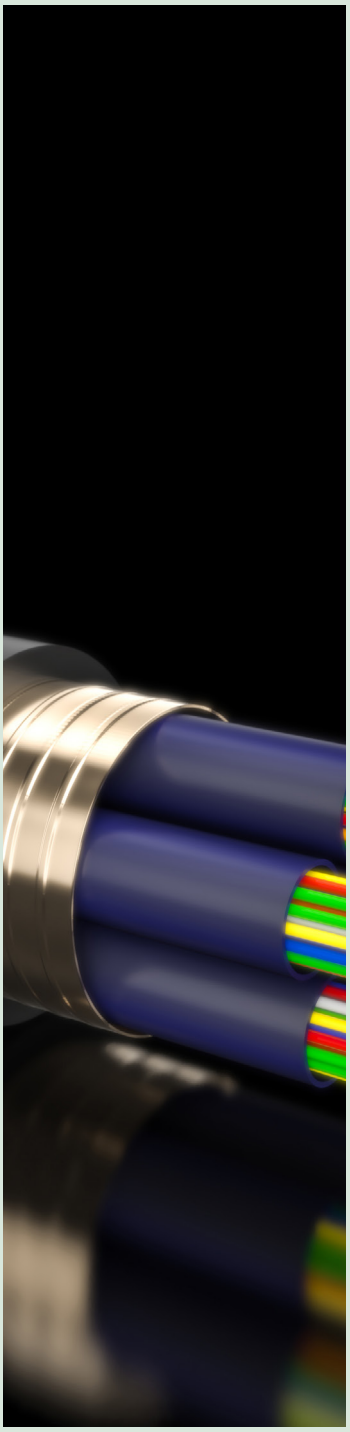
WHITE PAPER



APPROACHES FOR COST-EFFECTIVE AND ACCELERATED FIBER ROLLOUT

Infosys®
Navigate your next

Table of Contents

Introduction

Since the last decade, home and business users have clamored for uninterrupted connectivity .While the rise of media streaming platforms, end user devices, and online gaming platforms are driving demand at home, multi-channel collaboration platforms, IoT, cloud and as-service models are the major triggers for enterprises. In addition, the COVID-19 pandemic has introduced another dimension by forcing several in-person activities to be remote – for example, education, health consultation, business collaboration and infrastructure operations. Collectively these further amplified the need for better connectivity and accelerated the fiber (FTTx) rollout.

From the network technology convergence perspective, Fixed Mobile Convergence (FMC) and converged access for 5G are also propelling the fiber rollout. These positive trends are validated by market predictions as well. A new market study published by Global Industry Analysts Inc.(GIA) forecasts that the global FTTx market will hit 22.4 BUSD by 2026. While the demand is skyrocketing, global telcos and cable providers are battling two key problems: reducing cost and increasing rollout speed. This paper discussed the various cost and efficiency elements in a fiber rollout and Infosys' unique approach towards addressing the key challenges.

Fiber rollout – A hot trend

Telcos in Europe, the US and Asia Pacific have used fiber based broadband solutions since 2007. As a result, there has been a significant breakthrough in how fast telcos can build fiber networks. Also, they have been able to increase the upload and download speeds consistently . As a result, many countries have found and declared Fiber Network Delivery a critical measure for their economic growth.

Fiber broadband can be classified as Superfast and Ultrafast.

- Superfast broadband is delivered by Fiber to the Cabin (FTTC). Most countries have a higher penetration of superfast fiber broadband ranging from 70% - 95%.
- Ultrafast broadband provides significantly higher speeds than superfast broadband. Ultrafast broadband is delivered as Fiber-to-the-home (FTTH).

While the demand for ultrafast broadband is growing significantly , demand outweighs supply at this point.

Figure 1 represents the growth and forecast for fiber penetration in Europe and the key drivers influencing the growth.

	2021	2021	2026	
	NGA Penetration	FTTH Penetration	FTTH Forecast	Key Drivers
UK	97%	8.8%	63.1%	
France	69%	49.2%	86.2%	
Germany	95%	8.4%	59.9%	
Sweden	88%	67.0%	79.4%	
Netherlands	98%	23.8%	45.2%	
Spain	92%	70.6%	86.2%	
Italy	93%	10%	29.3%	
Belgium	79%	15%	45%	

Source: FTTH Council – Europe, European Commission DG Communications Networks, Content & Technology and The Digital Economy and Society Index (DESI)

NGA - Next Generation Access Networks

IoT, Immersive Tech
Home Office
Fiber Migration
Govt approvals for rural segment
Smart homes/OTT/Infotainment

Figure 1 Fiber penetration in Europe

The upsurge in demand for ultrafast broadband is driven by

A. Globalized workforces, smart homes, home offices, and small businesses
   - Almost all industries have their sales operations, SCM and customer services on the internet
B. Immersive tech such as VR and IoT driven business models in healthcare and insurance
C. OTT use by media, entertainment and education industry
D. Government funds to build a fiber network in rural areas
E. Large telcos are migrating to fiber networks and moving away from High-cost copper networks

Global Industry Analysts Inc. (GIA) estimates the global FTTx market to reach USD 22.4 billion by 2026. US, Major portion of this FTTx market share is being contributed by US, Europe and China.

