Prodapt powering global telecom

Building a 360° Network Cockpit

Implement an intelligent network visualization solution powered by Graph technology to deliver network insights faster

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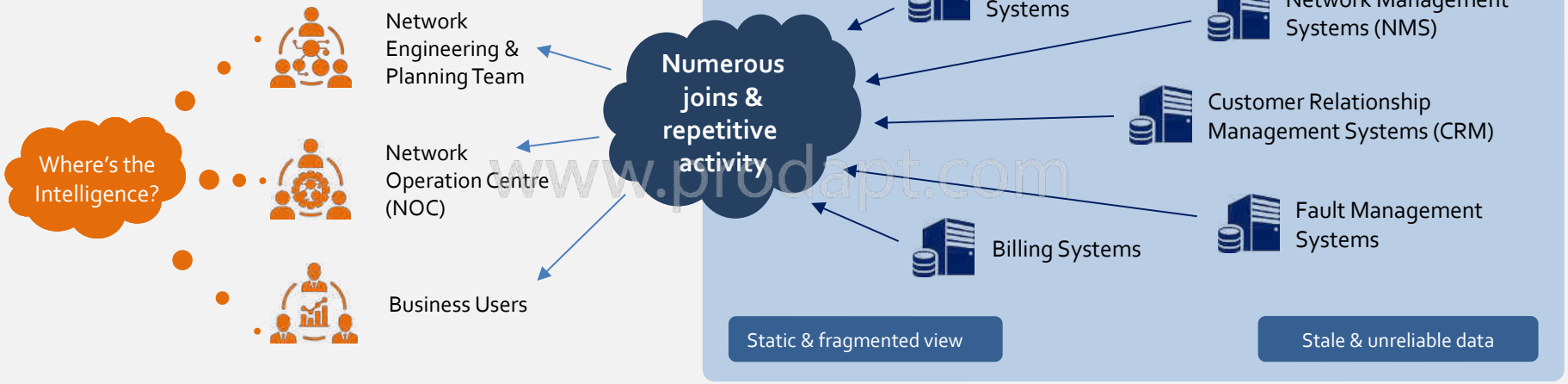
Scattered data across DSPs' siloed & disjointed network systems significantly impacts its operation

Complex DSPs' Network

Rapid network expansion, among other factors, has caused data silos in Digital Service Providers (DSPs), which affects time-to-insights for their data assets.



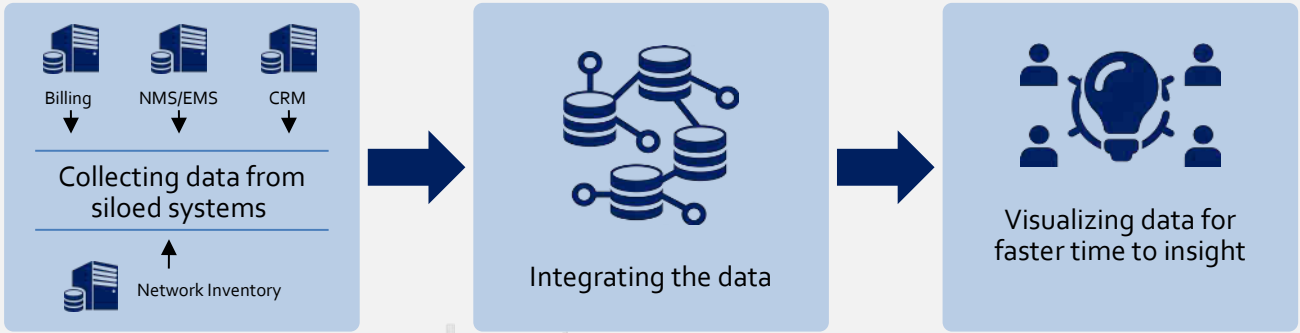
How this impacts DSPs operation

- Inefficient network and resource utilization
- Delay in new network design and rollout
- Ineffective network modeling & troubleshooting
- Errors in assessing impact of network outages

DSPs need to build 360° network visualization to drive smart decision making

Network 360

Data integration can solve the problem of data silos & information asymmetry in network management



Key Benefits

Network engineering and planning team

- Improve process lead time for network design rollouts
- Faster network modeling
- Improved traffic engineering & traffic intelligence

Network operation center (NOC) team

- Faster network outage modeling
- Easier troubleshooting
- Better capacity utilization

Business users/ BU Heads

- Better capacity utilization
- Reduce overheads & costs
- Improve Order to Activate timelines

Data pipeline and visualization framework: Two key ingredients for building 360° network visualization leveraging graph database

This Insight deep dives on the two frameworks and brings out key ingredients required to effectively build them.

