of 5G also helps extend the reach of mobile broadband, making a significant improvement to innovative power technologies including the internet of things (IoT), artificial intelligence, virtual reality and augmented reality.

5G will play a significant role in the future of connectivity, so maintaining a high-performance fiber optic network is critical to its reliability. 5G networks, with their high frequency of light, are susceptible to refractive angle changes, making them more vulnerable to contamination.

Every milliwatt of power is required to provide uninterrupted connectivity and ensure consistency. Therefore, service providers must use proper fiber cleaning tools and methods to future-proof connections during installation or maintenance.

CONTAMINATION IMPACTS CONNECTIVITY

Contamination is the primary cause of fiber network failure. It also causes insertion loss (the loss of light between two fixed points), reflectance (when light has reflected the source), or even a complete system shutdown.

Dust-based contamination originates from many sources. Airborne dust can come from dead skin, plant pollen, vehicle emissions, cardboard boxes, and clothing line. It can also come from the foam swabs and paper-based wipes installed to clean the optical connectors.

The most significant contributor to dust contamination is connector wear debris. Wear debris is produced by contact friction when fiber connectors are mated. It creates a problem between end-faces resulting in back reflection, signal attenuation and instability. Particles can also be ground into the ferrule surface, resulting in pitted, scratched or scarred end-faces.

Residue-based contamination includes fingerprint oils, moisture and substances such as isopropyl alcohol (IPA) when cleaning. IPA is hygroscopic, so it absorbs moisture from the air and draws in airborne contamination. Rather than cleaning the fiber, IPA makes the problem worse with contaminated fluid.

Items intended to protect fiber from contamination can actually be one of the biggest causes of contamination. Protective dust caps are made using mold-release compounds. The leftover release agent inside end caps can transfer to the connectors, making them dirty. Outgassed plasticizers from the protective plugs on end caps can also leave tiny oil droplets on the end-face. Putting the protective plugs on at the factory and removing them by the network installer in the field can cause wear debris.

If not cleaned correctly, fiber's refraction index changes some wavelengths off and

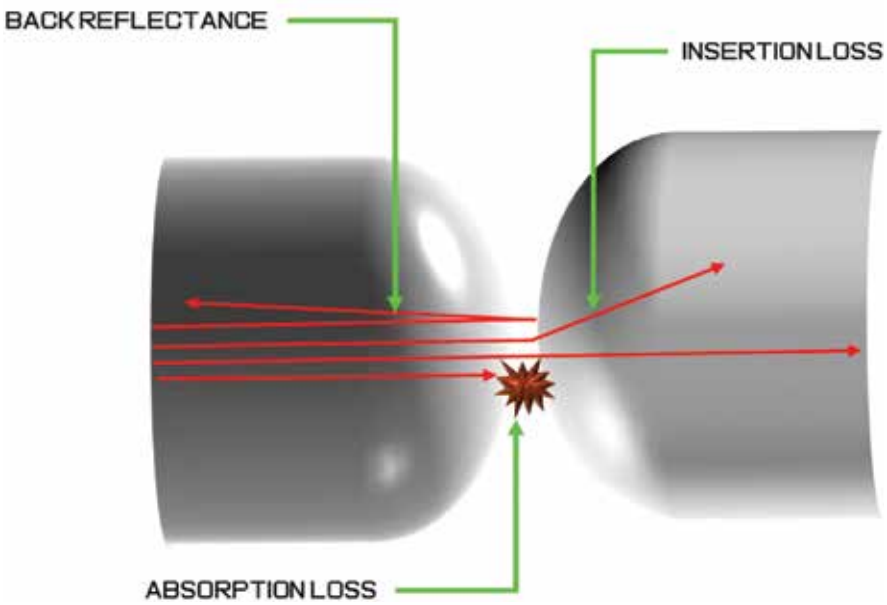
5G networks will play a significant role in the future of connectivity, improving innovative power technologies including the internet of things. Their high frequency of light makes them susceptible to refractive angle changes and more vulnerable to contamination.

weakens a signal. In the worst cases, it changes the refractive angle enough to lose a light signal completely.

FOLLOW THE RULES

For 5G technology to successfully deliver data, existing infrastructure must be in good order and working perfectly. New, denser fiber is essential to provide the performance required to power high data rates reliably. Fiber, even brand new, must be perfectly clean to meet this objective as high transmission speeds leave no room for error.

