

THE FUTURE OF CABLE MANAGEMENT

AN INSIDE VIEW OF
NETWORK INFRASTRUCTURE

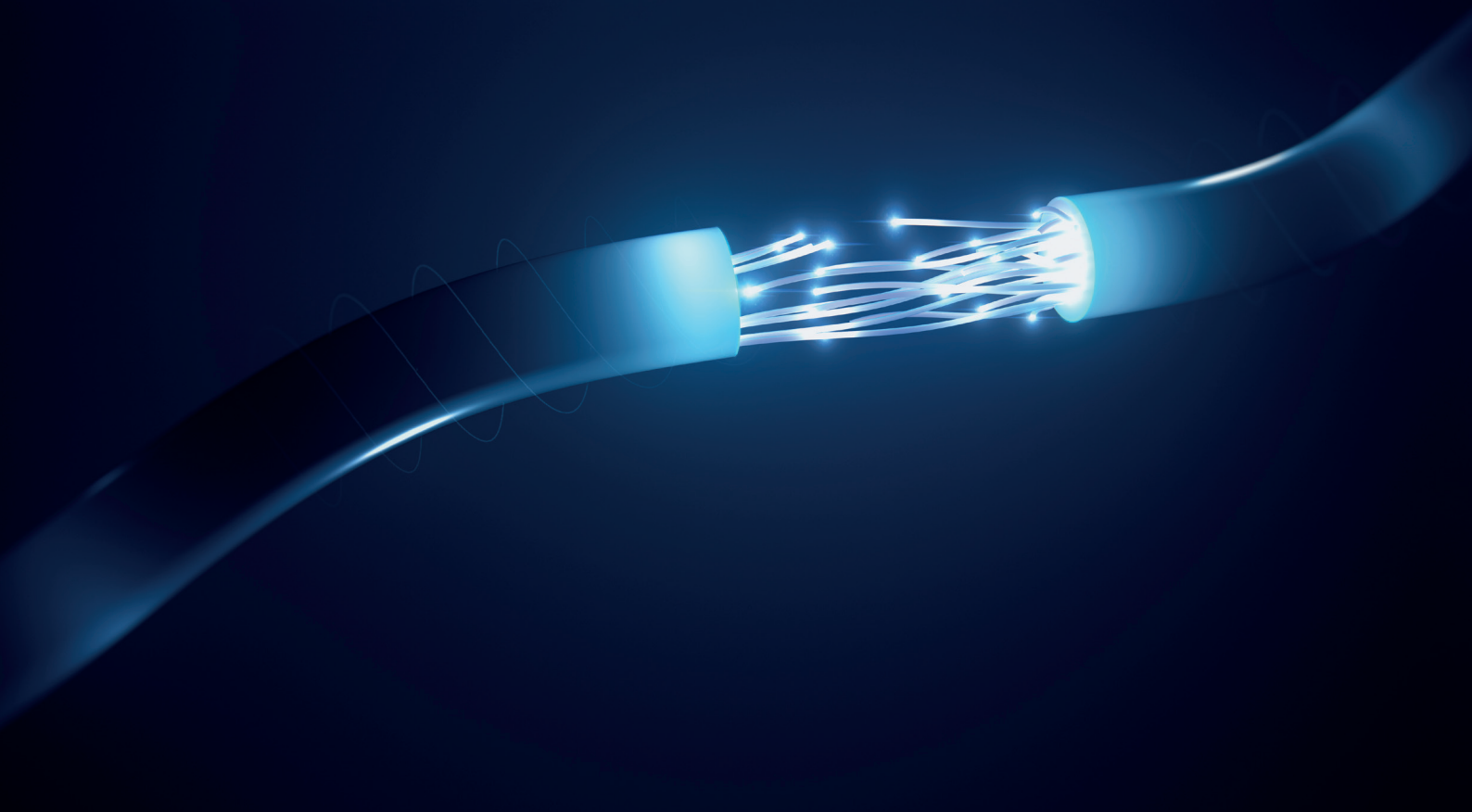


IN THIS WHITE PAPER

The world is becoming ever more digital. Network infrastructures continue to grow and complexity is increasing due to new technologies, such as AI and blockchain, combined with challenging application scenarios. The Internet of Things and Industry 4.0 are adding billions of new devices. At the same time, security and availability requirements are also rising. Against this backdrop, an inside view of network infrastructure is the key to efficient management of operations and future expansion. Modern cable management systems offer the requisite central data, management capability, and specialty tools.