A

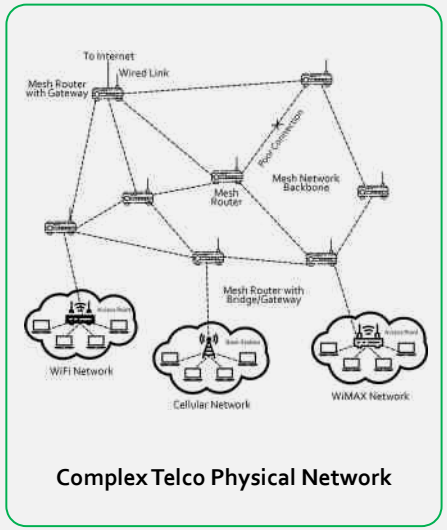
Data Pipeline Framework

To extract and ingest data from heterogenous sources into Graph database

B

Rich Network Visualization Framework

To filter, correlate and visualize real-time data to enable informed & optimized decision making



Complex Telco Physical Network

Network Inventory

Billing

NMS/EMS Alerts

CRM

Telecom networks can be naturally modelled as graphs

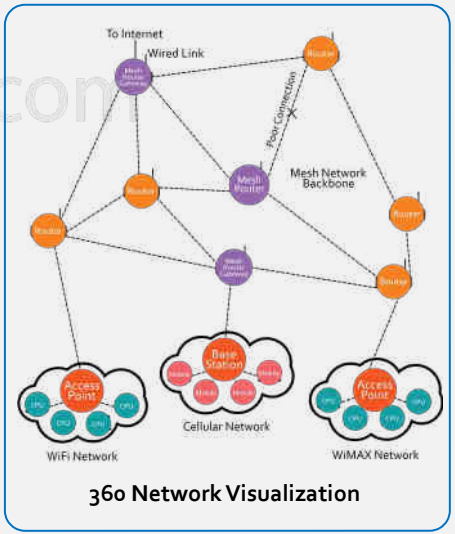
Relationship-Driven Platform (Graph Database)

