NetSocket Session2Topology™ Correlation Engine:

Technology White Paper

Introduction

Communications networks in enterprises, government agencies, and service providers are undergoing a major transition. For example:

- Enterprises are expanding their use of IP for voice- and video-based services, including unified communications, teleconferencing and telepresence, and industry-specific applications such as trader voice for financial services enterprises.
- For wireless providers, the growth in smartphones and new Internet-based applications/services has triggered the need for increased bandwidth and a migration to IP technology in the radio access network (RAN). Many operators are addressing this demand in the short-to-medium term by deploying femtocell networks that re-use a subscriber's residential or enterprise broadband IP connection to carry mobile traffic back to the wireless operator's network.
- Government communications systems, particularly for military and defense applications, have always been designed with high reliability, security, and fault tolerance in mind. Now, they are applying these same requirements to IP networks as they migrate their infrastructures to accommodate the needs of highly mobile tactical units.

The changes being made in all these segments include:

- The use of IP, MPLS, and virtual private networks (VPNs) for connectivity.
- A shift from circuit-based telephony to IP-based telecommunications (e.g., VoIP).
- Increased data center (server and storage) virtualization and geographic distribution.
- Greater adoption of real-time services including telepresence, mission-critical transaction systems, streaming audio and video, and data replication services.
- Use of sophisticated collaboration applications.
- Rapid dissemination of mission-critical communications to any place, at any time.

Historically, the session/application layer, the routing/transport layer, and the access layer in a communications network have been architected and managed as separate entities. This was done for the best of reasons – no critical, latency-sensitive services were carried over the IP network, so there was no need for a legacy service manager to know how the IP network routed packets for best-effort services such as web browsing, e-mail, or file transfers. Critical, latency-sensitive services such as voice were carried on dedicated circuits that guaranteed the connection as well as the quality of the conveyed information.

This paradigm changed with the advent of voice over IP (VoIP) and has since been extended to a multitude of services including videoconferencing and telepresence, collaborative applications such as unified communications, and even 3G/4G wireless access. The organizations responsible for managing these services have become exposed to the constantly changing nature of IP networks, as they try to ensure a high-quality experience for the users of their service. It has become essential for these service managers to know the impact of the IP network on the services that they are delivering.

Understanding the Challenges

The first challenge is that operating personnel rarely have a good understanding of the traffic dynamics of real-time and business-critical services in their own IP networks. The connectionless nature of Internet traffic and the distributed operation of routing protocols make understanding traffic flows, connectivity, and session paths very difficult. In fact, most providers do not see topology changes and their effects on routing; they see the detrimental consequences for the services only after it is too late.

The second challenge is that operating personnel lack sufficient, real-time network control. Even if they understand the dynamics of their IP networks and know what they want to achieve in controlling these networks, the limitation of current IP routing protocols – coupled with separate, non-integrated overlay networks with their own service routing – restricts what network planners can achieve. The mechanisms to control the routes and paths in multiple control planes, as well as reserve resources for real-time service flows, simply do not exist.

The third challenge is that the fundamental design of IP network architectures – in which the network, media, and application/service planes operate largely independently of one another – means that crucial service information is located in different places and is not coordinated at a higher level. This lack of coordination prevents network operators from seeing and controlling the network and services as a single, coherent entity.

Thus, to evolve IP-based networks so they can support new, higher-margin services, operations teams need to understand the traffic sessions that exist in their networks along with the paths and resources they use. This understanding must be in real time and easily accessible, to leverage the operational advantages. Further, operations teams must be able to understand IP traffic dynamics and identify routing problems before application performance is impacted, and they must reduce the time that an application is performing poorly by correlating specific sessions in real time.

Whether for a financial enterprise, a defense agency, or a wireless carrier, communications success today requires:

- Dynamically monitoring and understanding network conditions and knowing where real-time sessions are in the IP network.
- Ensuring that bandwidth is dynamically allocated based on priority and service characteristics.
- Providing a geographically resilient solution for mobile deployments.
- Delivering a reliable, high-quality end-user experience for real-time services over IP networks.

Session Management Today

Today, IP network operators use passive, non-real-time tools to monitor, analyze, and control their sessions, sometimes augmented by active probes or test calls to validate connectivity.

