SUBEX

ENERGIZE SMART GROWTH WITH NETWORK INTELLIGENCE

White Paper

Energize Smart Growth with Network Intelligence

Introduction

Consider the daunting challenge faced by today's Communications Service Providers (CSPs)—traffic volumes are growing exponentially, fueled by content-rich applications and services, while CapEx budgets are being squeezed to preserve margins. The traditional capacity management approach of plotting time-to-exhaust and applying generous headroom as a contingency no longer makes economic sense. Deploying new capital and allocating new resources requires a more nimble, just-in-time, just-where-needed approach.

Capacity Management is not a new discipline. Most Operators enlist planners, engineers and other skilled professionals to collect network data, collate it, and draw trend lines. Data collection is typically ad-hoc and time-consuming to produce. A patchwork of Element Management Systems, direct element access and perhaps some performance management tools are commonly employed. These are then dumped into a database (or perhaps simply a collection of spreadsheets) and analyzed. Sound familiar? In the past, this approach was adequate to the task… but that was before Netflix; before IPTV; and before the mobile data

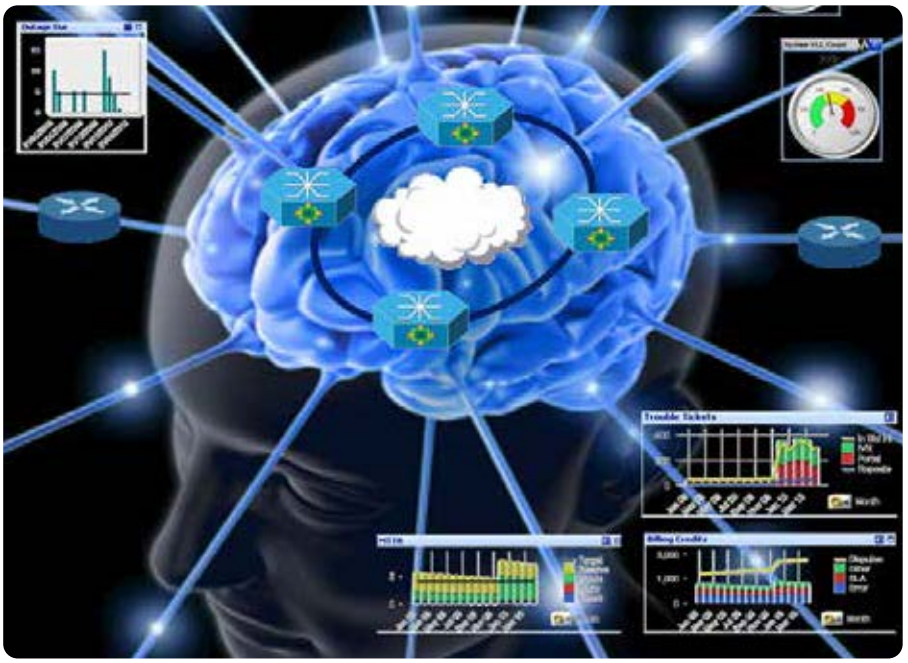
From Business Intelligence to Network Intelligence

Business intelligence gives savvy operators historical, current and predictive views of business operations and aims to support better decision making. Consider large retailers who cannot survive in today's hyper-competitive marketplace without business intelligence on consumer behavior, supplier/partner interactions and store-by-store inventory levels and depletion rates. Many things can be said regarding what comprises effective business intelligence but we'll highlight a few:

- Information is timely
- Information is comprehensive
- Information is filtered and normalized to extract meaning
- Information is actionable

Now, let's switch focus from retailers to CSPs. Network Intelligence extends the above aspects to include deep insights on network configuration and performance. Network Intelligence is at the core of the Subex Capacity Management Solution

Energize Smart Growth with Network Intelligence



Intelligence that is …	Powered by …
Timely	Network Discovery
Comprehensive	Data Enrichment
Meaningful	Analytics & Visualization
Actionable	Workflow & Case Mgmt

Capacity Management

Capacity Management is generally defined as the process of determining the (network) resources required to prevent a performance or availability impact on business critical applications or customer experience. In today's Inventory-centric OSS environment, Communications Service Providers (CSPs) tend to apply an "Inventory-planning" approach to capacity management where resource consumption is predicted based on subscriber count and allocated circuits/paths. Although this approach may have worked well in the past with predictable consumer/traffic patterns, today's social media and event-driven data consumption patterns are creating an unpredictable network traffic environment. CSPs can no longer effectively predict, through traditional processes, where and how much CapEx spending is needed to stay ahead of the growing/changing nature of capacity consumption in their network, or, the true impact of congestion to their business applications.