Index-free Adjacency

Reduced Complexity

Flexible Schema

Easy Correlation



360 Network Visualization

Network Engineering & Planning Team

Network Operation Center (NOC) Team

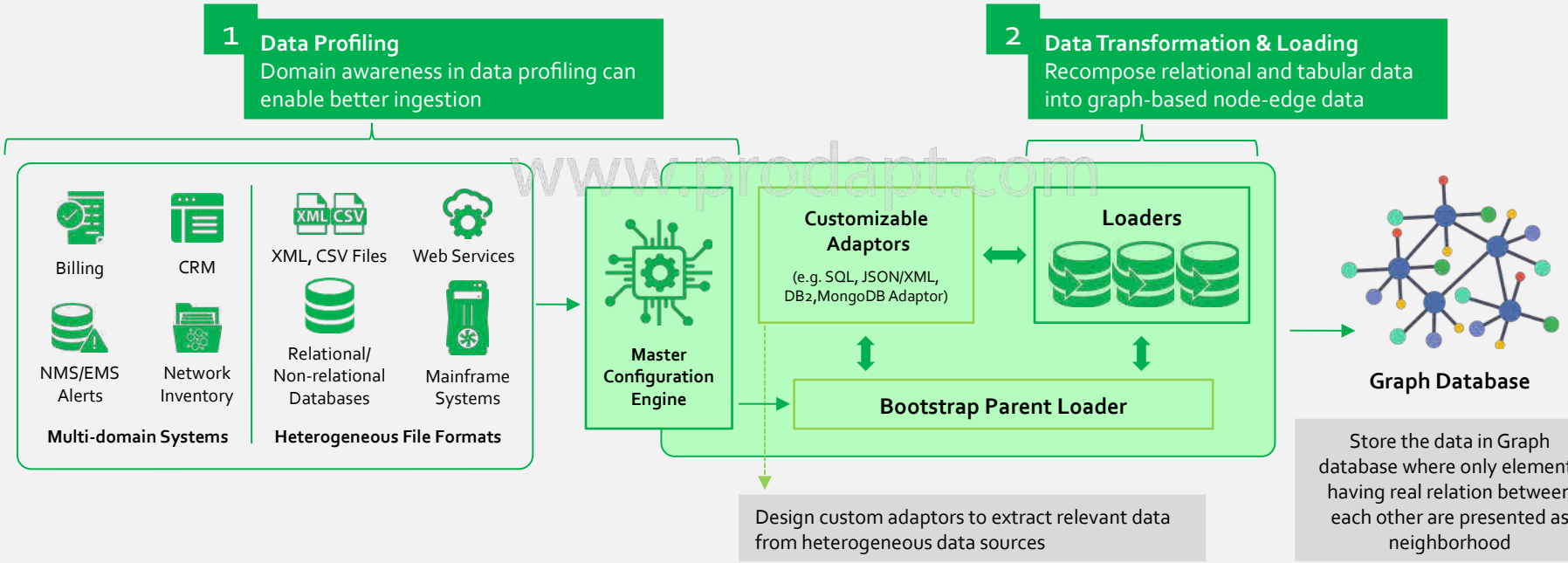
Business Users/ BU Heads

Solution approach for building data pipeline framework

A

Data Pipeline Framework
To extract and ingest data from heterogenous sources into Graph database

Data coming from multiple sources in different formats and at variable speeds can be efficiently collected and managed for graph database creation using this framework.



Key considerations in data profiling

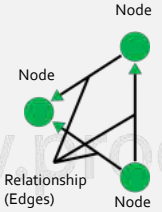
Domain awareness in data profiling can enable better ingestion

Elements of Ingestion Profiling

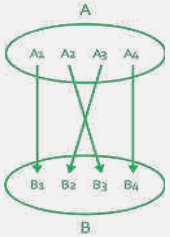
Filter out network domain-level data points

- Identify disparate systems & their subsets
- Filter relevant equipment details (racks, shelfs, cards), circuit details & other system details
- Identify and filter subcomponent details such as mounting position, port address, circuit position etc.

Collect principal parameters with dimensionality reduction & group them accordingly



- Identify what data belongs to nodes & what belongs to edges
- Identify key properties associated with vertex, edges and their interconnection



- Analyze relationship between different vertex
  - One-to-one or one-to-many relationship
  - Hierarchical or a flat relation

Implementation

Plan out data ingestion frequency

- Live traffic data -> Ingest in every 15 mins
- EDR (end of the day record) -> Daily ingestion
- Billing -> Ingest in every 15 days or monthly ingestion

Compute capacity required for ingesting at desired frequency

Compute memory, parallelism (no. of threads)

Mutually exclusive subsets needs to be can be run in parallel or else this can create redundancy issues

Decide filtering criteria

- Time-based
- Parameter-based
- Location-based
- Device-based

Identify querying format

Required to extract data form different source systems

- Kafka streams
- MongoDB
- Other customized queries
- SQL
- XML/JSON
- DB2

Data transformation & loading in Graph database

Recompose relational and tabular data into graph-based node-edge data

Transforming to Graph databases can be challenging when the mission critical applications are in the backend

Bringing **domain expertise** & **best practices** in Graph database deployment eases the pain of transition