Traditional service assurance products have no visibility to individual sessions in the IP cloud. At best, they use router-provided tools to obtain an aggregate view of traffic types, but without knowing whether a given user's traffic is actually traversing that part of the IP network. These tools also exert a cost on the routers' capacity and are therefore not used continuously – a significant issue when trying to manage IP-based services in real time. Alternatively, service assurance products have meant hardware probes, which provide metrics for specific locations at the edge of the network, but not from an end-to-end perspective – and with no way to guarantee the quality of a user's session. These mechanisms are in addition to any SNMP polling of the network nodes, another option that adds a burden to the nodes being monitored while producing volumes of uncorrelated data that becomes difficult to manage.

Products designed to manage and administer policy have no knowledge of the real-time state of the IP network. Instead, they rely on static rules and rudimentary mechanisms such as call counting at the edge of the network. This is akin to trying to design the interior of a home without ever having looked inside the house.

These limited, ineffective approaches fail to give enterprises, service providers, and defense organizations the service assurance required for the advanced IP network architectures used to deliver services today.

A different approach is needed to support new services on IP-based networks. Operating personnel need to understand traffic sessions in the network along with the path and resources they take. Additionally, this understanding must be in real time and easily accessible, so that organizations can reap the promised operational advantages of their IP infrastructures.

A Revolutionary Approach

NetSocket has designed the industry's first solution that truly addresses the needs of real-time IP service assurance: the Session2Topology™ (S2T) correlation engine. For the first time, network operators for enterprises, government agencies, and wireless carriers can gain meaningful visibility into, and focused resource control for, their real-time IP services.

As the name suggests, Session2Topology correlation technology automatically correlates the real-time state and changes in the IP network to the individual sessions being carried through that network. In real time, S2T knows the exact hop-by-hop path of any session and can identify what network event has impacted, or is impacting, that session.

Further, this same knowledge is used to proactively alert the service manager to changes in network configuration that can impact the traffic on the network, to enable preventive resource and admission control actions to ensure the quality of the service being delivered.

Significantly, S2T operates without adding any burden to the IP network itself, and without relying on proprietary, single-vendor tools.

S2T provides a way to monitor end-user voice, video, and other communications traffic (i.e., sessions) in a routed IP network, giving services managers the power to understand how these sessions traverse their IP networks.

Passive monitoring of signaling information exchanged with the session control node (e.g., femtocell gateway in a femtocell deployment, a call controller in a VoIP deployment, etc.) is used to obtain real-time session information. S2T inherently learns network topologies and the status of available network resources very efficiently by participating in IP routing protocol sessions using protocols such as Enhanced Interior Gateway Routing Protocol (EIGRP), Intermediate System to Intermediate System (IS-IS), Open Shortest Path First (OSPF), and Border Gateway Protocol (BGP), and by occasionally polling the monitored routers using SNMP and CLI.

Routing protocols are designed to distribute network connectivity and performance data quickly and efficiently. By participating in the routing protocol sessions, S2T learns about changes in IP routing, network topology, and resource availability on a real-time basis – providing a vast improvement over the cumbersome and inefficient traditional methods, which can discover these changes only through periodic polling of the network resources. In a logical sense, S2T lies in both the service management domain and the routed control plane, and it merges the control planes of the IP network with the control planes of the overlay, or service, layer.

The S2T technology bridges the worlds of routing with service control by correlating session information with topology to deliver visibility and control for real-time, mission-critical services, and to provide real-time and historical operational statistics for the service. As sessions are established and released, operational metrics for each session are maintained. If these metrics deviate outside the normal operational range (based on manager-defined thresholds), the service management/operations team is alerted to potential problems and provided a list of affected sessions. This allows the operations team to proactively manage the network and significantly reduce the Mean Time to Isolate (MTTI) in problem resolution.

Key Capabilities

NetSocket's patented, award-winning Session2Topology engine uses an 'information mashup' approach to correlate information from the application/service, media, and underlying IP network layers into a single, dynamic 'map' that provides:

- **Real-time visibility.** NetSocket's S2T engine enables network and service management teams to monitor IP-based services in real time to identify and localize issues instantly – anywhere in the network. Correlation of mission-critical real-time sessions to dynamic IP network topologies reduces troubleshooting time for any problems that do occur – from hours or days to a couple of mouse clicks – while eliminating the traditional mode of attempting to solve the problem by recreating it.
- **Dynamic resource control.** NetSocket's S2T ensures real-time, end-to-end guaranteed quality of end-user experience – a capability vital to the successful deployment of VoIP, videoconferencing/telepresence, unified communications, and other real-time services in the enterprise, as well as in limited-bandwidth tactical deployment environments where the IP network topology is extremely dynamic.

