The Mandate to Better Integrate Network Planning and Network Operations

By Jim Metzler, Cofounder, Webtorials Editorial/Analyst Division

Introduction

It would be difficult to overstate the importance of network uptime and performance to the vast majority of organizations. On an ever-increasing basis, organizations run their key business processes over their network. As a result, if the network is not available or if it is not performing well, the organization's key business processes are severely impacted.

To ensure high availability, most IT organizations design their network with the goal of minimizing single points of failure on the end-to-end network paths. To accomplish this goal, IT organizations typically deploy redundant configurations of highly resilient network devices complimented by the use of fast fail-over protocols. Minimizing single points of failure clearly increases network availability. However, there is a larger issue that impacts network availability that many IT organizations avoid dealing with. A recently published white paper highlighted that issue when it pointed out a well-known fact. That fact is that between fifty and eighty percent of network outages are caused by human error[1]. That document also explained one of the reasons why user error has such an impact on network availability when it stated that, "System complexity with multiple components and many types of interactions creates an environment where the relationship between actions and outcomes is not always obvious."

In order to truly have a highly available network, IT organizations need to take steps to reduce the human errors that occur when IT organizations make any kind of change to their network. One of the factors that make reducing the errors associated with change management so difficult is that historically there has been a significant gap between the IT professionals who are responsible for planning the network and the IT professionals who are responsible for the ongoing operations of the network. This gap has been perpetuated in part because the computational challenges associated with taking data from a "million points of light" in a network (devices, interfaces, endpoints, etc.) and calculating the effects of one or more changes on the performance of the overall network. Since these computational challenges are so daunting, the traditional solutions to this problem are large, complex, and static and also require volumes of information that typically are not easily available.

The goal of this brief is to present evidence that the gap between network planning and network operations is closing. As will be shown in this brief, one of the primary factors that is driving the closure is the deployment of tools such as route analytics that are being used by both the network planning and the network operations organizations.

In preparing this brief, three IT professionals were interviewed. Only one of the interviewees can be referenced by name and company. That interviewee is Vikas Khanna, Director of Engineering for Covad Wireless. The other two interviewees were the VP of network planning for a service provider and the global manager of network design for a financial services organization. They will be referred to in this brief as The Network Planning VP and The Network Design Manager.

[1] What's Behind Network Downtime?, http://www.juniper.com

The Gap between Network Planning and Network Operations

In most small and medium sized organizations there is not a significant gap between network planning and network operations. That follows because given the size of these organizations and the relative simplicity of their networks, the associated IT functions tend to be small and as a result there typically is not a high degree of segmentation between planning and operations.

However, in those organizations that run a large, meshed network there often is a significant gap between network planning and network operations. One of the reasons for this gap is that due to the complex nature of the network there tends to be a high degree of specialization amongst the members of the IT function. Put simply, the members of the organization who do planning understand planning, but typically do not understand operations. Conversely, the members of the organization who do operations understand operations, but typically do not understand planning.

Another reason for this gap is that historically it has been very difficult to integrate planning into the ongoing change management processes. For example, many IT organizations use a change management solution to validate changes before they are implemented. These solutions are valuable because they identify syntax errors that could lead to an outage. However, these solutions cannot identify how the intended changes would impact the overall performance of the network.

As mentioned, there is some evidence that the traditional gap between planning and operations is closing. For example, Khanna commented that within Covad Wireless there used to be a gap between network planning and network operations. However, they recently implemented an initiative to bridge this gap. As part of this initiative, members of each function continue to focus on specific areas that are unique to each function. In addition, Covad Wireless instituted processes to better manage the areas of overlap between the two functions. The Network Planning VP added that within his company they are striving to close the gap between planning and operations in part by implementing some new processes and in part by involving the operations group in some traditional planning functions, such as the ongoing evolution of the network design and architecture.

Involving the operations group in planning functions is not just a service provider phenomenon. Recent market research[2] indicates that within the majority of enterprise IT organizations the operations group is involved in what has traditionally been planning functions. In particular, that research showed that in the majority of IT organizations, the operations group is involved in:

- Network design
- Selection of new technologies; i.e., MPLS
- Selection of network service providers

The Network Design Manager commented that the planning and operations functions within his company hold weekly meetings. He added that at these meetings quite a bit of discussion goes on relative to the problems that have to be solved and the steps that will be taken to solve them. The Network Design Manager also pointed out that it is not always easy to separate planning from operations. The example he gave is that in his organization the operations group is responsible for capacity planning for their network.

