VIEW POINT

# THE BIG SHIFT: IMPETUS OF TELECOM NETWORK TRANSFORMATION


## Abstract

With heavy CapEx committed to deployment of 5G networks, promoting NaaS & IoT services and introduction of newer broadband services, the extensive B2C business model of CSPs is shifting towards a B2B model, not to mention that the above-mentioned services shall not have any B2C play. However, it is slowly downing on the telecom industry that its business model is changing due to market forces. This redefinition of the business model is forcing CSPs to undertake OSS transformation to address advanced key business requirements.


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## Network Transformation Strategies

Globally, CSPs are unleashing massive network transformation strategies to modify their business model to deliver an enhanced customer experience to their enterprise clients and consumers. The precedence of these transformation strategies involve:

### Reducing operational costs

Over the past few years, most telcos have been investing heavily in reducing their operational costs due to stagnant or reducing revenues. They have implemented various strategies for cost reduction, ranging from outsourcing their infrastructure management to smart sourcing and procurement.

### Automating business processes

Currently most of the operations are manually intensive. These types of operations are not optimized to support emerging applications driven by mobile 5G, cloud, and IoT. Business workflows, currently deployed, involve many time-consuming, manual tasks to correlate and make sense of fragmented data scattered across many inventory and operational support systems (OSSs). It is impossible to automate operations if there is not a single, authoritative window of truth for operational data. Switching to a more virtualized and automated environment will improve infrastructure adaptability and operational efficiency.

### Demand for marketplace experience

Delivering new services is impeded by siloed legacy systems customized for static, circuit-based services, and cannot adequately model the dynamic services required by next-generation networks. Legacy systems also operate offline and prevent accurate visibility into what is really going on in the network. This is prone to errors, and rework is required for service fulfillment and assurance. As a result, it's difficult to respond quickly to market demands.

## Business Challenges

The network inventory management system is a crucial element of a telco's operational support system (OSS). It is used throughout the organization and has interfaces to many other databases, business support systems (BSS), and NMS/EMS. Network inventory management systems are vital to keep track of IT and network assets. They provide information on the devices on the network, their configurations, how they are interconnected, and the end of their lifecycle. They also help provision new equipment for new customers, plan changes for network optimization, and dismantle obsolete equipment.

NIMS is vital for service fulfillment across a number of workflows, such as O2A (order to activate) or O2C (order to cash). Inventory systems manage network connectivity of the elements on the network, facilitation of service assurance workflows like T2R (trouble to resolve), planned or unplanned service outage impact analysis (SOIA), and network single point of failure analysis (SPOF). Inventory management systems also facilitate other operational functions like asset management, network capacity management, warehouse & spare inventory management, and trouble ticketing & workflow management functions.

With the rapid growth in communication technology and customer demands, telcos have deployed new networks with older networks still in place. Most of the time older technology networks cannot be dismantled since they are still serving customers and generating revenues. So, it is not surprising that most of the tier 1 telcos currently support disparate legacy networks ranging from microwave to FR/ATM to xDSL to xG Mobile to SDH to VSAT to MPSL, to upcoming SDN/NFV networks. Inventory management systems function as universal connectors, supporting various manual and automated workflows in telecom operations. Telcos will greatly benefit from fast, accurate, scalable, and flexible network inventory management systems.

Network inventory management systems facilitate many work and data flows. They aid in managing products, services, and other resources. As we recognize that telcos have multiple networks to manage, we also understand that all these different networks shall have their own proprietary inventory systems, often not integrated among themselves. This forces the operations team to collect data individually from each inventory system and then club them to manage service fulfillment, delivery, and assurance. This type of workflow inherently has many challenges and pose problems in smooth operations; some of these problems include:

**Manual collection and collation of data** from various inventory systems results in numerous instances of incorrect data in the inventory database as against the actual network.

**Inconsistent data** leads to various automated provisioning and activation processes (e.g., network elements IP address assignment/release) to be plagued with a large percentage of service request fallouts resulting in further dependency on inefficient manual intervention.

**Dependency on manual workflows,** prone to human errors, results in network engineering and planning processes to not only be inefficient but also induce delays.

**Inaccurate network designs** eventually cause delays in service provisioning, necessitating costly and time-consuming manual order reprocessing.

**Inconsistent and non-standardized asset data** content across different networks may cause multiple business revenue and cost efficiency problems.