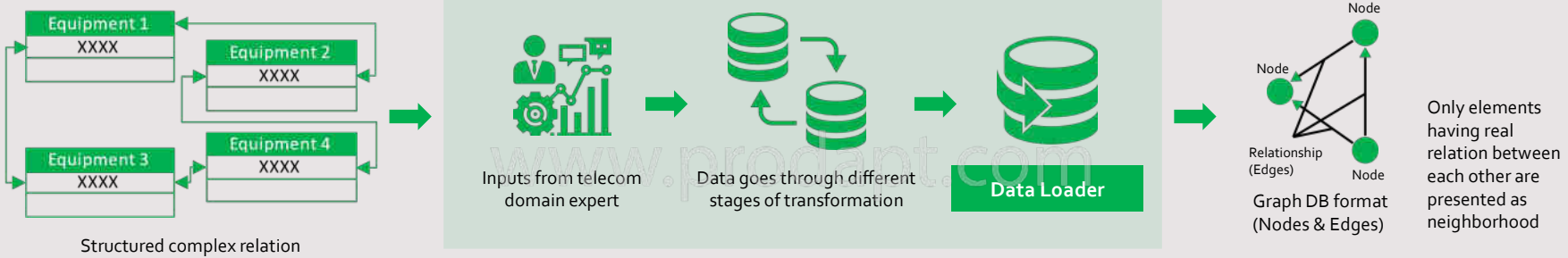


Fig: Map relational data to graph data paradigms involving nodes and edges

Mapping relationship for inventory and network design is key contribution from domain expertise

Identify key relational parameters such as circuit design ID & equipment ID that needs to be mapped to vertex

Traversing relationship between network attributes can be automated using best practices in Graph database design

Traverse relationship with following key attributes

- Mounting position edge - connection between two equipment
- Circuit position edge - connection between two circuits
- Port address edge - connection between circuits & equipment

Design **configurable loader component** with following attributes

- Form the required relationships between vertices (One-to-one, One-to-many) based on the properties associated with identified parameters
- Extract multiple entities and relationships using relevant adaptors based on querying format
- Traverse some major relations manually, while most of the relations can be automated based on the identified pattern
- Process multiple threads & load from different sources parallelly

Key considerations to create a rich network visualization framework

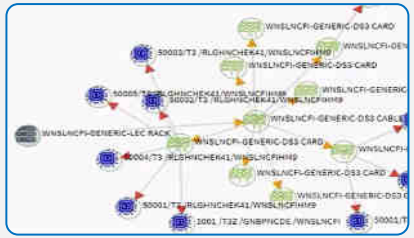
B

Rich Network Visualization Framework
To filter, correlate and visualize real-time data to enable informed & optimized decision making

The visualization framework addresses the disparate needs of network design engineers, NOC teams, and business managers, who will ultimately use the same data in different forms to make decisions.

1

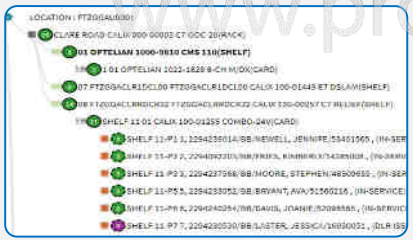
Use **force directed graph** for interactive & dynamic visualization



Network Engineering & Planning Team

2

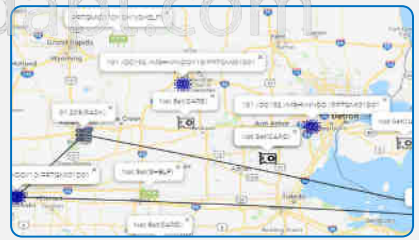
Use **hierarchical graph visualization** to get holistic view of all devices at a specific location



Network Operation Center (NOC) Team

3

Use **geographical view** of network systems to map physical location of devices



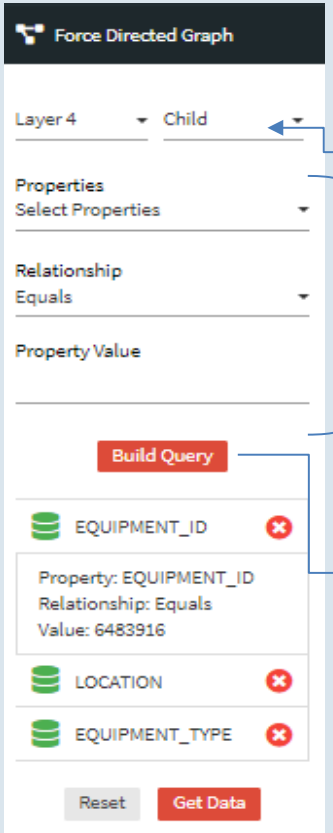
Network Engineering & Planning and NOC Teams