This whitepaper outlines a solution approach to Capacity Management that intelligently binds the dynamic nature of the network with the potential impacts to business applications; allowing CSPs to quickly identify and prioritize potential network hot-spots for CapEx spend or network asset redistribution to eliminate potential congestion and impact to customer experience.

From Business Intelligence to Network Intelligence

Capacity is often equated with managing bandwidth across the network, where the more available bandwidth is consumed the greater the potential for congestion. CSPs often introduce complex and sophisticated probes in the network to monitor traffic and bandwidth. Although bandwidth is a key characteristic, there are other elements that can significantly affect network capacity and lead to congestion. First, every device in the network has a different threshold for resource usage. For example, an Ethernet switch may perform optimally until it reaches a maximum level of Virtual Leased Lines (VLLs), or an IP router may perform optimally until it reaches a maximum number of allocated routes (e.g., VRFs). Beyond those maximums, device performance begins to degrade and/or traffic is impacted (resulting in dropped packets, jitter, excessive queuing, etc.). And, each device may have dozens of physical and logical elements that can be affected by resource consumption which can adversely impact capacity and customer experience. As a result, the capacity management solution must collect and track a wide range of physical and logical resources to be effective. Figure 1 illustrates some of these resources.

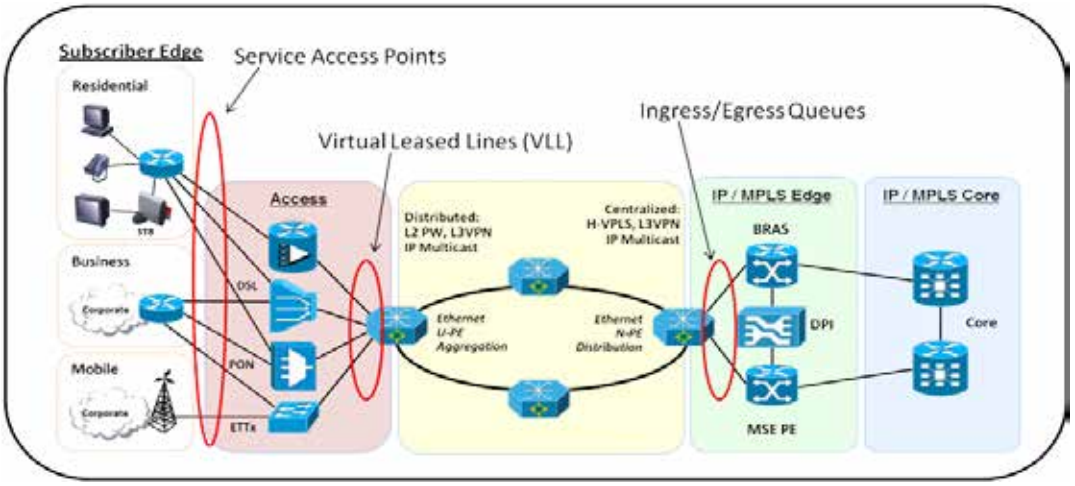


Figure 1: Capacity Related Attributes

A few observations with regard to Figure 1:

- A single device can have multiple threshold crossings, e.g. SAP, Queues and VLL; LAG group, PeerGroups.
- Some Threshold crossings are more critical than others, e.g. exhausting VLL may impact more than SAPs
- An initial goal is to identify what devices have triggered a crossing based on resource criticality
- Ultimately, it is the correlation of resource consumption end-to-end across services that is critical for understanding customer affecting congestion – this is often missing in today's traditional capacity management strategies;

Capacity Management Solution

A Capacity Management solution must cover key areas of data collection, transformation, analysis and presentation in order to be effective. The following outlines the essential components CSPs need for a successful capacity management solution.