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An Inside View of Network Infrastructure

Cables are the arteries of modern society and the nerve pathways of digital transformation. Without them the Internet would not function, supply chains would be disrupted, and production frozen. Online banking would be impossible, autonomous driving would never happen, aircraft would be grounded, and communication would cease.

Cable is a deceptively simple word. It has many complex variations and possible applications. Cables carry the data needed to light our cities, make cloud computing possible, and enable billions of devices to function, be it miniature sensors, Industry 4.0 machines, or huge industrial facilities. Some 2.5 quintillion bytes are transported through cables every day. That's equivalent to the storage capacity of 36 million iPads.

Data cables carry the impulses that power the economy. They make visionary aspirations such as artificial intelligence (AI), robotics, automation, the smart factory, and predictive everything realistic attainments.

Despite their importance, cables are taken for granted. We only concern ourselves with cabling when there is a problem with these copper and fiber optic conductors and the processes and services they support go down.

€4,900 (\$5,800) per minute

Market researchers at Gartner investigated the cost of a network outage. If employees are unable to access their work environment or if entire production and supply processes are disrupted, it costs an average of €4,900 – or \$5,800 – per minute.

Current Drivers in Cable Management

- International business activities, country-specific networks and standards
- Better utilization of existing network infrastructure, identification of market potential
- Edge computing, edge data centers
- Increasing service orientation
- Rising demands due to IoT, smart grids, smart cities, and smart home applications
- New 5/6G mobile data standards
- Demands for greater security and availability
- Desire for simpler, more intuitive operating and monitoring tools, such as Google Maps-style mapping and GIS functionality
- Integrated data model for incident management to cover the entire infrastructure, from cable to service



EFFICIENT MANAGEMENT OF EXPANSION AND OPERATION

This is an area where professional cable management makes a real difference, both inside and outside. Cable management provides a complete and inside view of the entire network infrastructure, whether it's building cabling, a campus network, or a national supply network. By doing so, it optimizes the cost of cable network expansion and operation.

Modern cable management includes an integrated data model that brings together and documents all physical elements and device dependencies.

Cable management reduces operating costs and expenditure for incident processes by up to 50 percent.

This allows monitoring of the complete stack, from physical hardware to the mapping of the services and processes that are managed and enabled by the cables and various networks.

Comprehensive, precise, and target group-specific information can be viewed at the touch of a button, such as where cables are laid, which routes are crossed, and where junction boxes, main distributors, and sub-distributors are located. The aim is to manage end-to-end processes. Cable management provides the solution, with signal tracing being an important function in this context. Cable management reduces operating costs and expenditure for incident processes by up to 50 percent.

Cable management solutions make a significant contribution to greater transparency and help to identify which services are affected by a fault and the possible impact

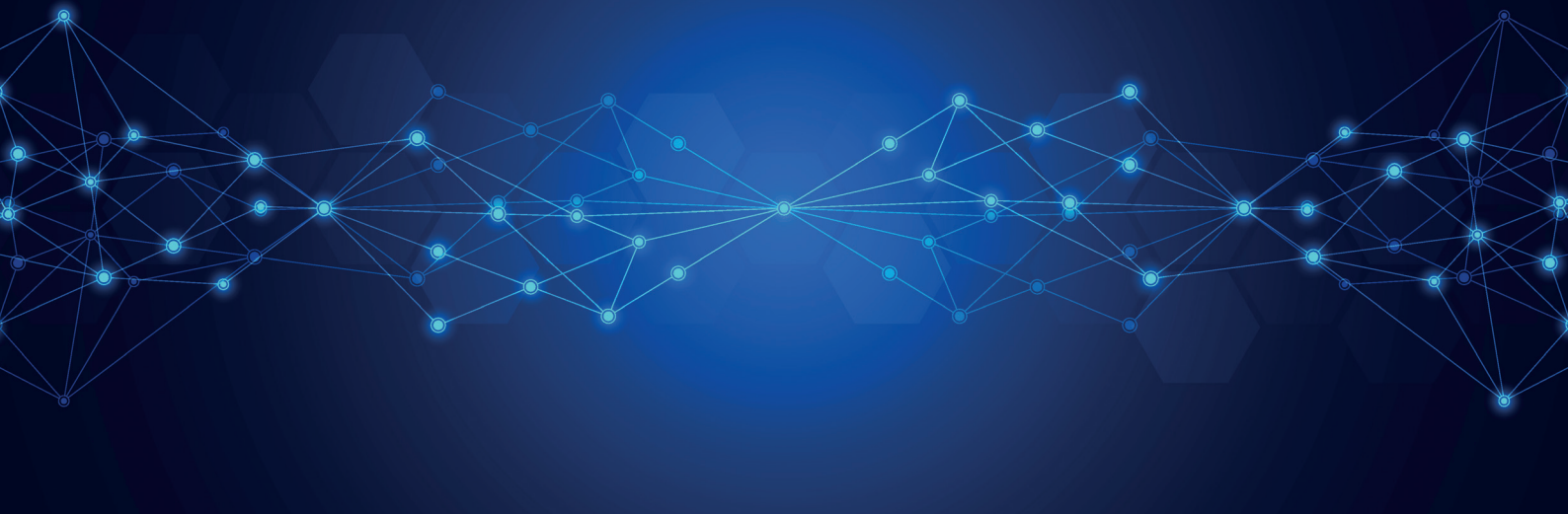
on service level agreements (SLAs). Fault resolution can be handled efficiently, with the system generating recommendations on how to respond. Who needs to be informed of the shutdown, which people and services are affected, and where exactly should the repair team be sent? Providing answers to these questions keeps downtime and cost to a minimum.