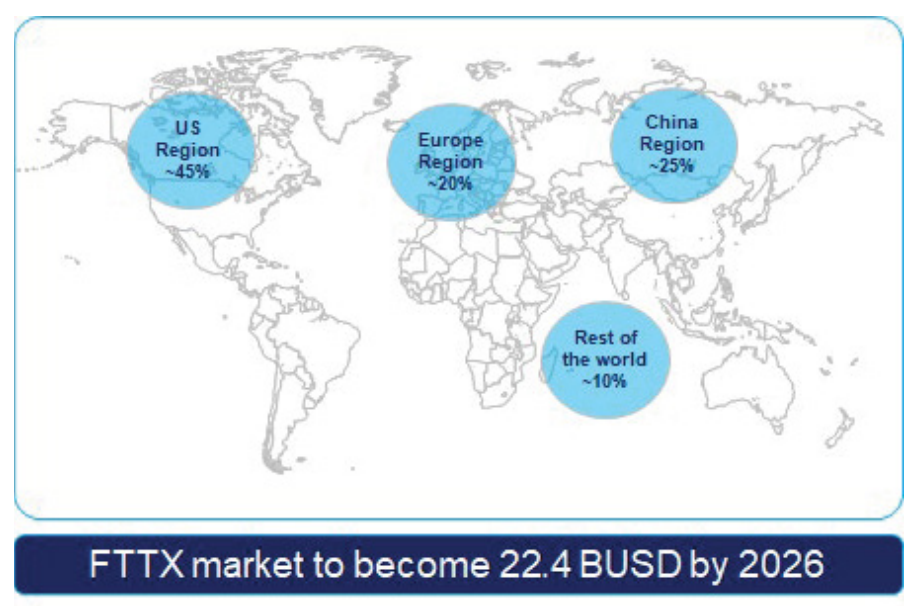


Figure 2 Global FTTx market

In summary, both investment and the technology maturity factors make fiber rollout popular globally.

Understanding the cost elements of fiber rollout

It is essential to understand a typical fiber network before getting to cost. A fiber network contains these segments,

Exchange or Headend: This holds the intelligent nodes of the fiber network, namely Optical Line Terminator (OLT) and the aggregation nodes.

Outside Plant (OSP): Outside plant part of the network includes the entire network that connects the exchange to the home. It typically includes:

A. Distribution Hub, which connects fiber optic cables to splitters
B. Local Fiber Network, which brings the fiber from the distribution point to curb or the base
C. Drop Network, which is the last mile connection to home

The cost split between the different segments of the fiber network is shown in figure 3.

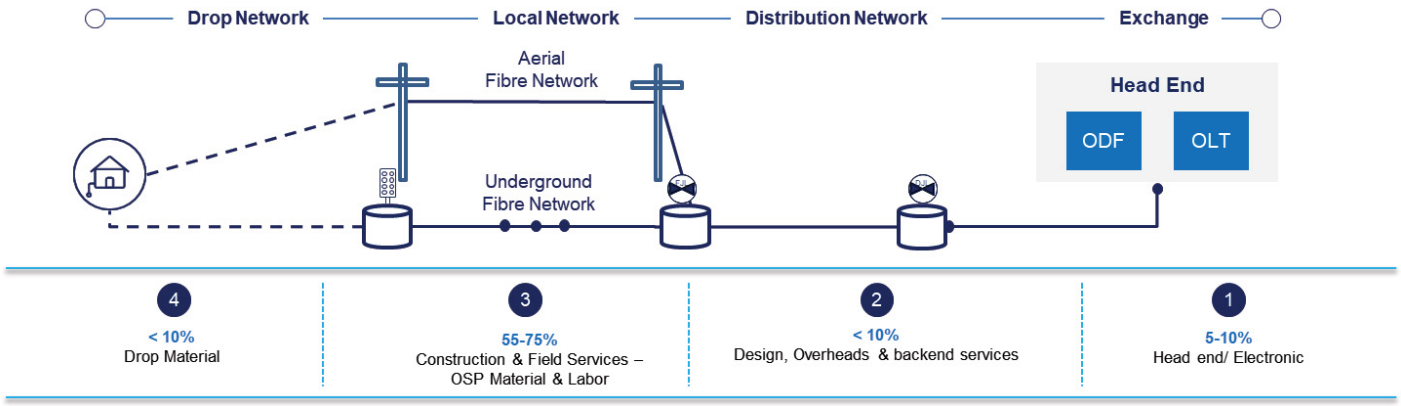


Figure 3 Cost across the fiber network

Cost Categories	Subitems	Variabilities
Head End / Electronics	• OLT/Aggregation • Nodes • Feeder • Rack/Shelf	• GPON / NG PON/ XGS PON • HFC VS FTTX • Virtualized vs. legacy • OEM vendor pricing
Design	• HLD • LLD • Design Validations • System updates	• Automation baseline • Internal vs. outsourced • Geo specifics
Overhead & Other back end services	• Strategy • Planning • Management • Validation • Audit	• Level of outsourcing • Regulations • Geo specifics
Outside Plant (OSP) material	• Cabinet • Splitter • Fiber • Civil Works	• Underground vs. aerial • Length of cable • Splitter placement • Deployment architecture • Civil work structure
Outside Plant (OSP) Labor	• Civil & Construction • Pitting & Piping • Pole construction • Field Engineering	• Cost of Labor • Country/geo specifics • Regulations • Legal /land acquisitions
Drop Material	• Drop Cable • Modem/ONU • Civil Works	• Drop cable length • CPE technology • Civil work structure • MDU VS SDU

It is the industry standard to calculate the **Per Home Pass (PHP) cost,** which is the unit cost of covering a home through the fiber rollout process. In some countries, there are two units, PHS which covers the cost up to the local network and Per Home Connected (PHC), which is up to the home and includes the drop network. Ultimately, these cost elements lead to an average PHP number which in simple terms is calculated by dividing the total cost (adding all the cost elements) by the total number of homes covered during rollout. Due consideration must be made for Single Dwelling Unit (SDU), an independent home and Multi Dwelling Unit (MDU), a building with multiple connections, typically an apartment.