The fact that network planning and network operations are working together on tasks such as network design is encouraging because that cooperation is likely to result in networks that are more highly available. However, as was pointed out, system complexity with multiple components and many types of interactions creates an environment where the relationship between actions and outcomes is not always obvious. As such, in order to design high availability networks and ensure that changes made to those networks do not negatively impact availability or performance, IT organizations need tools that can accurately predict the impact of change.

[2] The 2008 Application Delivery Handbook, Dr. Jim Metzler, http://www.webtorials.com/abstracts/Kubernan2008handbook.htm

Predicting the Impact of Change

In order to be able to predict how a planned change will impact the performance of the network, some large IT organizations incur the cost of pre-testing a change in a lab environment prior to implementation. However, it is not possible to accurately represent a complex network in a lab. As a result, lab testing can provide some insight into how a planned change will impact network performance. It has, however, the potential to miss some of the most significant components of how the performance will change.

To overcome the limitations of lab testing, some IT organizations have deployed tools that model the performance of the network. Unfortunately, as noted in the introduction, in many cases these tools are very expensive, not only in terms of the cost of the software itself, but in terms of the personnel, training, and time needed to manually update the tools. Most IT organizations simply can't afford the software or the personnel to run these tools. The Network Design Manager agreed with this assessment and commented that most design tools are unnecessarily complex and that "in the end they do not precisely mirror real world implementation." He added that by the time you get any value from these tools, it is six months after you should have delivered the system.

A more viable alternative is route analytics. Route analytics is a technology that was designed to eliminate the problems associated with running IP over a meshed network. In particular, the goal of route analytics is to provide visibility, analysis and diagnosis of the issues that occur at the routing layer. While route analytics has typically been regarded as a niche technology, a Kubernan Brief[3] published in 2007 showed that there is strong evidence that route analytics is poised to cross the chasm and become a mainstream technology for IT organizations that have complex meshed networks that support business critical applications.

More recent market research[4] confirmed the interest in route analytics. As part of that research, two hundred IT professionals were given the following question: "Sometimes logical problems such as routing issues are the source of application degradation and application outages. Which of the following describes how you resolve those types of logical issues?" Their answers are shown in Table 1.

Approach	Percentage of Respondents
Lots of hard work – typically by digging deeply into each device	38.7%
Employee specific tools such as route analytics	24.9%
N/A or don't know	19.9%
Waiting for it to happen again and trying to capture it in real time	13.3%
Other	3.3%

Table 1: Resolving Logical Issues

It is certainly possible to look at the data in Table 1 and be discouraged. In particular, the data shows that half of the time that logical problems such as a routing issue cause either an application outage or application degradation that it is dealt with by either lots of manual effort or waiting for it to happen again. However, since this is the traditional approach to resolving logical issues, the fact that only half of IT organizations take that approach is actually encouraging. What is even more encouraging is the fact that a quarter of IT organizations use a tool such as route analytics to quickly identify the source of logical problems.

[3] Route Analytics – Poised to Cross the Chasm, Jim Metzler, http://webtorials.com/abstracts/KubernanBrief-1-3.htm

[4] The 2008 Application Delivery Handbook, Dr. Jim Metzler, http://www.webtorials.com/abstracts/Kubernan2008handbook.htm

Another one of the reasons why route analytics is gaining in popularity is that, as previously noted, without a tool such as route analytics it is difficult for IT organizations to know in advance the impact of making a change to a complex, meshed network. The Network Planning VP commented that their use of route analytics allows them to see in advance changes to their routing tables that are caused by a mis-configured router. Khanna stated, "We use our route-analytics tool on a regular basis for everything from doing a 'routine checkup' for the NOC group to our network planning folks using the tool to make recommendations as to 'what we have to do next'. The great thing about the tool we use is that not only does it give you the data you need to make the right routing decisions; it represents things visually thereby clearly illustrating the change. For us, the ability to model this 'real time' information is invaluable."

The Network Design Manager stated that the value of route analytics is that "In the event that the infrastructure had issues, that they were not scratching their head as to why something did not work in the past." He pointed out that his organization used route analytics extensively when they were designing and building out their MPLS (Multi-Protocol Label Switching) network. He added that a recent earthquake in Asia disrupted their network. By using route analytics his organization was able to understand when things failed, how they failed, how the service degraded and whether or not the network performed as they intended it to.