FAST AND CONSISTENT PLANNING

The rich functionality of cable management solutions makes it possible to achieve up to 100 percent faster planning and documentation. Graphical geo-referenced network representations, signal tracing, and auto-routing, plus an integrated change management process for handling all changes, facilitate routine tasks.

Achieve up to 100 percent faster and more consistent planning and documentation.

The future of cable management includes supporting providers in their sales and marketing activities, thereby enabling the best possible use of existing networks. For example, data analysis and geo-referenced information (GIS) allow instant insights into whether the available bandwidth is actually being used. Marketing campaigns can then target households or businesses with new services or add-ons. Cable management makes it possible to manage infrastructure with the click of a mouse, centrally document all components, create logical links, identify dependencies, and be proactive. That's the future!



FROM CARD INDEX TO INTEGRATED SYSTEM

Patch connections indicated by wool threads and pins stuck in a map are relics from the early days of cable management, but quirky methods of documentation can still be found today, as can card indexes. More typically, a variety of modern tools are now deployed to document and manage inbound and outbound networks. Spreadsheets and database systems are commonly used for storing information about the services delivered via the cables, while drawing programs, CAD tools, GIS systems, or traditional building plans are the popular options for recording the physical location of cabling. Alongside the range of diverse tools, many different entities – often including external planning and construction firms – create documentation in their own very specific planning, architectural, and surveying systems.

The disadvantages are obvious. The data is not integrated, it is frequently outdated, and services cannot be automated. What's missing is transparency. For every update and every change the relevant data needs to be added in the various systems, usually by hand, then manually collated and transferred to the digital environment. This process can often take days or weeks. It ties up resources and costs money.

NETWORK INFRASTRUCTURE IS OF SYSTEMIC IMPORTANCE

Continuing to use old-school documentation is no longer sustainable. It has become a liability because today's cable infrastructure is subject to huge challenges traditional methods are not capable of addressing. Users need huge amounts of bandwidth at every location and at all times, making network infrastructure systemically important today. Remote working, grid and edge computing, smart homes, the IoT, medical networks, and AI are among the big trends facing network providers and businesses. The ability to change network routes as needed is increasingly important. Does the existing documentation enable managers to quickly identify whether data flows can be diverted? Is there a point-to-point connection? How can gaps in the network be closed quickly and what diversion options are there?

Today's customers are much more sensitive to outages, which increases the pressure. If a music streaming service is briefly offline, customer satisfaction takes a hit but it's not a life-threatening problem. A network shutdown in a petrochemical plant, however, or the failure of airfield lighting at a commercial airport or a cable problem in an operating theater is an entirely different matter.

COMPLEXITY CONTINUES TO INCREASE

There has been a deceptive trend in recent years toward less complexity and diversity of physical cable infrastructure, due partly to the convergence of technologies, such as telephony and data using a single physical LAN cable. However, that's no cause for complacency with regard to infrastructure management because complexity is growing as a result of new, different types of cable. These include hybrid cables (copper for power, fiber optic for data), combined with pre-laid ducts and micro-duct systems inside buildings. Companies are also increasingly looking for solutions other than stock cables, preferring customized cables that can serve multiple functions.