The PHP cost value differs across geographies for different reasons and the variability play. For example, in certain East European and South American countries, the PHP is low because of the overall low cost owing to OSP labor. While in Australia, even though the number of homes is few and other factors are on par, the PHP is high because of the length of the fiber required to reach homes. On the other hand, some operators have tried to reduce the cost by innovating on the headend and virtualizing it.

Levers for optimizing cost and accelerating fiber rollout

Whenever telcos rollout new offering or technology upgrades, they face challenges on multiple fronts that stress costs and timelines. This directly impacts competitive pricing in the market, customer retention, time-to-market and maintaining ARPU. Fiber rollout is no exception for this. As a result, the operators need to exercise cost optimization levers across people, processes and technology during the fiber rollout in order to stay competitive and ahead. Figure 4 captures the cost optimization and acceleration levers in a typical fiber roll out.

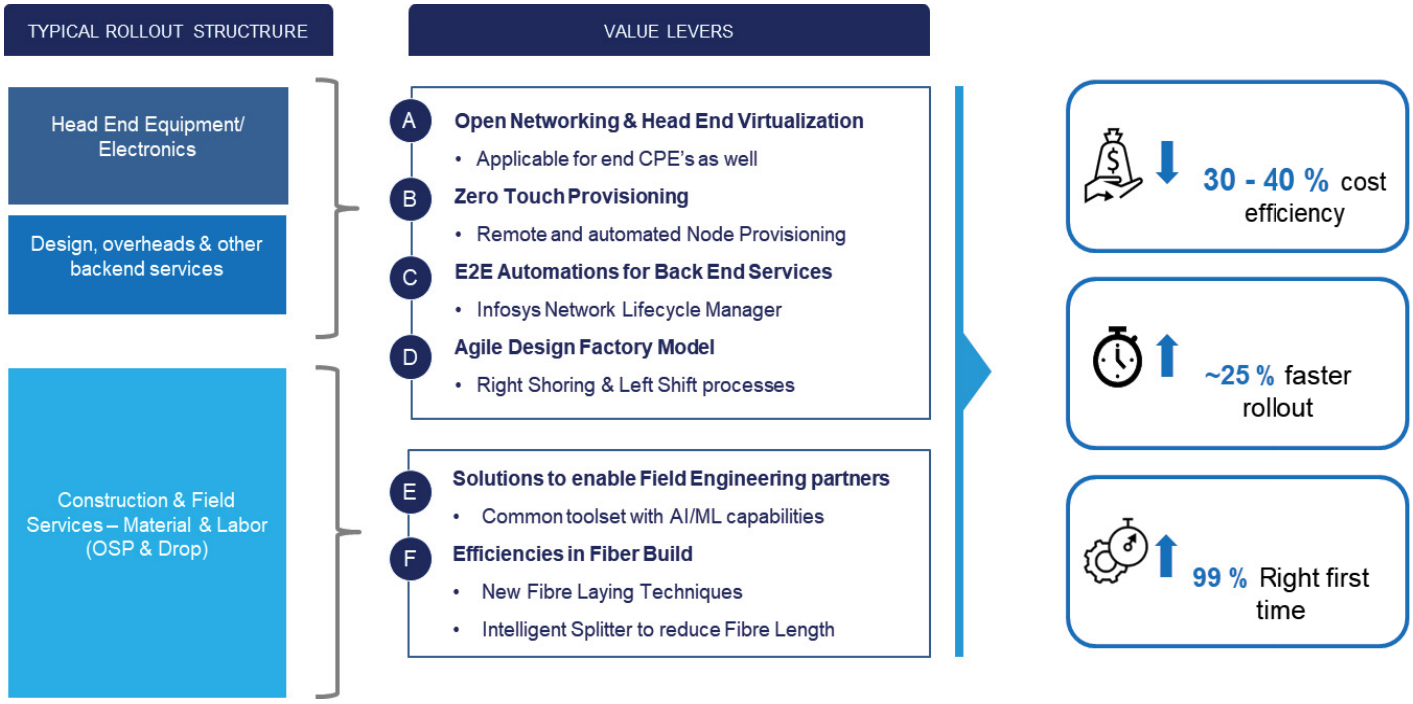


Figure 4 Cost optimization and acceleration levers for a fiber rollout

A. **Open Networking and Headend Virtualization** – FTTx based broadband services are traditionally delivered with OEM provided software and hardware stack solutions at the headend. The cost of these headend hosted solutions can grow exponentially to meet subscriber growth and capacity needs. However, by adopting Open Networking based SDN Controller (e.g., ONOS), disaggregated access network (e.g., R-OLT), and virtualized network functions (e.g., vBNG, vOLT) in building the solution, the cost can be significantly reduced both in the hardware and software stack.

B. **Zero Touch and Remote Provisioning** – Provisioning network elements like OLT, CPEs involve cost elements associated with field visits, truck rolls and manual configuration. The cost can significantly go high during scale and bulk rollout scenarios. Hence adopting to solutions that follow the principles of zero touch and remote provisioning can save the cost and accelerate the rollout of FTTx services.

C. **E2E Automations for Backend Services** – As part of the traditional fiber network build processes, there are many manual touchpoints in plan and design process areas. For example, the civil and fiber network design drawings, design changes, design commit, design updates have many touch points with backend systems. The fiber network planners and designers can deliver more designs with improved data accuracy when these are automated. It can usher in substantial cost efficiencies and accelerate the network build activities.