[1]Network resources that are trending close to congestion levels that will impact customer experience

Data Normalization

Typically, a CSP network is composed of many different vendor/equipment platforms where each platform has different physical and logical elements that affect capacity, measured in different units and presented in different formats, often requiring specialized network engineers to understand the effects of these elements on capacity. As a consequence, evaluating the potential for network congestion typically requires gathering dedicated network engineers to translate platform-specific results into a common view the CSP can use for CapEx decisions. This approach is time-consuming, error-prone and lacks the ability to evaluate and respond in "real-time" in the event of potential congestion.

A capacity management solution must support the ability to normalize on-demand the collected capacity related elements into a consistent and error-free view for capacity analysis.

Data Projection Based On Consumer Trend

While data trending is about understanding what capacity has been consumed (i.e., past results), data projection is about understanding the future behavior of capacity. Many capacity management approaches today focus on understanding the trend that led to a congestion event. A true capacity management solution for today's CSP must also focus on the ability to project when congestion may occur to enable the CSP to stay ahead of congestion events. Projection requires understanding the behavior of the network as consumption grows or capacity is added to the network. It also requires having the intelligence to avoid overreacting to "one-off" capacity spikes that may mislead the projection. Figure 2 illustrates the concept of projection based on example Virtual Leased Line resources consumed in the network. As service deployment accelerates, the VLL counts grow exponentially. However, due to fulfillment errors or data corruption, there may be spikes in counts that are exceptions and should be smoothed-over or minimized so as not to mislead the projected trend.

A capacity management solution must support data projection based on customer trends while intelligently filtering-out/minimizing exceptions from the prevailing trend.

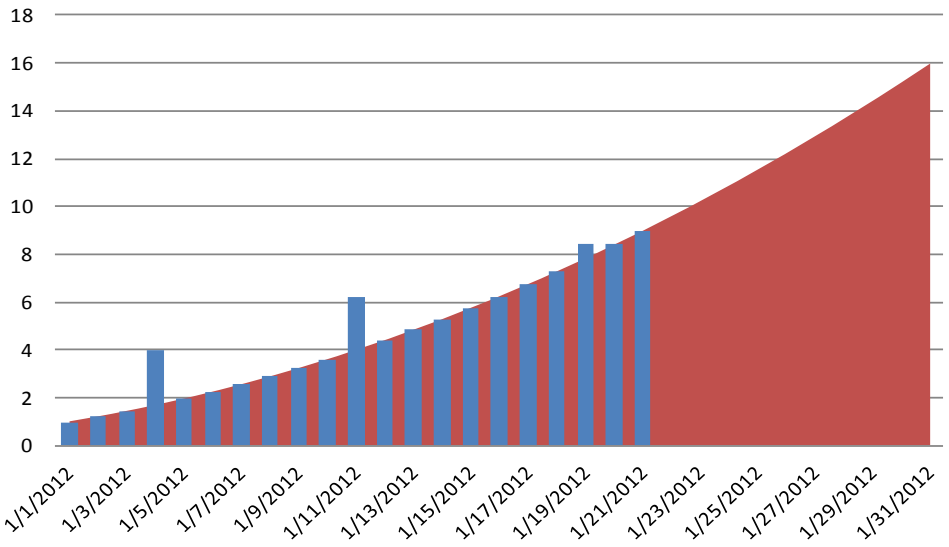


Figure 2: Capacity Trend line

Time To Capacity Exhaustion

To be successful, a CSP must stay ahead of potential congestion events that impact customer experience. To stay ahead a CSP needs to know how much time it has before key resources are exhausted in the network, i.e. the "Time to Exhaustion". Time to exhaustion refers to the time between current resource consumption and the maximum allowed capacity consumption as illustrated in Figure 3. With the dynamic nature of the network, the time to exhaustion can change, this is why it is important to have real-time calculations of customer trends and projected resource consumption. Furthermore, since it takes time (around 3 months) to test, validate and deploy new resources/capacity in the network, the solution must also report if the projected trend line and time-to-exhaustion shows that the CSP may be running out of time to introduce new capacity before customers will be affected by congestion. A classic example of this time-to-exhaust seen today is where CSPs engage in complex and expensive network