Alongside customer-specific cabling, cable management now takes more account of the services supported by the cable and the quality of those services. This reflects market reality: the number of services is rising exponentially, including nested services, which require operators to have a proper overview.

There are already some 27 billion IoT devices in circulation, according to Gartner's market researchers. That equates to three devices per person. By 2025, the number of IoT devices in use is set to top 75 billion. The majority of such devices are connected wirelessly and use conventional or rechargeable batteries. However, new mobile communications standards, such as 5G and 6G, and technologies like Sigfox and LoRaWAN, are also indirectly driving cable management efforts. Every cellphone mast and every distribution point also needs a cable connection.



THE SMART FUTURE OF CABLE MANAGEMENT

Demands on infrastructure management are rising, with the three key requirements being convenient planning, support for decision-making, and extensive management automation. Meeting this challenge calls for a centralized data model, powerful planning tools, and graphical support from management dashboards, together with geo-referenced mapping to allow faster and easier interpretation of the mass of data.

Data often arrives in the system from a wide range of sources: lists, upstream systems (such as external planning firms), and surveying systems used by the contractors who lay the conduits and cables. Future-ready cable management will therefore have open interfaces and a collection point for all data sources. The response from FNT is the FNT StagingArea. To facilitate integration into the existing infrastructure, cable management solutions come standard with preconfigured data models. These ensure that data is correctly structured to depict a valid network.

There is a growing desire and need to document changes to infrastructure very simply, for example, using a smart mobile app to quickly record the replacement of a patch without needing to log onto a computer. The data is then available immediately in the centralized repository. Future-ready cable management will check the integrity of the network infrastructure and flag any errors, for example, when importing legacy data. At the same time, visual representation of cabling is also becoming more important. In addition to making documentation easier, mapping systems help to identify faults, network utilization, and expansion potential at a glance.

Rapid growth of network infrastructures, increasing complexity due to new technologies and application scenarios, and rising security and availability requirements make one thing abundantly clear: an inside view of network infrastructure is key to efficient management of operations and expansion in the future.

Eight Arguments for Modern Cable Management

- **Complete transparency** into all physical and logical IT and telecoms networks and the associated services.
- **Reduced operating costs** due to automatable threshold recognition and reporting.
- **Greater efficiency** as a result of precision integration into existing processes.
- **Maximum uptime** through faster fault recognition and repair measures.
- **Higher quality** due to detailed planning and documentation.
- **Fast access** thanks to insight into infrastructure and services in a modular suite.
- **Peace of mind** due to a strong focus on legal obligations (corporate governance).
- **Less effort** around compliance audits and audit preparation.

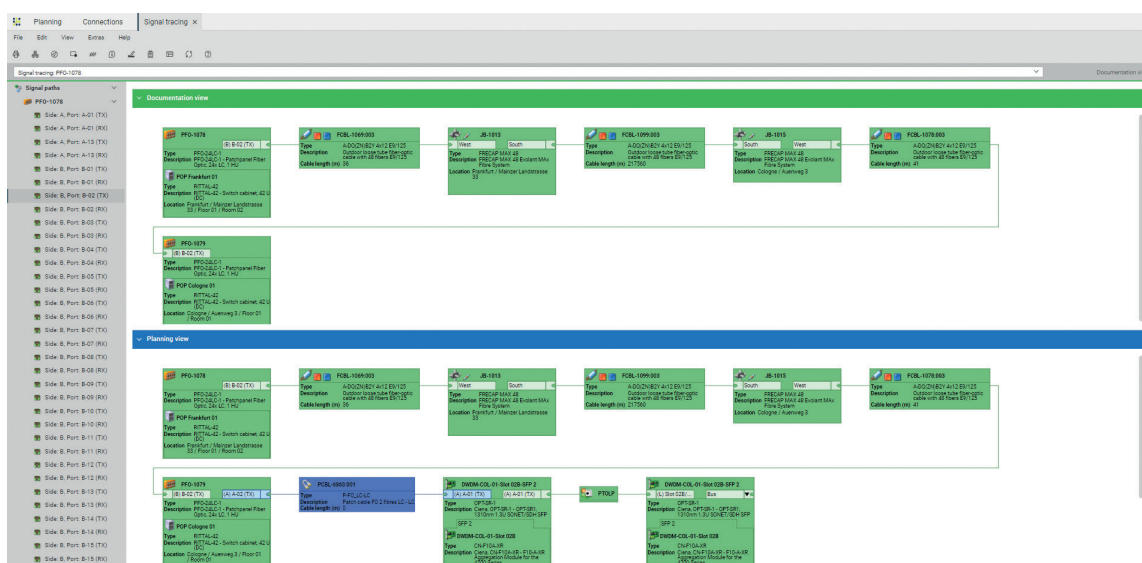
Network Operation and Expansion at a Glance