**Manual reports of existing assets** across disparate networks (e.g., active, spare, inactive, work in progress, etc.) are often filled with inaccuracies which result in CapEx inefficiencies through either overspending or underspending. This may also effect under-utilization of network assets.

**Service assurance functions** such as troubleshooting and planned maintenance require manual correlation between different network data sources and inventory systems. This often requires weeks of manual effort and delays planned maintenance and troubleshooting.

**Manual reports** with possible inaccuracies result in inefficient customer services, network asset utilization, and service volumes; it also delays customer service activation increasing revenue recognition timelines.

**Inconsistent inventory data** may lead to inflight process automation and efficiency initiatives undertaken.

Multiple mergers and acquisitions among telcos, very common in the industry today, significantly increase these challenges.

## Consolidating Network Inventory Management Systems

Telcos soon must consolidate their legacy inventory systems. This will be driven not only by the change in their business model but also due to the need for addressing new technology challenges such as:

Legacy inventory and asset management tools are inadequate and hence fail to deliver the required data because they do not have the required level of flexibility and configurability to support the introduction of new technologies such as 5G. The business model of 5G is predominantly B2B with heavy emphasis on supporting private 5G networks and IoT applications. This requires the consolidated inventory management system to be map resources across networks, outside plants, etc., physically, logically, and virtually.

Another challenge of NIMS is that telecom networks are expanding into customer domains (e.g., mobile private networks) as well as data center domains (core and edge data centers with applications, servers, storages). Network function virtualization (NFV) implementation across telecom networks has converted inventories from static systems to a dynamic, real-time data management platform.

5G, FTTx, 400G and NFV technologies may span multiple data centers and networks and add requirements that many current and legacy inventory management systems are unable to process. Virtual network functions, 5G, FTTx, and 400G networks all require more advanced resource management functionalities than most current and legacy inventory management systems can provide.

Eliminating disparate inventory systems that have been deployed in various networks over time is another frequently cited reason. Often such disparate solutions work in silos, using proprietary databases and separate customized inventory management systems for data center IP Networks and DWDM networks. Multiple systems existing in parallel within a telco infrastructure has an adverse effect on operational efficiencies.

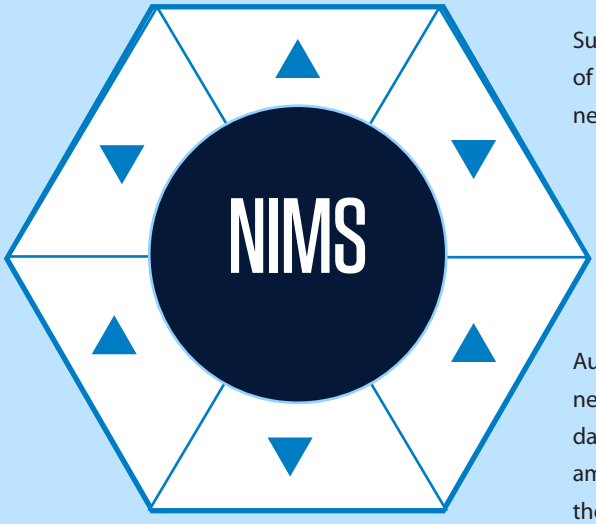
New consolidated NIMS should constantly evolve to address the changes in the networks and services. Inventory tools have historically been managed inside plant equipment (e.g., routers, switches, multiplexers), and outside plant resources (e.g., cables, pits, ducts, splices, towers), and their connectivity. However, these inventory management systems have to now adapt to manage virtualized infrastructure, logical and virtual connectivity, and new communications network models.

## Consolidated network inventory management systems should have the following key functionalities:

Manage inventory and assets of any type of network and services

Ensure the security of all the data managed by it.

Support real-time management of all resources across disparate networks.




Be highly scalable to manage ever increasing data volumes, data scope, any type of network infrastructure and all services being monetized by the telco.

Auto-discover all relevant network elements and service data and auto-reconcile among other data sources thereby ensuring that its data is trustworthy, complete, and consistent across the board.

Have an inbuilt engine to provide operational insights, from the huge amount of resource data it manages. These insights should be practical and actionable. Leveraging these insights, telcos can improve their operational efficiencies thus enhancing customer experience.