4

Correlate data from multiple devices to **generate customized reports when required**

All the Three Teams

Use force directed graph for interactive & dynamic visualization



Build easy to use GUI-based query builder tool

Create logics to quickly see different **layers** of child elements at a glance rather than traversing through each of them

Use **simple widgets and relevant filters** to build complex queries, thus avoiding dependencies on coding skills

Complex query generated using query builder

```
g.V().has("EQUIPMENT_ID",6483916).
has("LOCATION",textContains('PRTG
M01')).has("EQUIPMENT_TYPE",
eq('RACK')).emit().repeat(_.outE().inV(
)).times(4).path().unfold().dedup()
```

Use tools such as D3.js that support granular level of customization & interoperability

Network design and rollout time can be significantly reduced by up to 33%

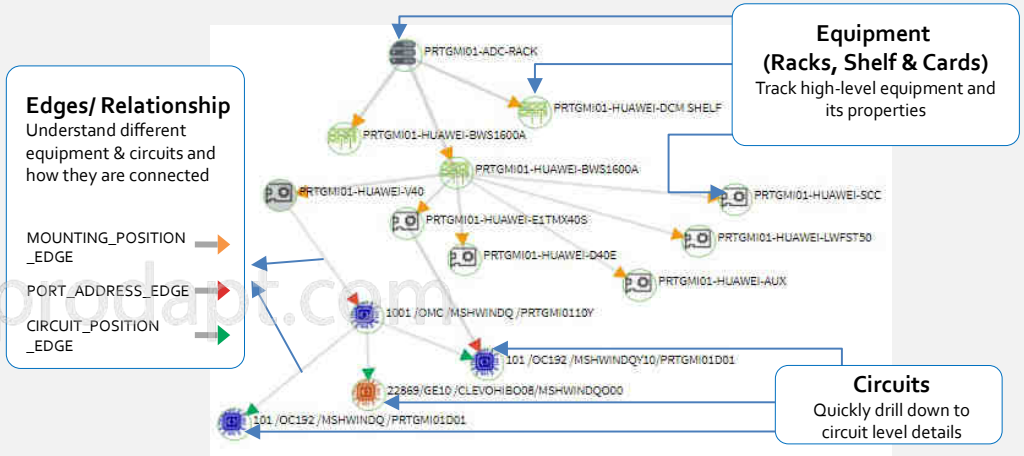


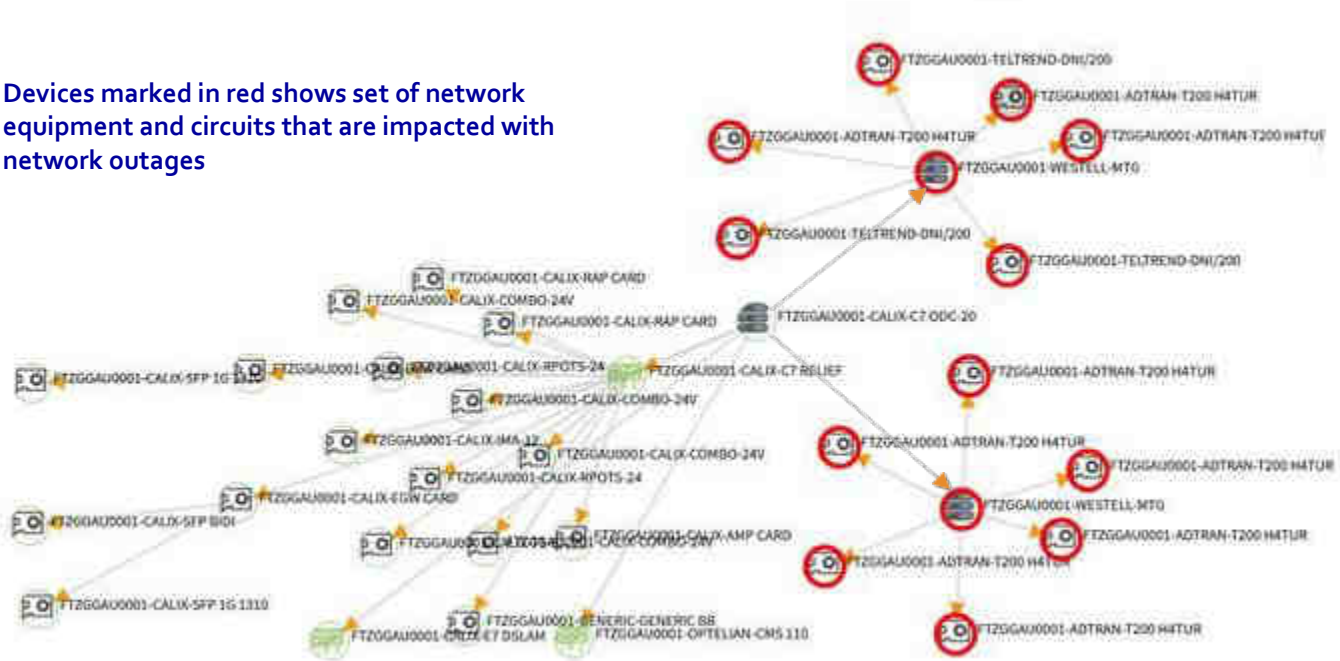
Fig: Sample force directed view of network equipment, circuits & their relationship

Network Design & Planning Team

- Gets **"single source of truth"** for the entire network
- **Easy traversal & fast retrieval** of relevant data
- **Effectively design alternate routes**. Quickly identify network weakness to uncover the need for additional redundancy

Sample image of force directed graph showing devices impacted by network outages