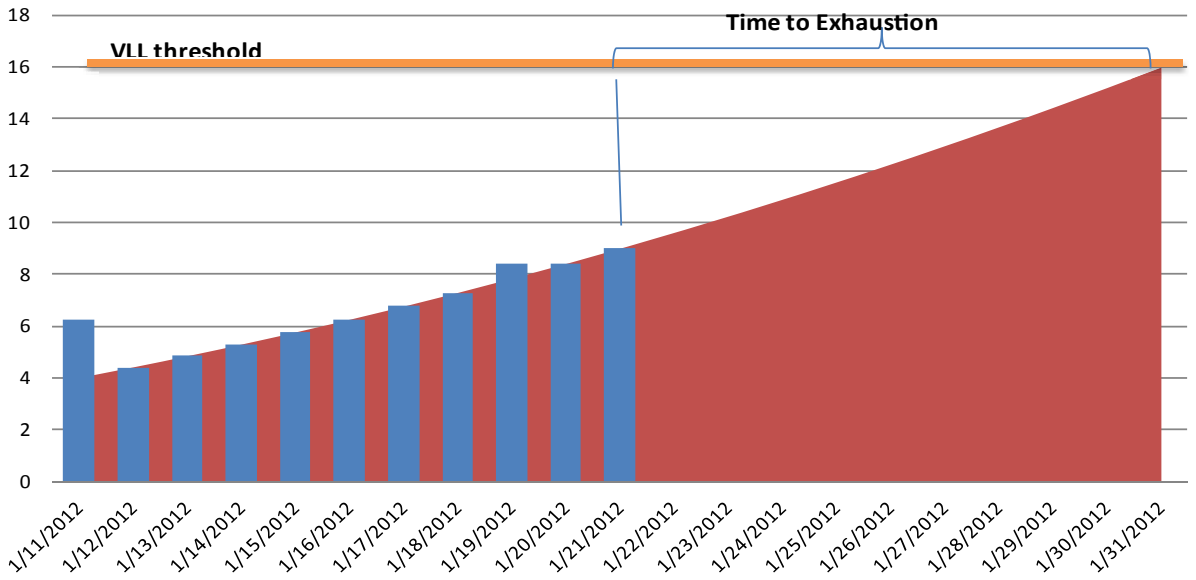


Figure 3: Time to Exhaustion

upgrades and run out of capacity in the network before completing the upgrade. The failures occur because traditional capacity management paradigms lack a real-time intelligent analytics feedback loop. This feedback loop is necessary to adjust the capacity rollout plan based on the dynamic change in resource consumption that allows the CSP to stay ahead of congestion issues.

The solution must be intelligent enough to identify changes in rates of consumptions as illustrated in Figure 4. In this example the rate of resource (e.g., VLL) consumption was at a constant rate for the first 10 days of data collection and then quickly accelerated from that point on. If an operator or tool would not pick-up the change in rate, the time to exhaustion would have shown a much longer time until impact than the reality of the network. Instead, the Subex solution employs intelligent algorithms that monitor the constant change in rate of consumption and constantly adapt the time to exhaustion report to reflect the current reality and ensure that alerts and corrective actions are adjusted to the new reality.