## Wishlist of Functionalities


### Catalog Management

A state-of-the-art inventory management system should enable creation and management of various catalogs, which can be referred to for service requests and their fulfillment. Desired catalogs are:

- A product catalog that defines attributes such as the place of its usage, its configuration attributes, and the resources and services that it uses.
- A service catalog that contains all service definitions, their attributes, and coordinates to various service fulfillment workflows.
- A resource catalog, that is your traditional network inventory, that captures resource data such as switches, servers, routers, cables, connectivity, and outside plant equipment. This catalog should also include spares and warehouse management. The resource catalog should support not only physical assets but also logical and virtual ones.
- A network entity identifier catalog which tabulates all data which includes telephone numbers, IMS identifiers, email addresses, IP addresses, and wireless network identifiers etc.

### Modern application architecture

The latest consolidated network inventory management systems should have a modular application design, a user-friendly interface and should take advantages of application architectures like:

**Three-tiered application architecture:**

- To provide for faster development, improved scalability, reliability and security the network inventory management system should have a 3-tier architecture. The inventory application should be cloud ready to take advantages of:
  - Microservices: functional application modules which help simplify design, build, release, and test cycles of integrations
  - Containers: semi-isolated environments in which applications or part thereof can run.
- Tiering the inventory application will expedite modernization of the application further as and when new technologies are available.

**Dynamic integration:** This is supported by standardized APIs like Restful and SOAP XML

## Data management functionality

Next generation network inventory management systems should take advantage of upcoming specialized database management technologies, such as graphic and time-series DBs to complement the relational DBMS used currently. These network inventory management systems should use robust data models, which is vital to achieve intuitive, accurate, fast, and flexible inventory solutions. These data models should be able to dynamically support changes like:

- Modern network tech, such as DWDM, GPON, FTTX, xDSL; SD-WAN; and SASE
- New network element types like software-defined switches, routers, etc., capable of supporting VNF updates in real time
- New network topologies like mesh, ring, star, network slicing, etc.
- New features and attributes like IoT things, device groupings, wholesale bundles, etc.
- New types of services which maybe non-telco but enterprise offerings
- Ad hoc user-defined queries and configurable insights dashboards

## Data security functionality

A telco's network inventory data is regarded as confidential; hence, data protection acts such as the General Data Protection Regulation (GDPR) and California Consumer Privacy Act (CCPA) are applicable. Network inventory management systems need to have strong data security. This is because they need to protect stored data as well as data in transit to other IT systems. Needless to say, such NIMS should have implemented a robust application access control mechanism like two-way authentication.

Inventory solutions form a repository of data on network devices, applications, and services that require data security monitoring. Unauthorized inventory application access and/or unauthorized modification of network element configurations constitute a security breach.

## Auto-discovery and reconciliation

Next generation network inventory management systems should have the functionality of auto-discovery and reconciliation of all network elements across a telco's disparate networks. This auto discovery and recon functionality needs to be able to track and update inventory and configuration data across disparate telecom networks on a real time basis since network elements and services are continuously being virtualized. The network inventory management system's auto discovery and recon functionality should ideally be configurable since some network elements are not prune to such frequent changes and other depend upon physical audits.

## Network capacity management

Traditionally telcos have been reactive to upgrading their virtual network capacity. Enhancing network capacity has always been a part of a slow network transformation project for telcos. For competitive reasons some telcos have tried to implement the famous Japanese kaizen process in firing up new network capacity.

Next generation network inventory management systems must have functionality of being aware of all disparate network resources of a telco to enable online upgradation of network virtual capacity as and when required. With futuristics services like 5G network slicing, NaaS, and bandwidth on demand this capacity upgradation functionality of network inventory management systems should be dynamic to the extend being near real time. In the future, next generation network inventory management systems may use AI/ML algorithms to predict network capacity upgradation needs.

# Network Inventory Management Transformation

The inventory management system is a very vital cog in a telco's operations management infrastructure. The data residing in the inventory management system is an asset that must be protected and properly managed. This data supports critical business functions such as asset management, capacity and bandwidth management, network equipment and service planning and build & operate program management, service outages impact analysis, troubleshooting and ticketing management to name a few. Crucial operational actions are undertaken with the usage of this critical data; hence, the network inventory management system should have high application and system availability and high level of data integrity.

Migrating to a new network inventory management system is a complex, time consuming, resource-intensive, often difficult, and risky undertaking. However, with proper planning, a smooth, zero-downtime data migration and efficient go-live of a new inventory management system is very much achievable. A smooth, zero-downtime data migration and efficient go-live of the new inventory management system is essential to prevent revenue loss, increase operational costs and have other adverse business impacts such as bad reputation and customer churn due to unacceptable customer experience.