Cleaning and inspecting fiber optic connectors are critical to the success of a 5G network. An excellent place to start to get the process correct every time is to follow the International Electrotechnical Commission (IEC) 61300-3-35 standard, which helps guide the industry in determining fiber optic connector end-face quality and ensures no negative performance impact. It includes precise cleanliness grading criteria to measure pass or fail certification to inspect a fiber end-face before connection.



Contamination causes insertion loss, absorption loss and back reflectance

IEC 61300-3-35 uses certification criteria based on a series of concentric circles, with the center being the fiber core. The standard includes four zones; "A" is the core zone and "D" the contact/ferrule zone on the outer edge. Each site indicates the acceptance of contaminants, whether permanent defects, such as scratches and pits, or removable contamination, such as dust. Each area has a different requirement for connector end-face quality and focuses on a specific size and number of defects and how they will affect the signal.

Following the rules of IEC 61300-3-35 is one of the best ways to meet cleanliness standards. Following IEC 61300-3-35 rules and the correct use

Engineered fiber optic cleaning fluid removes contaminants, leaves no haze and dissipates static.

of fiber optic cleaning tools and fluids specifically engineered for fiber optic applications help ensure reliability.

THE RIGHT TOOLS FOR THE JOB

There's a saying that a poor workman blames his tools. In the case of fiber cleaning, this may well be the case. If the tools used are not correct to begin with, contamination likely will remain and compromise network reliability. The first tool to get right is the cleaning fluid.

Although experts no longer recommend it for cleaning a fiber end-face because of its ineffectiveness compared with specialist cleaning fluids, IPA is still often found in a fiber technician cleaning kit.

The problem with IPA is that it absorbs water, minerals and dust from the atmosphere, which redeposits onto the fiber end-face. So, although engineers believe they are proficiently cleaning with it, they actually exacerbate the contamination problem.

Water molecules found in IPA also slow the drying process. Because the water evaporates slowly from the end-face, it takes longer to clean and provides more opportunity for dust contaminants to migrate to the fiber.

Contamination risk increases more because of the way IPA is stored. Menda-style dispensing containers are not hermetically sealed. These containers draw moisture and contamination from the atmosphere, cross-contaminating the fluid.

To make a bad situation even worse, IPA is highly flammable, making it a safety risk. It is also complicated to transport easily and can be problematic if technicians need to carry kits by air to a remote job site.

Replace IPA with a high-quality, ultra-pure, optical-grade cleaning fluid specifically engineered to clean fiber that will not leave a residue on the end-face. It is also essential to make sure the liquid is not hydroscopic so it doesn't absorb moisture and contamination from the air. It must be fast-drying to save an installer time and reduce the risk of contamination.

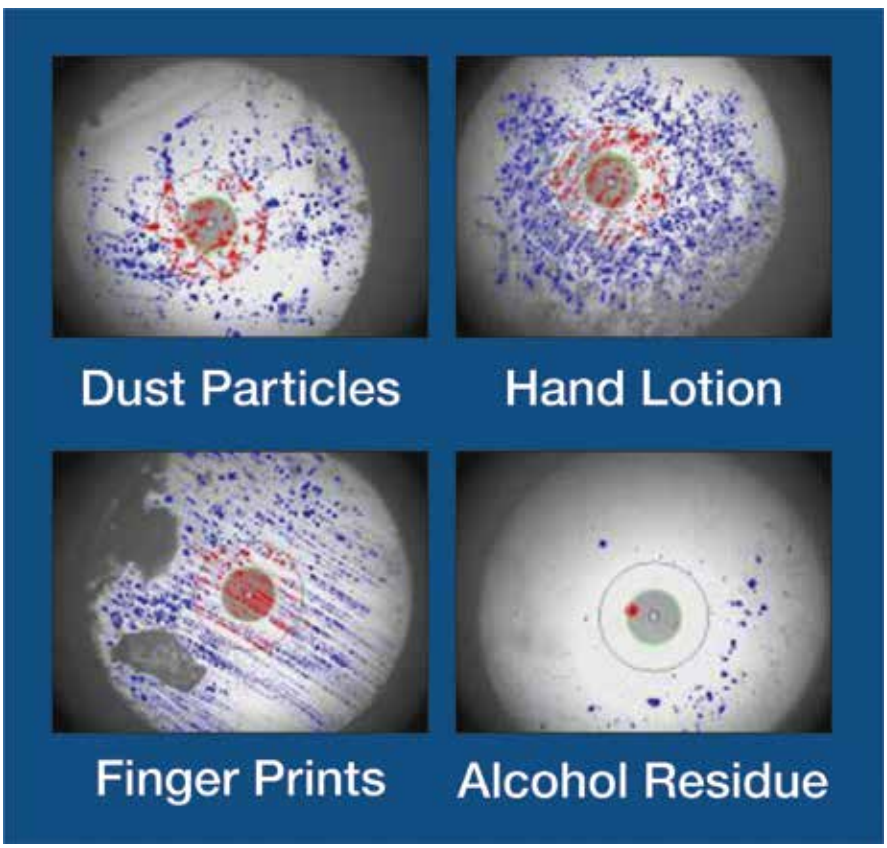
Unlike IPA, a specialized fiber optic cleaning fluid removes contaminants without leaving a haze after drying. It dissipates any surface static that attracts impurities, particularly dust, onto an end-face or bare fiber when splicing.

