Infrastructure Readiness For 5G and Beyond

Gyroscope-based 3D mapping of telecom ductwork will verify whether it's ready for high-density fiber optic cable.

By Clay Harris / *Condux International*

As the era of 5G wireless arrives, the field of telecommunications is about to become even more dazzling, dramatically impacting every aspect of people's lives. Autonomous cars and smart communities soon will be the norm, and the internet of things will expand its reach. With the rollout of 5G currently underway, many contractors and telecom operators are discovering significant challenges with existing underground infrastructure as well as potential obstacles for installing new fiber optic cable – the backbone of 5G and beyond.

As a result, gyroscope-based 3D mapping tools are beginning to play a critical role in telecom infrastructure, enabling operators to track assets digitally as well as ensure that installations are not inadvertently compromised.

MULTIPLE CHALLENGES

The challenge for operators is twofold. First, because of a much greater fiber count (nearly 7,000, compared with 1,700 for 4G), the physical makeup of fiber optic cabling for 5G is not only considerably heftier – having a much larger outside diameter than 4G – but also is less flexible in many cases because the fill ratio may exceed 80 percent.

Second, the duct that fiber must run through often is installed in highly congested underground areas competing for space in a tangled web of utility infrastructure. This is where telecom, electricity, gas, water and cable TV grids all compete for space with drainage, mass transit and other networks.

As a result of these and other natural obstructions, contractors are often forced to maneuver the ductwork to avoid existing barriers. This sometimes results in unexpected turns or bends that compromise minimum bend radius specifications mandated by the cable manufacturer, which can cause fiber to break and fail during installation. Additionally, these maneuvers with the path of cable ductwork can leave assets that are not properly mapped more vulnerable to accidental damage.

Not only new construction is challenging. Many plans for installing 5G cable include utilizing empty or "dark" HDPE ducts installed to allow for future growth. Yet, not many telecom experts foresaw the potential shortcomings of these preinstalled ducts. With smaller 4G and earlier cable generations, the fibers within were able to withstand tighter bends. Installing 5G cable in many of these same areas has become an unknown risk.

EVALUATING POSSIBLE SOLUTIONS

Using advanced duct mapping technology is saving operators significant time and money during the ramp-up to 5G.

"Proper mapping of the duct in both new and previously installed ductwork promises to expedite the installation of fiber optic cable

The duct that fiber must run through often is installed in underground areas highly congested with utility infrastructure.

for 5G and beyond, as well as reduce future downtime due to improperly mapped ducts," says my colleague at Condux International, senior engineer Santosh Saride.

The fact is many, if not most, telecom operators do not have precise maps of their underground assets. Even for those that have invested in geographic information systems (GIS) to store network-related data, the quality of their three-dimensional (XYZ) data provided from most standard GIS platforms often is inaccurate or inadequate. This is largely due to factors that include unknown depth, references to aging or no longer existing aboveground landmarks, analog data references, and the inability to map infrastructure installed by means of trenchless methods such as river crossings and underneath buildings.

Alternative techniques such as ground-penetrating radar and beacon-based systems are unreliable or impractical because these systems are difficult to use and don't get the exact measurement of a pipe's centerline. Moreover, beacon-based systems can measure to a limited depth and are highly susceptible to electromagnetic interference, rendering them virtually useless in densely piped areas or near railways and powerlines.

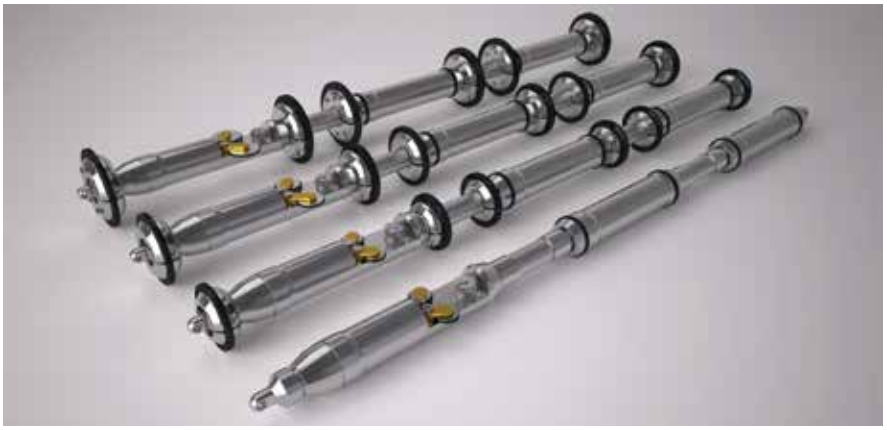
Gyroscopic-based 3D mapping systems are solving the underground duct mapping problem, however, by delivering reliable XYZ data as well as the centerline of the duct or pipe. The technology, which has been proven through years of mapping underground water infrastructure and pipelines, now is being applied to both existing and new ductwork within the telecom market.

GYRO-BASED MAPPING

Companies including Condux now provide gyroscopic-based 3D mapping technology that allows customers to ensure successful installations of pipelines and ducts – including those for fiber optic cable.

Precise mapping of underground cable ducting is now possible through the use of gyroscopes, accelerometers and magnetometers. Incorporated

The Condux duct-mapping solution at work



The 3D gyro tool seen here is articulated, enabling it to pivot through various bends, bumps and turns that typically occur in telecom ducts.

into an innovative tool that travels through the cable ducts, they can precisely map the path from end to end, including bends, undulations and other deviations that may have been required to route the duct through the congested maze of existing underground infrastructure.

Knowing the extent of those deviations, particularly bends, can be critical to understanding the true capacity of the ducts to successfully accommodate the bulkier super-high-bandwidth fiber cable. This is because the radius of every bend in an underground duct can adversely affect the ability of the 5G-or-higher cable to perform according to cable manufacturers' specifications.

"The gyro-based tools can precisely map the duct or pipeline through miles of dense infrastructure, accurately locating irregularities in ductwork and providing data on bend radius and other deviations that can interfere with the transmission of fiber optic signals, often robbing a 5G cable of up to 40 percent or more of its transmission capabilities," Saride says. For that reason, these tools are essential to the future of 5G. ❖

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