Integrating Planning and Operations: A Call to Action

All three of the interviewees agreed on the importance of having tools that enable better integration of the network planning and network operations functions. For example, Khanna stated that it is important to have tools that can support both operations and planning because it lowers cost and means that both groups are more likely "to be on the same page". He added that, "The underlying goal is to have a common set of tools that allows multiple groups to get the information they need to make an educated decision." The Network Design Manager agreed and said that "We are striving for consolidation because we want to have a lot fewer tools."

How Route Analytics Bridges the Gap between Planning and Operations

Route analytics can be used by network planning and operations to:

- Make sure that nothing bad will happen when a router is upgraded.
- Demonstrate how to tune routing metrics to spread traffic away from congested links to underutilized links.
- Ensure that the network will behave as desired in a disaster recovery scenario.
- Make sure that design assumptions still hold true when changing, adding to, or upgrading the network in some fashion.
- Ensure that service levels will be maintained after an initiative such as consolidating data centers.

Route analytics is effective as a planning tool because it:

- Records an always-updated model of the network based on real-time routing and traffic changes.
- Is operationally accurate enough to be able to move back in time and perform simulated network changes using a peak traffic period or other important phenomena as a baseline
- Incurs low network overhead.
- Is completely accurate in the way that it displays both current, historical behavior and modeled network behavior
- Enables IT organizations to easily and accurately simulate changing one piece of the network's routing or traffic, and calculate the effect on the rest of the network in a holistic fashion.

The Network Planning VP commented that because their operations and planning groups both use a route analytics tool it reduces the mean time to repair a problem. He added that having common tools reduces cost and that in general "The fewer tools the better." Khanna agreed on the value of route analytics and said that, "Route analytics is a key instrument in our 'network tool chest' in the sense that whenever we have a network related issue we use route analytics to look at what has been happening to the routing tables and to get a view of performance down to a particular IP address."

In order to increase network availability and performance, IT organizations must integrate the appropriate components of network planning and network operations. That certainly includes involving the network operations function in tasks such as the design of the network. It also includes taking a more formal approach to implementing change, including the use of route analytics in change management processes to validate that proposed changes will have the intended effect not only on the device being changed, but on the whole network.

In terms of choosing a route analytics product, all three of the interviewees agreed that if they were in the market to acquire a route analytics product today, that they would look for a tool that had the following characteristics:

1. Records an always-updated model of the network based on real-time routing and traffic changes. The solution must be operationally accurate enough to be able to move back in time and see exactly what the state of the network was in a past moment when a problem was occurring.
2. Provides the ability to model a wide variety of routing and traffic changes, including adding, moving, and downing routers, links, and peerings; changing metrics, and adding or shifting traffic flows by class of service (CoS).
3. Incurs low overhead on the network as it intelligently uses routing protocols to understand the global network topology and efficiently utilizes Netflow/IPFIX data to overlay traffic flows onto that routed topology.
4. Is completely accurate in the way that it displays current and historical behavior, as well as the way that it portrays simulated future behavior.
5. Removes the burden of updating because the solution itself is self-updating.
6. Is easy enough to be used by all of IT for a wide variety of tasks including quantifying the impact of a change (i.e., upgrade a router, consolidate data centers) prior to actually making the change.

Khanna summarized the challenge facing IT organizations when he stated that, “Operations and planning need to focus on a unified direction. The only way I think that’s going to happen is when you get people on the same page. The right tools with the right information get people speaking the same language.”

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Packet Design, Inc. is the leader in route analytics and traffic analysis solutions, which are deployed by over 300 leading Service Providers, global enterprises, and government agencies. Route analytics provides the critical management link between application performance and the underlying network device infrastructure by providing visibility and analysis into the logical operation of IP networks.

Route Explorer is the industry’s leading route analytics solution, supporting network engineering and operations best practices in the world’s largest OSPF, IS-IS, BGP, and EIGRP networks.

VPN Explorer provides per-customer and network-wide MPLS VPN routing analysis to ensure the VPN reachability, privacy and routing policy integrity.

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Division Cofounders:
Jim Metzler
jim@webtorials.com
Steven Taylor
taylor@webtorials.com

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