CABLE MANAGEMENT - FEATURES & FUNCTIONS

Future-ready cable management means complete transparency across all cable and network infrastructures from inside plant management through to outside plant management.

Which components does a modern solution offer to achieve these goals?

- An integrated, central data model, which contains analyzable information on all infrastructure dependencies from the building level through physical, logical, and virtual assets to applications and services, including business services.
- A comprehensive data model that combines cable, network, and service information, providing a complete and consistent picture of the current situation as a basis for decision-making. Planning of network expansion or modification work can thus take account of all the relevant parameters. All network resources and costs remain under control at all times.
- Interfaces to source systems together with a staging area for data cleansing prior to import.
- Continuous end-to-end signal tracing across the entire cable infrastructure in both actual and planning views, based on the relevant geo-referenced nodes and routes in the GIS representation.
- Faster fault analysis and repair, based on seamless integration between the physical network infrastructure and supported services at the logical and service level.
- Efficient planning and analysis of redundant circuits, because redundant services need to be managed separately at the physical level, not just logically.
- Efficient measures to rectify faults and allow structured planning of replacement cycles for obsolete components. Work orders are generated directly from the system, based on the underlying infrastructure data.
- Auto-routing functionality for trays and duct infrastructures, which enables optimal planning of connections.
- Auto-routing functionality for the cable infrastructure that allows optimal automated routing, with work orders for the required patches and splices being created for the route automatically.
- It must be possible to display a geo-referenced view of the entire network infrastructure out of the box and to support expansion planning. The actual activity relating to ducts, duct bundles, junction boxes and splice plans, distributor assignment, and cable and fiber management, as well as equipment and component management, takes place via dedicated, task-specific graphical and schematic applications.





Automotive Group Creates Transparency into Factory and Office Cabling

100 PERCENT DATA QUALITY

Whether cables carry power or data, having a proper overview of the existing infrastructure is essential. One major automotive group uses an FNT solution to manage all its cabling. Deploying this standard product creates transparency, thereby allowing fast action in the event of an outage and enabling efficient planning of network expansion.

The car maker decided to replace its existing cable management solution, whose maintenance and development was due to be discontinued, with FNT Command over an extended phase-in period.

The requirements for the new system were demanding. A graphical view of tray routes and switch cabinets was needed to provide rapid answers to questions, such as: Can excavation work be carried out in a specific area without damaging cables? Which trays contain which types of cable and which are affected by a fault or modification work? A graphical view of the switch cabinets had to show at a glance how full the patch panels are, the assignment of ports, and the rear of the cabinets.

A further requirement was a status report showing all the ports of a switch with the port number, patch information, and IP addresses. When printed, this report needed to be concise enough to fit on a single sheet of paper, while containing all the relevant information for replacing components in the event of a fault. The intention was that technicians should be able to get to the affected device with as little baggage as possible because equipment on the site is often not accessible by car.

The first step was to migrate the data center documentation – locations, devices, and network – to the FNT cable management solution. Step two saw the creation of data

center footprints with the details being carefully verified through on-site inspection to ensure excellent data quality. As part of this exercise, the cable management team also captured information on the installed power cables.

Completion of this data acquisition phase enabled much more efficient analysis. Reporting options and the assignment list made it possible to measure data center utilization. Once data center migration was complete, the team transferred the rest of the data, including that from the offices. The focus here was on the cabling in the buildings through to the workstations and connectivity to the data center. Cables were also assigned to (internal) trays and their routes documented graphically using GIS functionality.

