The Logical Causes of Application Degradation

By Jim Metzler

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Introduction

As recently as a few years ago, application delivery was not even a discussion point within most IT organizations. Today application delivery is a top of mind issue for virtually all IT organizations. That point was demonstrated in a recent market research project in which Kubernan surveyed 200 IT professionals on a variety of topics, including application delivery. Sixty percent of the survey respondents indicated that application delivery was increasing in importance in their organization, and only one percent of the survey respondents indicated that it was losing importance.

As part of that market research project, a consulting architect who works for a large IT organization was interviewed. That architect stated that within the last couple of months managing application performance has become his CIO's number one priority. That CIO told the architect, "Managing application performance is the thing that I am getting the most flack on. We have to begin to work outside of the silos and get away from the application and networking organizations pointing fingers at each other."

The comments of that architect reflect the that fact that most IT organizations do a good job of device management. Put another way, most IT organizations do a good job of managing within well-defined technology silos. However, few IT organizations do a good job of managing technologies that are more complex, from either a technological or an organizational perspective, than are individual devices.

As will be discussed in this white paper, it is quite common to have an application degrade even though each device in the network is performing well. Throughout this white paper, the factors that cause an application to degrade even though each device in the network is performing well will be referred to as logical factors. Given that most IT organizations focus primarily on device management, they are ill equipped to either reduce the occurrence of application degradation caused by logical factors or to identify the cause of the degradation.

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This white paper will describe some of the primary characteristics of the current approach to application management. The white paper will also briefly describe a key technology, route analytics, that IT organizations can use to better manage some of the logical factors that impact application performance.

Application Management – The Current Environment

In the vast majority of cases if an application degrades the general perception is that the cause of the problem is the company's Wide Area Network. As a result, many network organizations have developed a somewhat defensive approach to application management. For example, the consulting architect mentioned in the preceding section commented that application performance issues are usually found first by the end user and not by the IT organization. He stated that once a problem has been identified that identifying the root cause of the problem bounces around within the IT organization and that "It's always assumed to be the network. Most of my job is defending the network."

When IT organizations defend the network they typically strive to demonstrate that each device and link in the network is available and is experiencing acceptable levels of utilization. However, as is discussed in a subsequent section, it is very common to have factors other than device or link specific factors negatively impact application performance.

The Routing Layer

The vast majority of IT organizations have deployed a network based on IP (Internet Protocol). One of the many strengths of IP is its distributed intelligence. For example, one of the primary functions performed by IP is to determine the path that traffic will take as it transits the network. IP performs this function by having routers exchange information with each other. Based on this information, each router makes its own decision about how to forward a packet. While IP's distributed intelligence is a strength, it is also a weakness. In particular, while each router makes its own forwarding decision, there is not a single repository of routing information in the network.

The lack of a single repository of routing information is an issue because routing tables are automatically updated and the path that traffic takes to go from point A to point B may change on a regular basis. These changes may be precipitated by a manual process such as adding a router to the network, by the mis-configuration of a router, or by an automated process such as automatically routing around a failure. In this latter case, the rate of change might be particularly difficult to diagnose if there is an intermittent problem causing a flurry of routing changes.

Increasing Network Complexity

Historically data networks have been built using some form of a hub-and-spoke design in large part because that design reflected the natural traffic flow. However, many factors are changing the traffic flow in data networks and hence causing IT organizations to move away from simple hub-and-spoke network designs. One of these factors is that branch offices often need access to multiple data centers, either for disaster recovery or for access to applications that are only hosted in one of the company's multiple data centers. Another factor is that the vast majority of companies have deployed VoIP and voice traffic does not tend to follow a hub-and-spoke pattern. Voice traffic tends to follow an any-to-any traffic pattern.

As companies move away from a hub-and-spoke network design and adopt either a some-to-many or an any-to-any topology they are increasing the complexity of their network. By the nature of networks that are large and which have complex network topologies, it is not uncommon for the underlying network infrastructure to change or to be mis-configured and hence to experi-

ence the routing instabilities described in the preceding section. In addition, the network itself is likely to be designed in a sub-optimum fashion due in large part to its size and complexity. Any or all of these factors can have a negative impact on application performance. As a result, an organization that has a large complex network needs visibility into the operational architecture and dynamic behavior of the network.

However, today few IT organizations that operate large, complex networks have even an up-to-date map that depicts the physical configuration of their network. Even fewer IT organizations have an automated mechanism that creates and stores information that accurately depicts how information flows through their network.

The Impact of Logical Factors

As part of the market research mentioned in the introduction, Kubernan asked the 200 survey respondents to indicate the percentage of time that one of their organization's applications is either unavailable or performing poorly, that the cause is a device specific factor vs. a logical factor such as sub-optimal routing or intermittent routing instability.