Devices marked in red shows set of network equipment and circuits that are impacted with network outages



Use hierarchical graph visualization to get holistic view of all devices at a specific location

Supports NOC engineers with faster network troubleshooting & impact assessment

Quickly traverse to get the hierarchical details of all devices at a specific location.

There is possibility that another 12 devices can be plugged in this switch

Quickly visualize which network element is down and what is the outage impact on other connected devices

Understand how many child circuits are mapped under the parent circuit. Drill down a specific circuit to see the information.

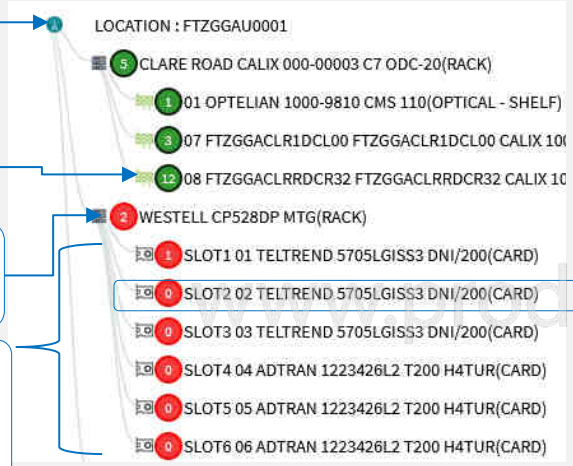


Fig: Sample hierarchical-view of network assets
Devices marked in red indicates elements impacted with network outages

NOC engineers

- Quickly model outages using faster network-topology queries
- Identify capacity of individual network element and occupied/available ports
- Easily identify what devices are plugged in which ports
- Faster impact assessment of any network outages

Impact assessment - Understand which elements will be impacted if a specific circuit goes down

Same circuit can be attached to other equipment at a different location

A circuit can have multiple parent and child at either same or different location

Thus, creating a view to analyse all the other connected equipment are of great significance.