D. **Agile Design Factory** – The individual processes within Fiber plan-design-build life cycle stages have matured over years to bring efficiency in delivering large project windows. To a large extent, they are not flexible to accommodate design changes resulting in increased cycle time. Further, the siloed nature of certain processes also makes it difficult. The Agile Design Factory model offers opportunities to shift left, consolidate, right-shore the network plan and design processes. As a result, the model can optimize the cost of execution, to accommodate changes and accelerate delivery.

E. **Solutions that enable field engineering partners** – The ecosystem of construction partners and field engineering teams is crucial to fiber rollout both in build and overbuild activities. While the partners capitalize on their plan and design tools to accomplish the work, there is a significant manual effort required for capturing the design data in operator systems, resulting in added cost. Hence enabling the field partners with innovative tools and solutions that integrate with CSP systems can optimize the cost of delivery - for example, AI/ML enabled video analytics for work order audit and system updates.

F. **Efficiencies in Fiber Build** – Laying new fiber and/or duct to add more capacity can be costly. Hence adopting new ways to meet such requirements helps save costs and improve the existing infrastructure's utilization. For example, some cost reduction techniques are microducts in the existing duct with coax cables, fabric based innerducts and intelligent splitter options.

SDN Controlled and Managed Headend components through Infosys Network Controller

The disaggregated and virtualized components of the fiber access network require SDN control and management at the headend. Therefore, many fiber access solutions expose the API layer on top to extend SDN capabilities and achieve control and management use cases. However, due to the closed nature of SDN solutions, telcos end up going through cycles to realize the required use cases and face challenges when keeping multi-vendor solutions in silos. The Infosys SDN controller solution called Infosys Network Controller aims to solve these challenges.

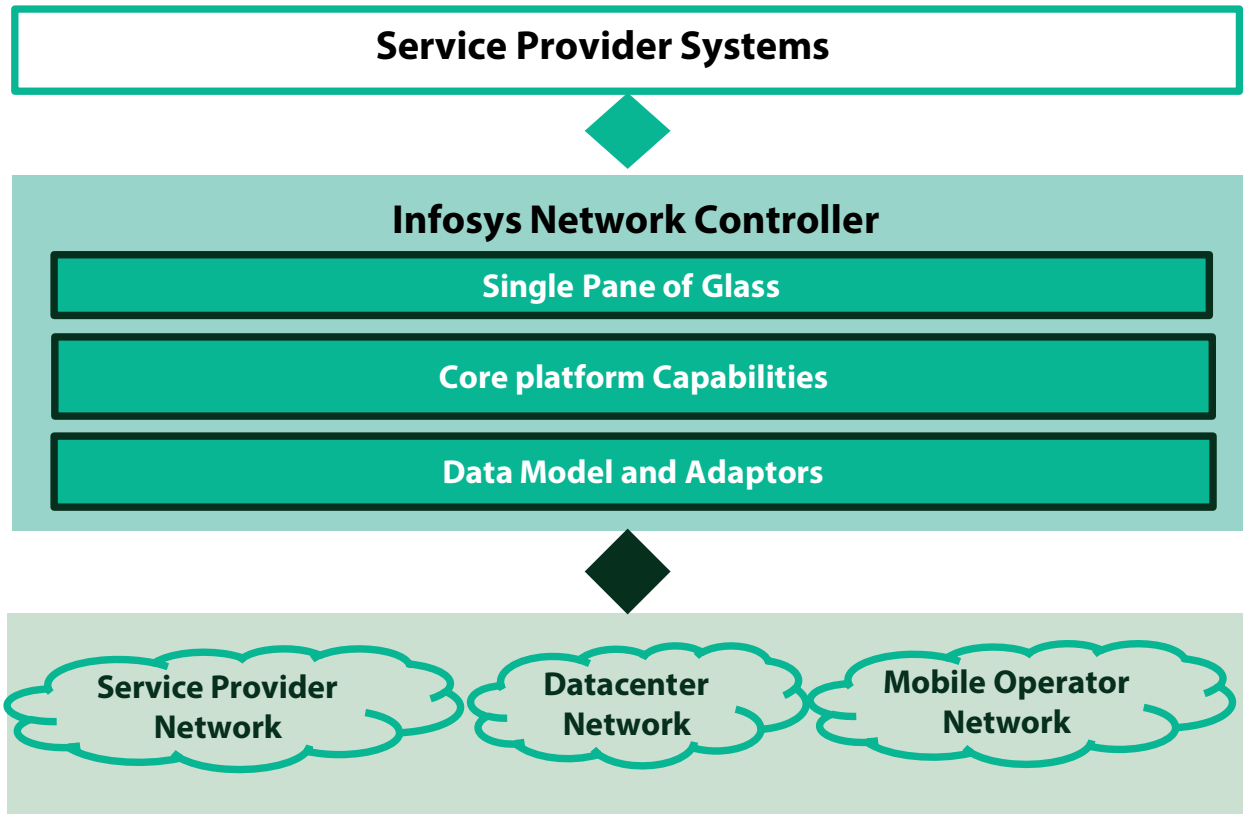


Figure 5 Infosys Network Controller

The **Infosys Network Controller** platform is built on a hardened open source based ONOS SDN controller and integrated with microservices based network management functions. The key components include

- **Single pane of glass through unified UI -** An interactive UI that provides operator dashboard, provisioning handles and many other features to integrate the SDN-O and SDN-M functions.
- **SDN-O** –an ONOS based hardened SDN controller supporting the control and forwarding functions.
- **SDN-M** – A microservices style based network management function that includes Service Provisioning, Configuration Management, Inventory Management, Fault Management, Image Management, Telemetry and Backup and Restore functions.