The strengths of the FNT cable management solution are particularly apparent in two areas: reliable infrastructure operation and expansion planning. At the planning phase, the system validates technical feasibility and checks whether the cable and plug types are compatible, for example, and whether the overall lengths are appropriate. The complete order management process – from planning through to commissioning – is managed and monitored transparently via a workflow. Location data, manufacturer data, and device data, along with details of port utilization and the connected devices (assignment list), are all fully documented. This information is essential for smart incident and change management.

The first major milestone has now been reached, as stated by the project management team in its final report: “Deployment of the cable management solution has given us 100% data quality.” For the next stage, the car maker is planning to expand parts of the solution using cloud-based components to further optimize process support for users.

Geodata Shows the Way

INFRASTRUCTURE OVERVIEW AT A CLICK

Integrated deployment of Geographic Information Systems (GIS) has proven to be a strategic component in infrastructure and cable management.

Stefanie Siegel, product manager at FNT and responsible for the FNT GeoMaps solution, explains why.



What added value does geo-referenced data bring to infrastructure and cable management?

» **Stefanie Siegel:** GIS components provide greater transparency and support intuitive working. People are now very adept at working with maps and visual information. Map apps from companies like Google and Apple are a standard feature on every smartphone and tablet. Users get up to speed really quickly. We leverage those skills in our infrastructure and cable management solutions by providing graphical depictions of network infrastructure and signal tracing for both inside and outside plant, from cables to ducts, shafts, distributors, junction boxes, and service connections. This gives teams full insight into the infrastructure, whether they're managing existing networks, planning new infrastructure, performing scheduled maintenance, or troubleshooting.

What are the specific benefits of this increased transparency?

» **Stefanie Siegel:** Having that knowledge and overview is hugely helpful in reducing costs – for planning work and also when managing existing networks. In the past, companies laid empty ducts to allow them to run

cables in the future, documenting them in lists or drawings. When the time came to expand the network, this information was often not available. That's bad news because it clearly makes sense to consider the existing network before simply laying new routes.

A second advantage of GIS components is their support for ongoing network operation by making it possible to pinpoint the spot where work is required. Imagine the need to replace an amplifier as part of routine maintenance, for example. GIS solutions provide precision data to allow excavation at the exact location of the cable, often by using signal tracing.

Data on the location of infrastructure and on the services that use the cables is also stored in the central repository of the cable management solution. So isn't GIS just a nice add-on?

» **Stefanie Siegel:** It's true that all information on the physical location, cable type, and the supported services is available in the central cable management solution. Users can view reports in the dashboard to see when a service is required, for example. However, it's also very convenient to be able to immediately see the physical location on a digital map that's accurate to the last centimeter. Color coding makes the current status instantly apparent, so users can distinguish between planned and existing cable trays, for instance. Available capacity can likewise be quickly and easily identified.

It's very convenient to be able to immediately see the physical location on a digital map that's accurate to the last centimeter.



So the GIS components make it possible to identify infrastructure utilization?

- » **Stefanie Siegel:** Yes, that's an exciting but little-known aspect. The system uses color coding to show heavily used points and routes and to highlight spare capacity in the network. Visualization supports sales teams and assists with the planning and

A geo-referenced view makes it easier to recognize commercial opportunities.

implementation of targeted marketing promotions, such as local mailings and direct mail. A geo-referenced view makes it easier to recognize commercial opportunities.

What maps does FNT use?

- » **Stefanie Siegel:** We use maps from esri, the market leader. As a global partner, our applications are built around esri content and offer full integration between esri and our cable management solutions. Every object on the map – cables, trays and tray sections, shafts, street cabinets, service connection points, and amplifiers – has an equivalent in our centralized system.

What's more, the user can load any desired geoformat or different layers as the map background – from the land registry, for example, in-house building plans, or factory plans produced using a CAD or architecture tool.

How accurate is the GIS data?

- » **Stefanie Siegel:** As accurate as the survey data and actual installation, so right down to the last centimeter. That's extremely helpful because looking at the map can provide useful pointers as to the cause of a problem. For example, if a route runs close to a river, a junction box could be suffering from corrosion or water ingress. The faults team can go straight to the right place and check it out.

How is data transferred from existing systems into the cable management system?

- » **Stefanie Siegel:** There's no defined standard for data integration, so it really depends on the individual case. Information is stored in a variety of systems, sometimes spread across different companies, planning firms, surveyors, or the actual provider. The point of entry for the various data sources into the cable management system and thus also for the GIS is a staging area. To make the importing process easier, interfaces and preconfigured data models are provided, which ensure that the data is correctly structured and duplicate entries are avoided. But sometimes the only option is manual data entry, for example, if the infrastructure is documented in a proprietary format or only on paper.