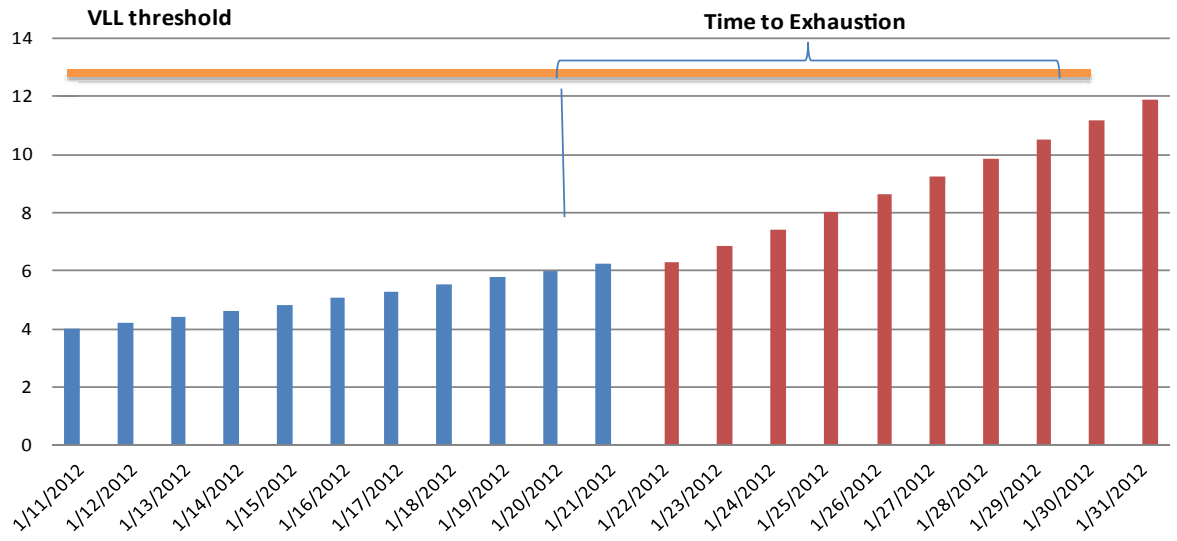


Figure 4: Time to Exhaustion

Time To Capacity Exhaustion

Although collecting, analyzing and acting upon individual resource capacity congestion is an essential first step, the value-add for CSPs is in the ability to go beyond node based view and correlate the capacity characteristics of all resource attributes supporting an end-to-end service and reporting on the overall congestion characteristics of the service. The Subex ROC Capacity Management solution enlists a leading edge Topology Server for both physical and logical topology discovery and then correlates the resource capacity attributes of both physical network connectivity and logical service topology to report on capacity hot-spots affecting revenue generating services. For example, a CSP may have a committed service rate to an enterprise customer, but traffic usage shows that the customer only really uses 50% of committed capacity. Based on this information, the CSP can approach the customer with different service offering that are more advantageous for both customer and service provider. On the other hand, a CSP may have a committed service rate to an enterprise customer and although the individual resource attributes of each device supporting the service is not approaching a congestion point, the "aggregate" effect of the resources end-to-end supporting the service may have a lower capacity threshold and may put the enterprise customer in jeopardy of congestion. This latter case is the most difficult for CSPs to identify as it requires modeling the behavior of the network and service end-to-end in order to predict the response to customer services. The Subex solution includes the capability to model the network resources in response to capacity behavior so as to build an end-to-end service capacity profile.

What If Scenarios

Once the CSP has a view of time to exhaustion, the ultimate step to capacity management is the ability to run "what-if" scenarios for either increased capacity consumption and/or adding capacity to the network. For example, the CSP may desire to see where hot-spots (potential congestion) can appear in the network as new services are offered to subscribers – This would be the case of increased capacity consumption. Another scenario entails observing how hot-spots are corrected as additional capacity (logical or physical) is added to the network – Here the operator can evaluate what is the optimal CapEx equipment and spend factor that will provide the highest capacity return and