Automation & AI through Infosys Network Life Cycle manager

While end-to-end automation is important across the life cycle stages [Plan-Design-Construct] of fiber rollout, it is equally important to bring them under a unified umbrella and framework. This unification enables a common tool across the board improving standardization and network design and build quality. The **Infosys Network Life Cycle Manager** is an automation platform in that direction, built with global experience and learning gained from fiber rollout.

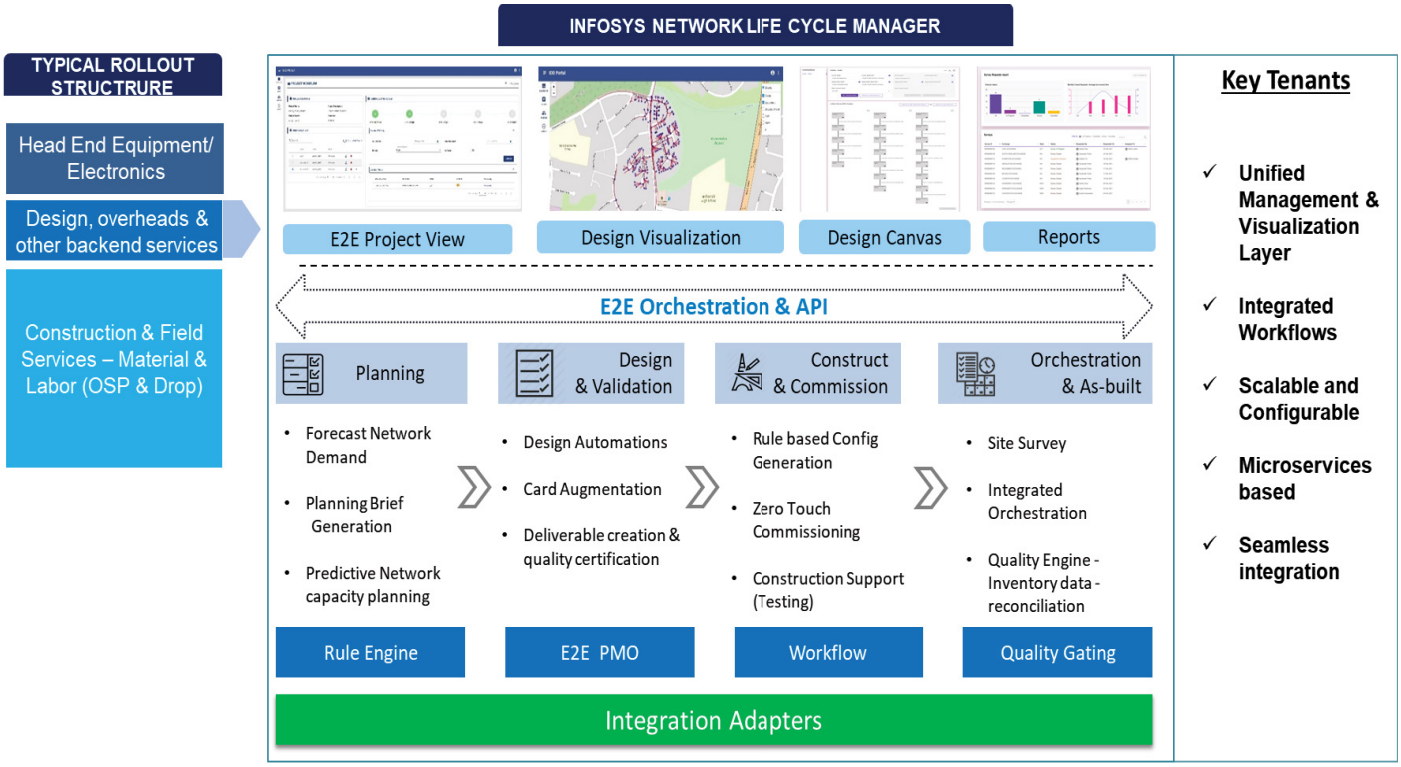


Figure 6 Infosys Network Lifecycle Manager

The **Infosys Network Life Cycle Manager** is built with key use cases and requirements that arise during the plan, design, construct stages of the network rollout, captured in Figure 6.

- **Unified UI -** It offers an interactive UI with dashboard views for the E2E status of the project, GIS-based design visualization, design canvas and prebuilt templates and persona-based reporting capability.
- **Scalable and Configurable -** It has been built on top of microservices style architecture with cloud-native principles allowing scalability and configurability requirements.
- **Integrated Workflows -** The integrated workflows and templates reduce the time to build new workflows through customization.
- **Seamless Integration -** The adaptors available within the solution enable integration with OSS systems in the telco environment, including network inventory and order management.

Execution efficiency through Infosys Distributed Agile Model

Today's network plan-design-construct processes in the telco environment are not flexible enough to manage Agile requirements and design changes. The Infosys Distributed Agile Model is built with rich experience from global fiber rollout engagements. The model offers standardization of tools and capabilities to build the e2e view of the project, status of tasks and integrations. It reduces the handoff and knowledge centers within the teams involved, thereby reducing

1. Dependency on previous teams
2. Time taken to transfer tasks between teams
3. Ability to control, validate and standardize input and output at each stage

Because of the modern digital capability and standardization, the Distributed Agile Model provides