Other Equipment Assignment

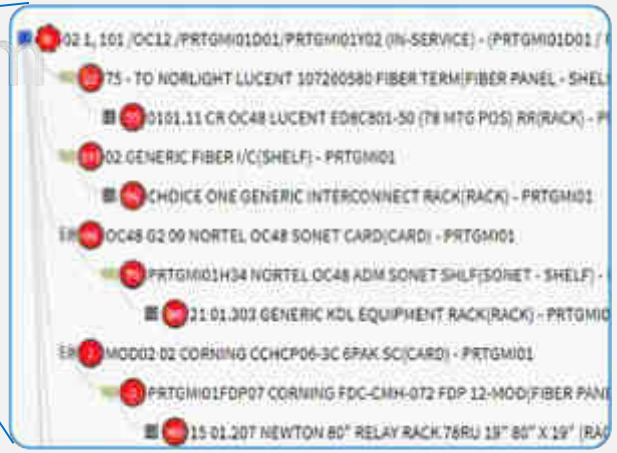


Fig: Sample image of all the other equipments assigned to particular circuit

Use geographical view of network systems to map physical location of devices

NOC engineers and network design teams can leverage this to fast-track and simplify key operational processes.
(Network elements marked in red have the network outage impact)

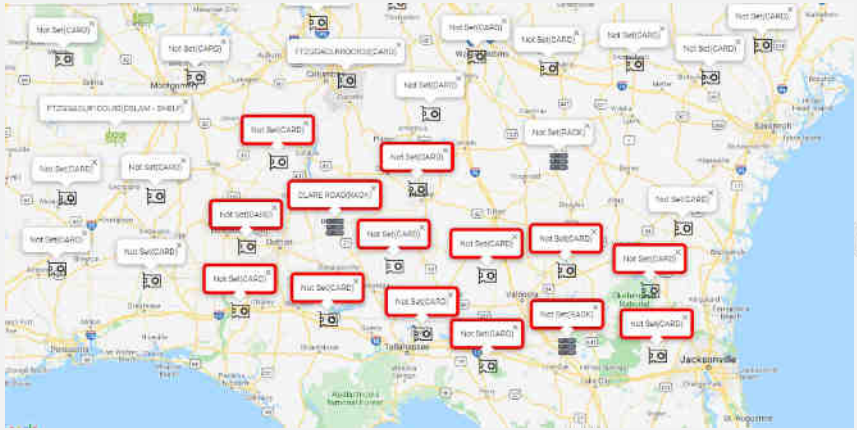


Fig: Sample geographical view of network assets
Devices marked in red shows geographical location of network equipment and circuits that are impacted with network outages

Network Design & Planning Team

- Efficient capacity planning by identifying which areas have capacity crunch with real-time visualization of existing network utilization
- Handle disaster recovery situations with real-time GIS (geographic information system) data

NOC Team

- Trace shortest/optimized route for truck rolls in circuit break areas
- Intimate to nearest service engineer on the field for quicker turn around
- Simplify alarm handling by operators - filter/group/eliminate redundant alarms via event correlation.

Leverage tools such as ArcGIS, OpenStreetMap or Google Map to support geographical visualization by integrating it with the visualization framework.

Group and correlate data from multiple devices to generate customize reports

Helps business intelligence teams to correlate disparate data and reduce report generation time by up to 67%