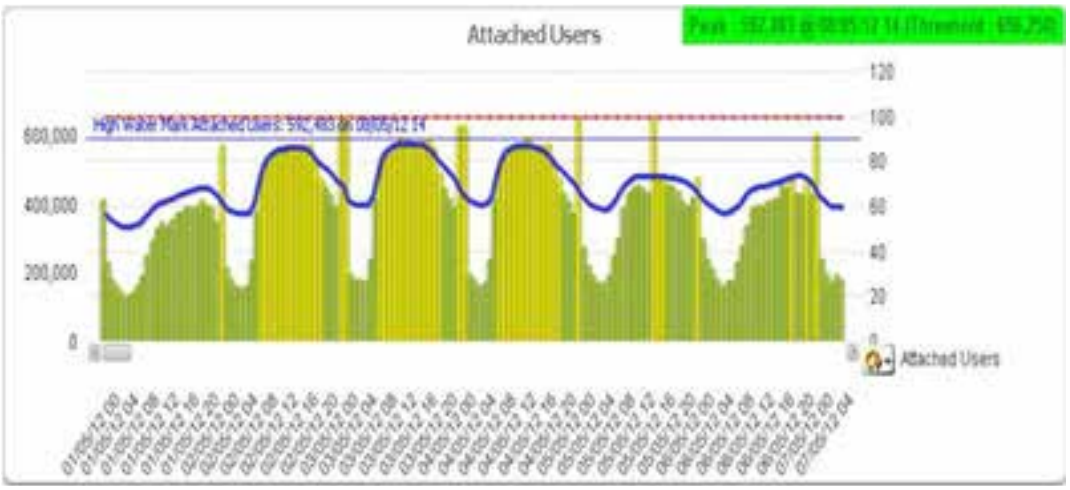
revenue for the investment. The Subex ROC Capacity Management solution and sophisticated "what-if" scenario approach based on network modeling can help the CSP's Marketing team successfully plan and launch new services by providing the CSP with a clear view of the network's ability to support the new services and the targeted CapEx spend required to support these new services. Based on an accurate view of CapEx spend the CSP can better assess the true ROI for new service deployment based on the known impacts into the network.

Through Subex's accurate data normalization, intelligent capacity consumption projection, real-time analytics and time-to-exhaust with advanced "what-if" scenarios capabilities, the CSP can remove the guess-work in capacity management and eliminate the expensive "incomplete capacity upgrades" that cost CSPs enormous time, money and customer impact.

Subex solution enables the CSPs to not only monitor discrete physical and logical resources but it also enables to define various KPIs. These KPIs can be visualized as function of one or more discrete physical and/or logical resources. Moreover, Subex' solution allows the correlation of different KPIs both visually using sophisticated dashboards and also mathematically where the CSPs can find the correlation factors between different KPIs. For example:

a) In 3G, any CSP might be certainly interested to find the impact of the number of connected user sessions, at any time, on CPUs of different NEs. In Figure 5, a visual correlation between Attached Users and CPU KPI has been shown. The histogram represents the reading of CPU KPI and the continuous deep blue curve on top of the histogram represents the data reading for attached users at the same time scale (or can be lower) as CPU. The X-axis of the graph represents the time stamp when both KPIs data has been collected; the left hand Y-axis represents the unit for Attached Users KPI in thousands and the right hand Y-axis represents the unit for CPU KPI in percent. The horizontal red line represents the peak value for CPU and the horizontal blue line represents the peak value for attached user. Similarly, Figure 6 illustrates, a mathematical correlation being calculated between Peak Attached User and Average CPU Load KPI. The algorithm is being executed in two different data sets to establish, how Subex' solution intelligently distinguishes different levels of correlations based on available data.

b) In fixed line, a CSP might be interested to find the effect of introducing a new DSLAM, on the NNI Link Aggregation Group, configured on the edge device of the aggregation network.



Input KPI	Output KPI	Correlation Coefficient	Correlation
Peak attached users (2G + 3G)	Average CPU Load	0.812	Strong

Input KPI	Output KPI	Correlation Coefficient	Correlation
Total PDP Context (2G + 3G)	Average CPU Load	0.737	Moderate

Figure 6: Mathematical Correlation of Attached User and Avg. CPU KPI

Workflow & Case Management

Subex' solution not only identifies and reports on potential hot-spots in the network, it also enables the CSP to enforce a process to resolve identified issues through a fully integrated workflow and case management module. Upon generation of a capacity alarm, each such alarm automatically creates a specific case and assigns them, based on the type of alarm, by case management. Alternatively, case management can also be configured to group similar alarms and create cases for individual groups. Each case can have its own workflow configured that might take different paths for resolution. A complete view of Subex' ROC Capacity Management solution architecture is depicted in Figure 7.