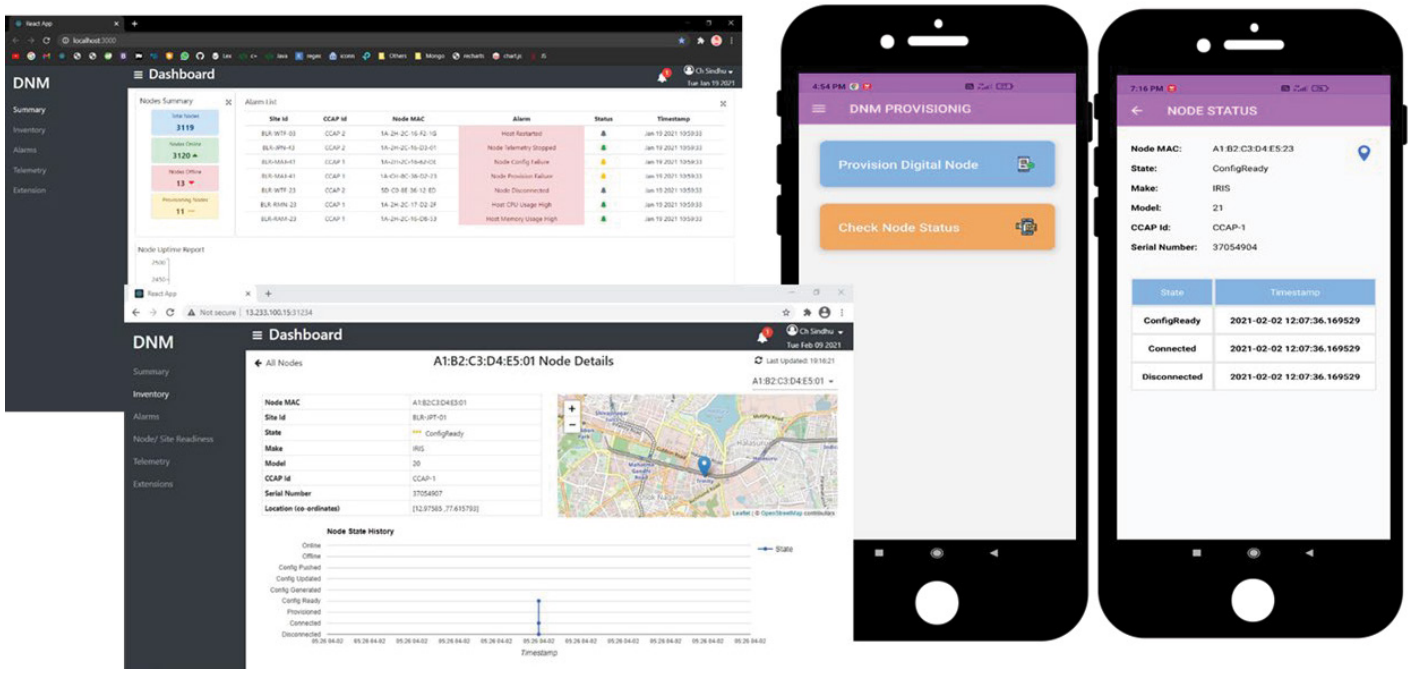
1. Improved quality of data upfront, creating a left shift in the pre-survey planning
2. Increased efficiency in the post survey feedback processes.

Integrations across the design and build systems help improve the quality of job packs produced, reducing the time taken to review job packs. As a result, there is a direct impact on how many work orders are released in a day to field engineering teams. More importantly, the high quality of data in the job packs reduces churn and time to build.

Integration with OSS helps update the As-Built-Network and publishing status to activate circuits or services. The capability ensures a smooth transition of the built network to in life teams. Figure 7 shows this model.

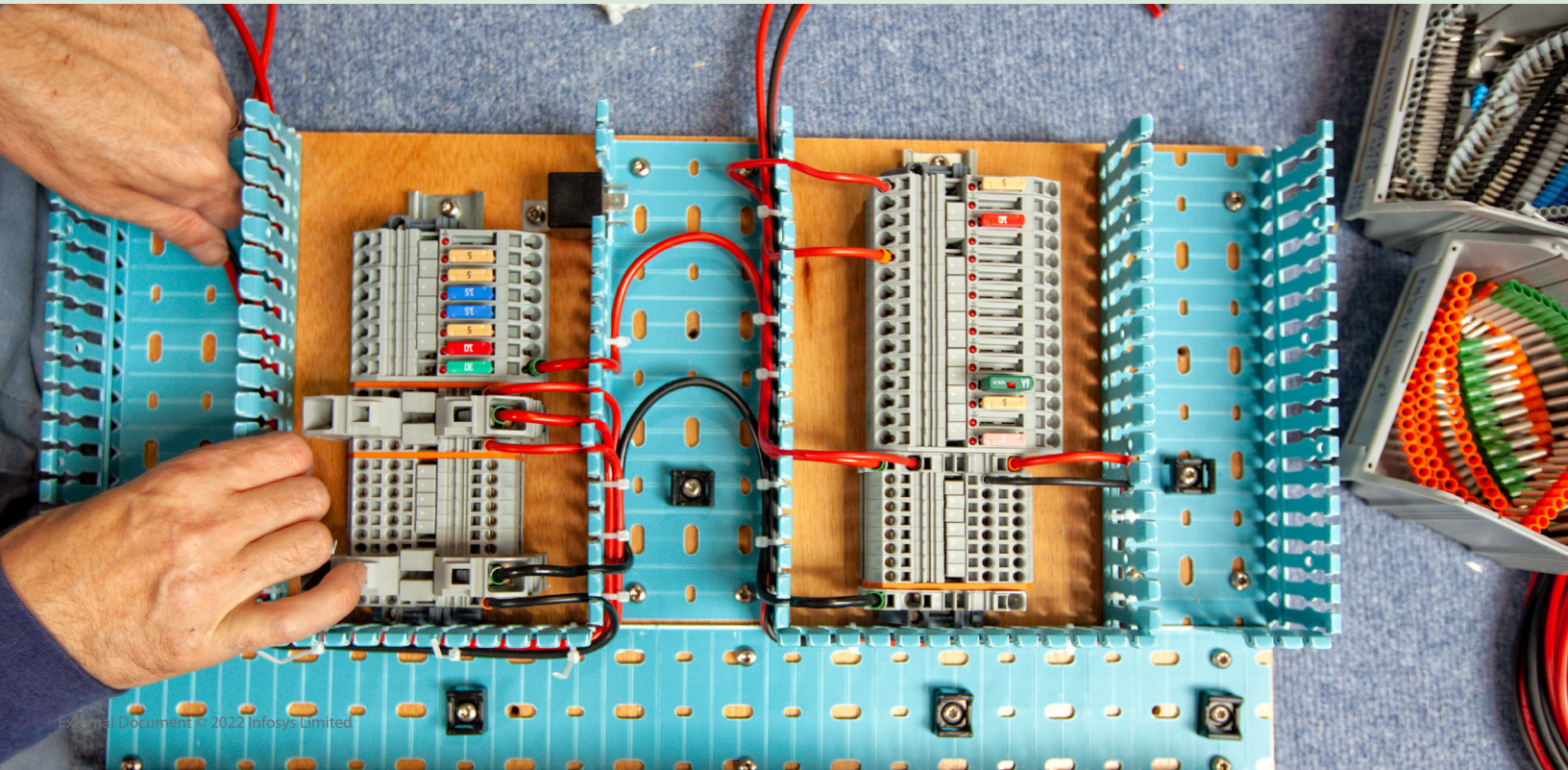
Smart Field Operations through Infosys Digital Node Manager