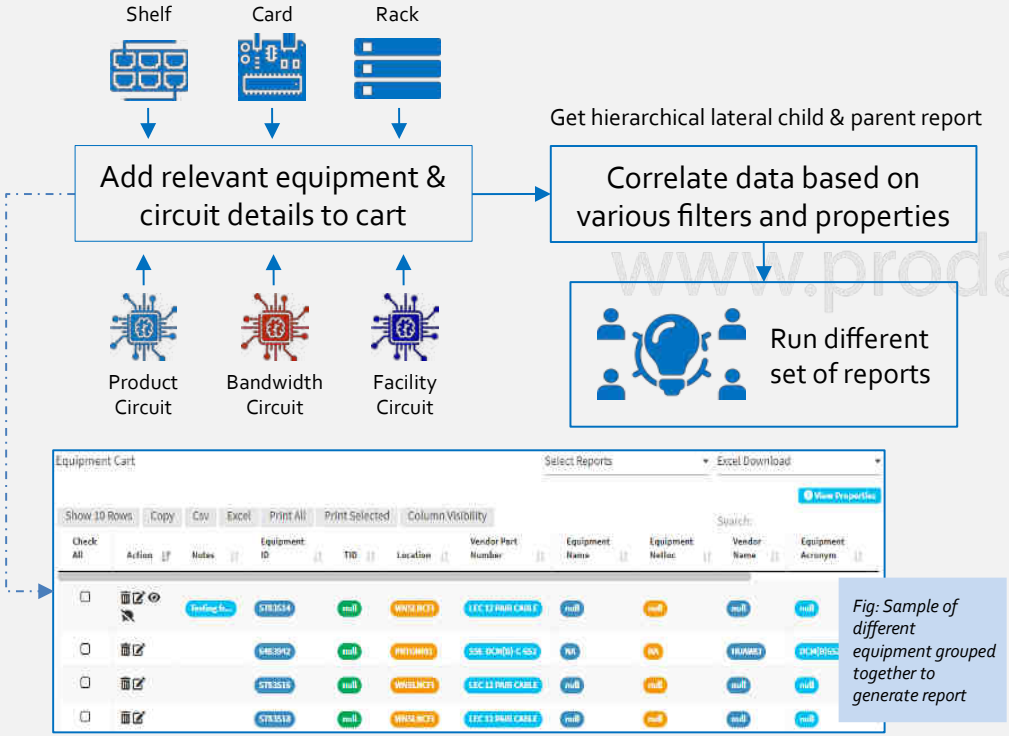


Fig: Sample of different equipment grouped together to generate report

Design and Planning Team

List current utilization level for certain set of devices and plan capacity expansions accordingly

NOC Team

- Group all stale/disconnected/failed devices for troubleshooting
- Find free ports in a group of devices

Business Users

- Revenue loss/impact assessment for certain set of device failures. Drill down to per equipment ROI
- Analyze existing trends to plan out future network investment/expansion strategy

Business & operational benefits achieved by a leading digital service provider (DSP) in North America

The DSP has legacy systems to do reporting & analytics for their network data. The data is distributed across multiple disjointed and siloed systems. As a result, DSP has very limited visualization of its network equipment and circuits.

Implementing **360° network visualization approach** discussed in this insight, resulted in the following benefits.

Key Benefits

Fast-track troubleshooting, reducing the report generation time by **67%**

NOC engineers could quickly model unplanned outages using faster network-topology queries. Also, they could quickly identify network weakness to uncover need for additional redundancy & effectively design alternate routes.

Understand the **revenue generation from individual equipment**

Business users could effectively correlate data from network inventory, vendor invoice & customers associated billing to quickly drill down to per equipment ROI

New network design rollout time **reduced by up to 33%**

Network planning team could easily locate exact location (lat/long) of existing devices and correlate information to expand network in new areas.

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Synopsis

Building 360° real-time network visualization

Frameworks leveraging graph technologies to drive smart decision making

- Rapid network expansion, among other factors, has caused **data silos** in digital service providers (DSPs), which affects **time-to-insights** for their data assets. These scattered set of data needs to be integrated from various set of disjointed systems, which comprise of untraceable integrations and interfaces. As a result, this impacts DSPs key operational processes leading to issues such as **inefficient network and resource utilization, delay in new network design rollout and ineffective network troubleshooting**.

- DSPs need to build **real-time 360° Network Visualization to drive smart decision making**. For this most DSPs have started implementing **Graph databases** to address the problem of data silos & information asymmetry in Network management. However, focusing only on the Data storage can be a futile attempt unless DSPs don't **create an effective upstream Data Ingestion and downstream Data Visualization strategy**. This Insight deep dives on these two key elements and brings out key capabilities required to effectively build them. Implementing 360° real-time network visualization approach discussed in this insight can enable an **intelligent and convergent view** of the network. It helps in meeting the growing demands of Network Planning, Network Operations (NOC) and various business user communities in a DSP.