Over a quarter of the survey respondents (27.4%) indicated that they did not know the answer to the question. The fact that such a large percentage of the survey respondents did not know the answer to the question is further evidence that IT organizations do not have a good understanding of the logical factors that can impact application performance. Factoring out the survey respondents who answered *don't know*, over forty percent of the survey respondents indicated that logical factors are at least as likely as device specific factors to be the cause of an application either being unavailable or performing badly. Logical network factors can have a significant impact on delay-sensitive applications, especially due to increased latency from changing traffic patterns or unstable traffic paths

Delay Sensitive Applications

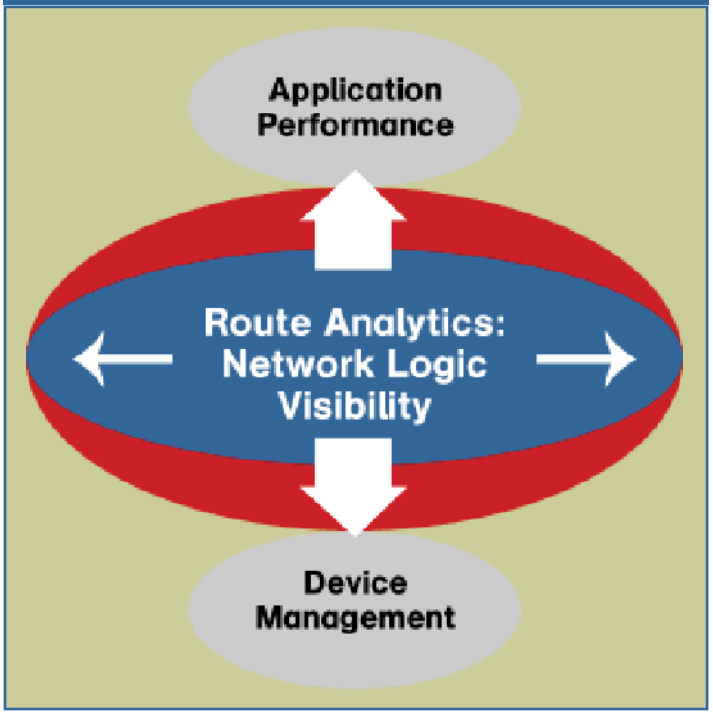
Many business-critical applications, such as SAP®, that are used in multiple industries are also delay sensitive. In particular, several SAP modules are notably delay sensitive. An example of this is the Sales and Distribution (SD) module, used for sales order entry. If the SD module is running slowly, a company can easily compute the lost productivity of the company's sales organization as they waste time waiting for the SD module to respond. Furthermore, if the SD module times out, this can irritate the customer and cause them to take their business elsewhere.

A preceding section of this white paper mentioned another example of a latency-sensitive, business-critical application that is widely deployed - VoIP. Over the last few years the majority of companies have deployed VoIP. One of the features that distinguish VoIP from a more typical data application is the rigorous demand that voice places on the underlying IP network. The ITU (International Telecommunication Union), for example, recommends that the end-to-end delay associated with a voice call not exceed 150 ms. Experience has shown that it is possible to exceed that goal by a small amount. If the delay becomes too large, however, the quality of the voice call degrades noticeably.

Route Analytics

As shown in Figure 1, route analytics enables IT organizations to manage application performance by providing IT organizations with insight into the routing layer. In particular, the goal of route analytics is to provide visibility, analysis and diagnosis of the issues that occur at the routing layer. A route analytics solution achieves this goal by providing an understanding of precisely how IP networks deliver application traffic. This requires continuous, real-time monitoring as well as the creation and maintenance of a map of network-wide routes and of all of the IP traffic flows that traverse these routes.

Figure 1 : The Position of Route Analytics



By integrating the information about the network routes and the traffic that flows over those routes, a route analytics solution can provide information about the volume, application composition and class of service (CoS) of traffic on all routes and all individual links. This information can be used for many purposes. As part of planning, this information can be used by the IT organization to simulate the impact of routing and traffic changes. Since this simulation reflects the actual nature of the company's routing and traffic flows, the results provide notably better insight into the effects of these changes than what would be provided by either testing the changes in a lab environment or implementing a controlled pilot. Used in this way, route analytics enables the IT organization to reduce the number of occurrences of application degradation.

This information can also be used to support both proactive and reactive troubleshooting. As part of proactive troubleshooting, this information can be used to enable the IT organization to notice and respond to a change in routing or traffic before it impacts the end user. This information can also be used to reduce the time it takes to improve application performance once the end user has noticed application degradation.

Summary and Call to Action

Application delivery is an important topic for virtually all IT organizations. Unfortunately, the difficulty associated with ensuring acceptable application delivery increases as the network becomes larger and more complex, and as IT organizations use the network to support delay-sensitive, business-critical applications.

Further complicating the task of application delivery is the fact that IT organizations typically do not do a good job of understanding and managing the logical factors, such as dynamic changes to routing and traffic patterns, that are the cause of a large percentage of the instances of application degradation. This lack of understanding is one of the reasons why IT organizations are not able to do a thorough analysis of planned routing and traffic changes, and why troubleshooting is so often a defensive activity.

In order to do a better job of managing application delivery from both a planning and troubleshooting perspective, IT organizations must reverse this situation. In particular, IT organizations must supplement their knowledge of the device-specific factors that cause application degradation with insight into the logical factors that cause degradation. Route analytics is a technology that should be considered as part of an IT organization's network management portfolio because it directly addresses some of the key logical aspects of network operations. In order to eliminate the defensive, silo-oriented approach to application management that exists within most IT organizations, the insight provided by whatever management solutions an IT organization implements must be trusted by all components of the organization.