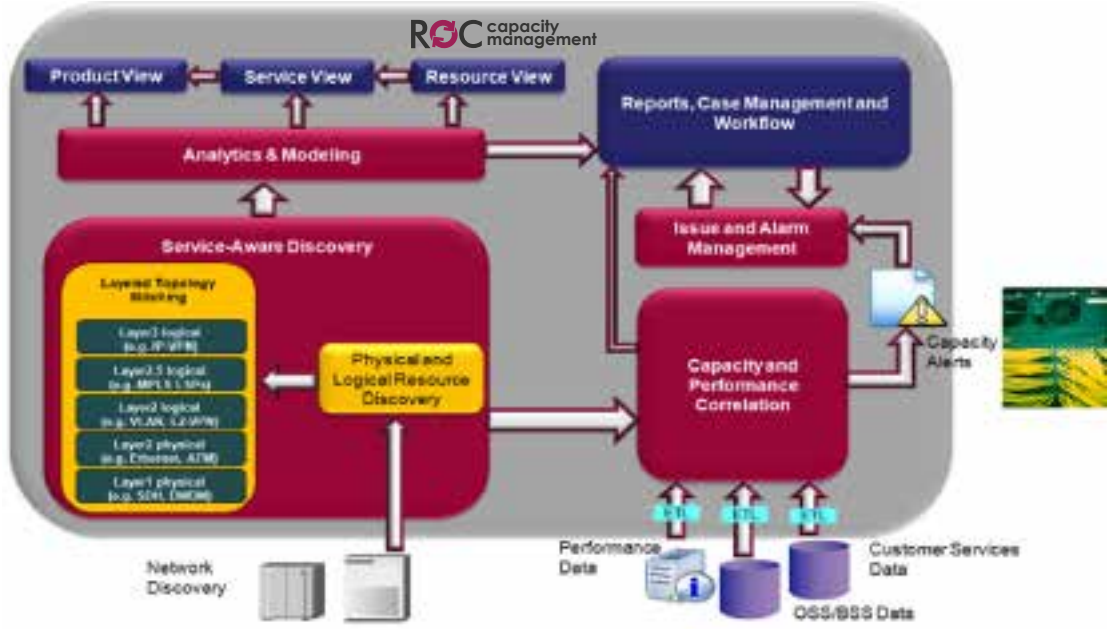


Figure 7: ROC Capacity Management Framework

SUBEX

www.subex.com

About Subex

Subex Ltd. is a leading telecom analytics solutions provider, enabling a digital future for global telcos. Founded in 1992, Subex has spent over 25 years in enabling 3/4th of the largest 50 CSPs globally achieve competitive advantage. By leveraging data which is gathered across networks, customers, and systems coupled with its domain knowledge and the capabilities of its core solutions, Subex helps CSPs to drive new business models, enhance customer experience and optimise enterprises.

Subex leverages its award-winning analytics solutions in areas such as Revenue Assurance, Fraud Management, Asset Assurance and Partner Management, and complements them through its newer solutions such as IoT Security. Subex also offers scalable Managed Services and Business Consulting services.

Subex has more than 300 installations across 90+ countries.

Subex Limited

RMZ Ecoworld,
Devarabisanahalli,
Outer Ring Road,
Bangalore - 560103 India

Tel: +91 80 6659 8700
Fax: +91 80 6696 3333

Subex, Inc

12303 Airport Way,
Bldg. 1, Ste. 390,
Broomfield, CO 80021

Tel : +1 303 301 6200
Fax : +1 303 301 6201

Subex (UK) Ltd

1st Floor, Rama
17 St Ann's Road,
Harrow, Middlesex,
HA1 1JU

Tel: +44 0207 8265300
Fax: +44 0207 8265352

Subex (Asia Pacific) Pte. Limited

175A, Bencoolen Street,
#08-03 Burlington Square,
Singapore 189650

Tel: +65 6338 1218
Fax: +65 6338 1216

For more information write to info@subex.com

Regional offices: Dubai | Ipswich