Specialized fluids are also safer to use because they are non-flammable and non-hazardous. Because a metered-dose dispenser is hermetically sealed, it prevents spills and potential cross-contamination and reduces fluid waste and exposure to fumes.

OPTICAL-GRADE WIPES

When cleaning fiber, an optical-grade cleaning wipe is always the best choice. Some technicians still use paper wipes, which tend to rip and shred easily, leaving behind dust debris. They also often generate high-static charges, making their use counterproductive.

Optical-grade fabric wipes, engineered for cleaning both fiber connectors and splices, should be used at all times. They are highly absorbent to remove contamination effectively and do not generate lint or cause surface scratches.



Contamination is the top cause of fiber network failure.

STICK AND CLICK

When used with optical-grade, static-dissipating cleaning fluid, a cleaning stick is the best option for low fiber counts or when cleaning highly contaminated end-faces. The cleaning stick should be non-linting for optimal cleaning and match the configuration of the end-face. It must conform to the end-face geometry to clean the entire end-face without the need to disassemble the connector or adapter. Sticks give the largest effective cleaning region on the terminus surface for eliminating issues associated with contaminants migrating into a signal path.

Mechanical clicker-style tools are best for lighter contamination levels or high volumes of connectors when time is of the essence. They are incredibly convenient and quick to use. A clicker tool cleans connectors of different geometries, sizes and scales in a fiber optic network, delivering the lowest cost per cleaning.

USING TOOLS CORRECTLY

Assembling the correct fiber cleaning tools is a good start, but contamination will remain if they aren't used correctly. The wet/dry method is the most effective process to ensure perfectly clean fiber.

Before doing anything, it's important to inspect what's being cleaned to identify problems such as scratches, pitting and any contamination that can interfere with or damage the optical termini's surface.

When cleaning with an optical-grade wipe, dampen a section with a static-dissipative cleaning fluid. The wipe mustn't be over-saturated because too much cleaning fluid on fiber increases the chance of recontamination.

When cleaning using a mechanical clicker tool, dampen a wipe with cleaning fluid first. Then touch the device to the drained area on the wipe. Finally, insert the tool into the enface and click to clean. Do not spray cleaning fluid directly onto the enface or onto the clicker tool itself.

When cleaning connectors with a cleaning stick, dampen the cleaning stick with cleaning fluid then use it to clean the end-face. After inserting the stick into the connector, rotate approximately six times in the same direction. Cleaning sticks should be kept in their package to prevent soiling or damage.

After cleaning is complete, inspect all termini on both ends of a connector pair before mating. Checking termini guarantees that everything is contaminant-free and helps ensure the system runs reliably and that all data transmits at optimal speed. Don't forget, it's not just fiber optics that must be inspected and cleaned. New fibers with protective caps are just as susceptible to contamination.

ENSURING A ROBUST, RELIABLE NETWORK

Fiber cleanliness is crucial for a reliable 5G interconnected future. Networks must now handle more data to stream demanding bandwidth seamlessly. The correct tools and cleaning procedures must be put in place to guarantee robust, reliable system performance. Without these elements in place, 5G networks are vulnerable.

Work to specified standards such as IEC 61300-3-35. Use only tools manufactured by experienced suppliers specializing in fiber optic cleaning and follow the inspection, clean and review processes for all fiber installations and maintenance. With these processes in place, the future of reliable 5G networks is in safe hands. ❖

Liam Taylor is the European business manager for fiber optics at MicroCare and IEC/SC 86B Working Group 4.