Do you only recommend geo-referencing for outside cable management?

- » **Stefanie Siegel:** No. Any company that needs to plan, maintain, and manage network infrastructure benefits from geo-referencing: power companies, Internet providers, data center operators, universities, research institutes, companies with a campus structure, such as hospitals, large industrial sites, airports, tower blocks, and also builders of individual houses. It is set to play an increasingly important role inside buildings, too, in the future. Examples include providing height information or a 3D capability. We're also seeing greater use of pre-laid ducts in hospitals and residential housing. GIS provides the necessary transparency here when the time comes to install the cables.

Any company that needs to plan, maintain, and manage network infrastructure benefits from geo-referencing.



NetCom BW Reduces Process Times by 95 Percent

SEAMLESS TRANSFORMATION

NetCom BW has the second-largest fiber optic network in the German state of Baden-Württemberg. FNT software is used to manage the critical outside network with regard to operating and maintenance costs and also simplifies expansion planning.

When transforming networks with new technologies and vendors, transparency of all existing resources across all technologies and levels is a prerequisite. Digital transformation is also creating a wider need for rapid technological change. It's high time to prepare for these challenges – something that provider NetCom BW has already successfully done. The company manages a complex, disparate network that features a range of technologies, such as WDM, PDH, SDH, and MPLS, as well as a variety of suppliers.

Managing network expansion and outages was complicated to achieve and even harder to plan because the passive cable infrastructure, with its multi-vendor and multi-technology systems, was not fully documented and the information was split across multiple tools. The same applied to the physical components, logical resources, and services throughout the transport network.

The declared objective was to standardize management of all network resources by way of a centralized solution and to improve planning processes around expansion of the passive and active network infrastructure. Another benefit would be the ability to manage maintenance more efficiently and proactively, with faster and more direct impact analysis of any outages.

SOLUTION APPROACH AND IMPLEMENTATION

For implementation of the FNT solution, the project team initially collated all the existing documentation from the various systems, using standardized import templates where possible. This step revealed the true potential of

the centralized database, providing the client with new insights into the existing data and data quality. The second phase of implementation saw the client beginning to standardize all existing systems in order to reduce the number of operating systems.

SIGNIFICANT OPTIMIZATION OF NETWORK OPERATION

Building on FNT's comprehensive data model, it's now possible to identify all services and customers that are dependent on a cable connection or use a specific card or node. Previously, this process generally took three days for each individual case. The new solution enables the user to directly run a comprehensive query on all services and the associated business data, such as whether there is already an alternative route available for a specific connection.

The results of the project are impressive. NetCom BW is now achieving maximum quality and efficiency when planning maintenance windows, thanks to automated what-if analysis and associated redundancy information. Furthermore, e-mails can be generated directly in the FNT solution to inform business customers of planned service outages or to instruct technicians to divert connections for specific services.

Process times are down to under an hour due to having a coherent data source for all cable and service resources in the network. That's a reduction of a staggering 95 percent. This helps to avoid costly outages, with the staff at the Network Operation Center able to immediately identify the services and clients affected and respond accordingly to ensure that SLAs are not breached.

"Having a centralized database for network and service resources with comprehensive analysis and reporting functions is key to our success because we can now improve our operational efficiency and flexibility along the entire value chain," says the project manager, summing up the results.



About FNT

Powerful, reliable and flexible infrastructures are the basis for all digital business processes and applications, especially those supporting Smart Cities, Industry 4.0 or 5G. With FNT's integrated software solutions, organizations can record, document and manage complex and heterogeneous IT, telecommunications and data centre infrastructures from the physical level all the way up the stack to business services. FNT stores this information in a manufacturer independent, uniform data model. In this way,

FNT provides the necessary transparency and tools to plan and manage the IT, data center and telecommunications landscape more easily, to eliminate faults faster, to optimize synchronization of resources and requirements and to automate delivery of new digital services. Over 500 companies and public authorities worldwide rely on FNT, including more than half of the DAX30-listed corporations. FNT is headquartered in Ellwangen (Jagst) and has offices in the USA (Parsippany, New Jersey), UK (London) Singapore, Dubai and Russia (Moscow). FNT offers its software in numerous countries through partnerships with market-leading IT service providers and system integrators.

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