## Risks and Challenges

Migration to a new network inventory management system comes with its own risks and challenges, which can be easily mitigated with a well-planned and tightly program managed transformation project. Some of the risks and challenges expected during network inventory management transformation could be:

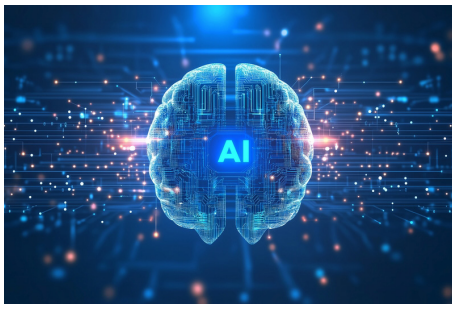
- Inventory transformation projects should never be executed in a "big bang" model. A big bang approach may end up utilizing considerable time and resources before transformational benefits are accrued.
- Inventory transformation projects may suffer due to inaccurate definitions of current and future states. Such a project may also suffer due to lack of poor program management.
- Managing E2E data integrity during the inventory transformation project may require more resources than available with a telco. Management of data migration, data cleansing and maintain data integrity for such inventory transformation projects can be outsourced to a services company who has data management specialists and can deliver from low-cost global locations; however, this necessitates additional program management of alien resources.

- Inventory transformation may also require reengineering of business processes. This may be necessitated due to non-availability of customization made in the legacy network inventory management systems to tailor them to the telco's operational workflows. Telcos should learn to use standardized best-in-class operational workflows instead of investing heavily in customization. Reengineering of business processes may also be required due to automation of processes inbuilt in the next generation network inventory management system.
- Implementing the inventory transformation project while operating the existing legacy inventory systems, operational workflows, and business processes.
- Human resistance to change, especially when retirement of legacy systems may necessitate reduction in operational and support resources.

## Future of network inventory management systems

The future of network inventory management systems lies in better network resources utilization, increased process automation, increased productivity, operational efficiencies, powerful operational insights, and lower operating costs with excellent customer experience. These current functionalities shall continue to play their vital roles however may experience redefinition, redesigning, and further fine tuning with changing technology landscape and evolving business models.

The future of network inventory management systems should include functionalities like:




### Use of AI/ML algorithms

Use of AI/ML algorithms for predictive analysis of capacity utilization, unplanned service outages, single point of network failure analysis, bandwidth utilization, spares management, etc. With deeper deployment of NFV in telecom networks AI/ML algorithms can be instrumental in discovery and prediction of network changes to automate inventory data reconciliation and updating.

### Use of drones

Usage of drones in assisting network maintenance efforts by identifying visible corrosion in physical infrastructure, missing nuts and bolts, rise of either man-made or natural obstructions to communication pathways. Drones can also be very effectively used to generate 3D photometric models of physical telecom infrastructure like towers, masts, poles, enclosures, DDF/ODFs, network element shelves and cards, etc.

### Use of digital twins

Usage of digital twins in network operations. 3D photometric models of physical telecom infrastructure using AI/ML algorithms can auto generate structural and geometric digital twins of telecom infrastructure. These digital twins can then be effectively used in network planning, network building and operations, and network maintenance rendering site visits redundant over time.

## Use of AR/VR Tools

Usage of AR/VR tools, robotics, and digital twin platforms to enable remote equipment maintenance thus making physical site visits redundant. Troubleshooting and fault resolution could be carried out by NOC operational staff thus increasing network and services availability, enhancing customer experience, and further lowering operational costs.

## Radio frequency (RF) as a network inventory entity.

Traditionally RF resources like allocated spectrum and coverage maps have never been considered and included in network inventories. However with increased deployment and dependencies on radio-based networks such as 5G, low Earth orbit (LEO), WiMAX, GNSS, UWB and IoT networks such as LoRaWAN, IoT-NB, and upcoming V2X connectivity for autonomous driving, RF coverage maps and allocated spectrum details are expected to become increasingly important inclusions in network inventory management systems. Managing these RF resources shall be as important as managing other network element identity (NEI) like telephone numbers, IP addresses, subnets, etc.

## Increased network automation

Increased network automation functionality in next generation inventory management systems designed for M2M communications will eventually facilitate dynamic network and services configurations leading to deployment of programmable, self-healing and optimizing telecom networks.

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