Field engineering and node provisioning are crucial elements in a fiber rollout to optimize cost. **Infosys Digital Node Manager** is a proven solution built with our global experience in addressing operator use cases for remote provisioning of the network nodes.



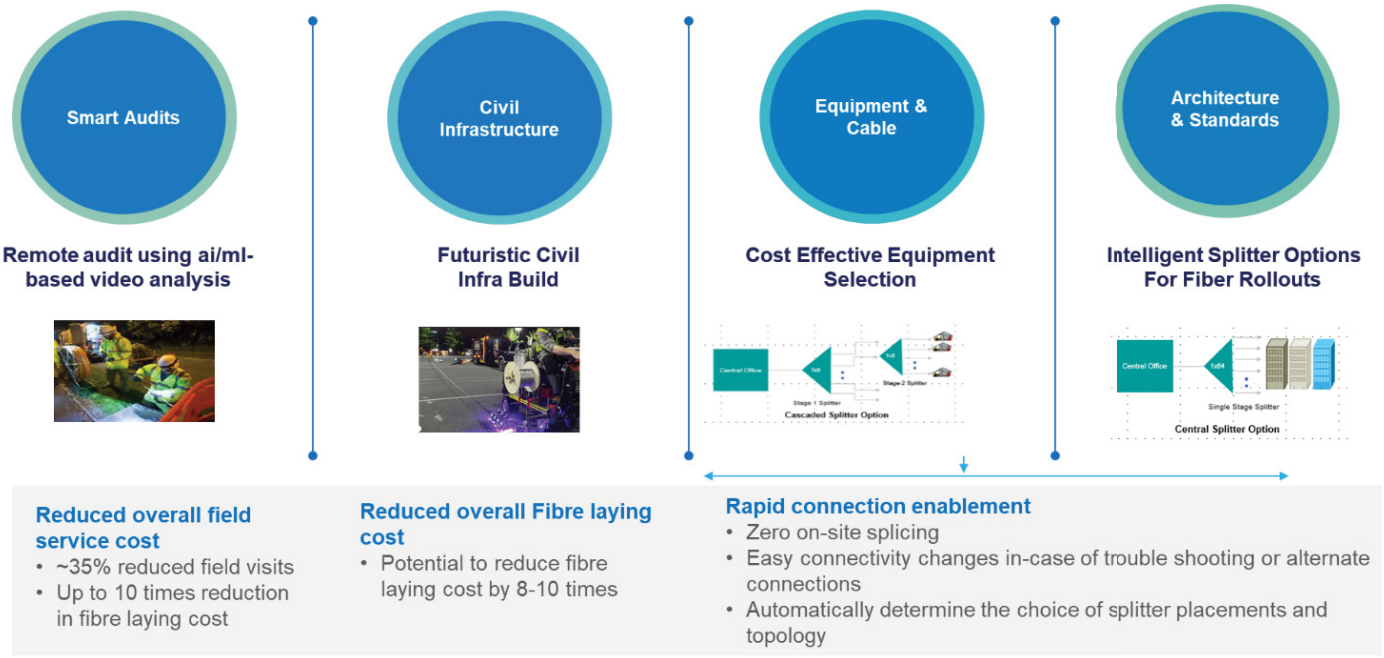
Infosys Digital Node Manager helps addresses the key challenges in preparing, installing and configuring stages of Network Node Provisioning through -

- **Plan and Prepare -** Pre-generated templates and automated tools help readiness of site seamlessly.
- **Deploy or Install -** Zero touch provisioning and automated retries to help deploy and maintain digital nodes effectively.
- **Configure -** Centralized and API based remote command modules make config updates efficient.



Smart levers for reducing Outside Plant (OSP) cost

In addition to the solution elements discussed so far, smarter tools, techniques and continuous innovation help reduce cost and accelerate fiber rollout, especially in the outside plant. Through its interactions in global forums, partner ecosystem and fiber rollout experience, Infosys that implemented these best practices to generate excellent results in cost and acceleration value levers.



Remote audit using AI/ML based video analysis

- AI based solution for remote audits and installation confirmation
- Smart workflows to reduce field visits and manual verifications

Futuristic civil infra build

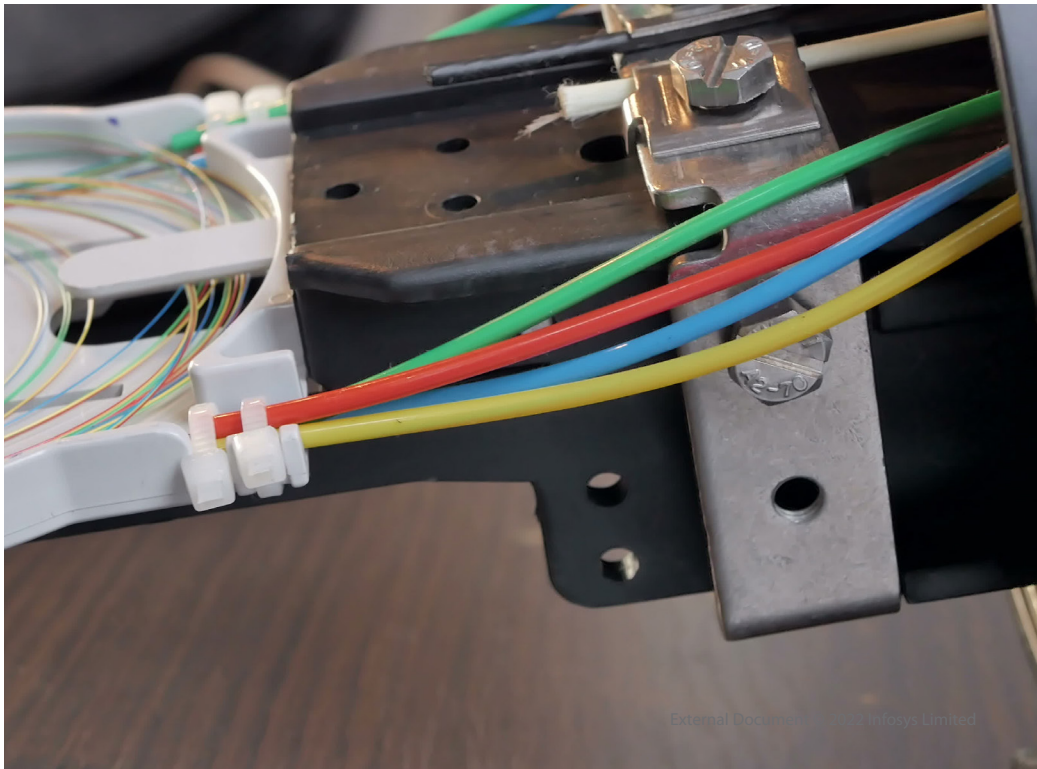
- Installing optical fiber lines along existing roadways without digging deep trenches.
- Driverless vehicle "paints" a fiber line on the surface of the road and then covers and protects the line. Targeting the last-mile customer segment compared to long-haul or backhaul segments.

Cost-effective Equipment Selection

- Use of ribbon type fiber cable to reduce fiber slicing time
- Connectorized cables to avoid splicing
- Small size (custom made) equipment to avoid pit remediations

Intelligent splitter options for FTTH rollouts

- Use GIS and building/home coverage data to determine the choice of splitter placements and topology automatically
- Help auto determine the connectorized or all-spliced approach based on the region
- Fiber indexing eliminates the need for splicing by offering a plug-and-play solution. It allows operators to use any level of skilled technicians (saving costs) and deploy FTTx faster
- Use intelligent optical splitters that can provide topology information and perform fault detection



Conclusion

Increased bandwidth and deeper connectivity are today a necessity. Fiber rollout and fiber deepening plays a key role in making it a reality. As discussed, fiber rollout is a cost intensive program for most operators, depending on the scale, cost of infrastructure, and manpower required. We have attempted to demystify the cost challenge by introducing the elements and variabilities. It is also evident that software driven, smarter and extreme automation led approaches can deliver efficiencies and business benefits. Infosys' focus is to invest in these levers and bring mature solutions incorporating global best practices so that any operator attempting a fiber rollout can easily reap the benefits without reinventing the wheel. We strongly believe this approach and strategy will help network operators roll out fiber services cost-effectively and efficiently and deliver on their market commitments.

About the Authors

Sreekanth Sasidharan

AVP, Senior Principal Technology Architect with Infosys Engineering Services and has over 23 years of experience.

He leads the Network Engineering Technology practice globally. He has incubated and led many technology services offering, including SDN/NFV, 5G, MEC & Network Rollout. Sreekanth is enthusiastic about telco technology. He has12 international publications and represented Infosys in several global thought leadership forums.

Balaji Thangavelu

Industry Principal with Infosys Engineering Services with over 23 years of experience.

He has led multiple consulting engagements for clients in communications services and other industries to adopt next-gen networking and communication technologies successfully. His research and focus areas are SDN/NFV, 5G, Fiber Rollout and enabling them for various industry use cases.

Jayram Govindarajan

Principal Consultant with Infosys Engineering Services with over 20 years of experience.

He has successfully led multiple consulting engagements for clients in communications services and other industries to adopt next-gen networking and communication technologies. His research and focus areas are SDN/NFV, 5G, FTTx, enabling them for various industry use cases.

Thank You Note

The authors thank Hari G Nair, Rajeev Ranjan, Rupesh Muraleedharan, Venkatesh Hariharasubramonian, Charles Varkey, Vignesh Ramamurthy and Girish V for their inputs and guidance for this document.

For more information, contact askus@infosys.com

Infosys®
Navigate your next