  In broadband wireless networks, NetSocket's solution offers policy-based, per-session resource and admission control in accordance with 3GPP/ETSI standards – while exceeding the standards requirements by knowing the real-time status and availability of end-to-end session-related IP network resources when making admission control decisions. NetSocket's solutions provide network state-aware, real-time resource control with prioritization and pre-emption of sessions as necessary to ensure that bandwidth is dynamically allocated for guaranteed communications, under all load and network configuration conditions.

Unique aspects of the Session2Topology correlation engine include:

- Works in real time to create a service assurance mashup, providing a dynamic map of the network onto which media and application/service information is correlated.
- Simultaneously enables both visibility and resource control across the network, media, and service/application layers.
- Provides a software rather than a hardware solution, which makes it more flexible and less expensive than earlier approaches to IP service assurance, as well as better able to leverage existing investments in networking equipment.
- Monitors the network without imposing any burden on the deployed network nodes, such as routers; it passively participates in the routed network using standard IP routing protocols.
- Enables a much finer-grained management of QoS in the network, without changing any of the established QoS policies (e.g., traffic classes, DSCP, queues) that might be in effect in the network.

Benefits of S2T Technology

Session2Topology correlation provides visibility into the traffic dynamics of IP networks and allows for better service management and assurance. Some examples include:

Session visibility for troubleshooting: A Quality of Session Record (QSR) details the network resources and paths used by each session, along with the performance metrics for that session. Analysis of QSRs aids the services operator in detecting network-based issues that impact real-time sessions. Likewise, the operator gets immediate feedback of the sessions affected by network topology events.

Resource management: Key to optimizing network architecture for capacity, traffic engineering, and traffic management is the understanding of session path and resources used. Using its insight into the dynamics of the network, S2T proactively ensures a high quality of experience by enabling session admission control and policy enforcement.

Alarming and service notification: Various service- and network-based Key Performance Indicators (KPIs) are generated from the analysis enabled by the S2T engine. NetSocket uses these KPI values to automatically trigger alarms for poorly performing sessions, routes, and peers. To remedy network events quickly, the solution generates alarms based on KPIs, signaling the operator to make changes in network or call routing.

Reduction of MTTI/MTTR: Service managers have been plagued by the inability to effectively localize IP service issues quickly and with minimal effort. Routing problems can be caused by fleeting changes in the network, yet even the most transient issues can lead to prolonged outages or service degradation. S2T technology enables the operations team to localize and identify the root cause of service issues instantly.

Network 'black box' analysis: Similar to the capability of an airplane black box, S2T helps diagnose issues for the IP network. Today, there is no efficient mechanism for determining the cause of many network failures. When routers reboot, they leave no trail of routing updates, making it hard to diagnose the origins of routing problems. Additionally, management systems have no knowledge of where the sessions go in the IP network, leaving operators with few or no capabilities to diagnose the problem. Operators need the ability to record network events that affect topology and session assurance – which is what the S2T technology provides.

By historically capturing routing changes, session statistics, topology changes, and resource changes, S2T empowers support personnel to analyze the impact to their networks when problems occur. Validation of network availability, connection availability, and resource availability are provided for forensic analysis, customer Service Level Agreement (SLA) validation, and troubleshooting.

Conclusion

The migration of real-time voice and video services to networks designed with IP technologies has become so prolific that virtually every enterprise and service provider wrestles with supporting these services while maintaining or improving the end user's quality of experience (QoE). The convergence of services over IP-based networks is forcing service providers not only to increase the reliability and efficiency of their networks, but also to correlate sessions to physical IP topologies so they can understand and optimize the QoE.

Session2Topology correlation enables three primary functions for real-time IP service assurance:

- A session management platform that provides visibility, in real time, of the network state, available resources, and the session paths over the network.

- A resource management device that manages bandwidth usage and congestion, distributes QoS policy, and performs admission control.
- A single point of contact in the network for both, thereby simplifying QoS architecture and increasing the efficiency of service management teams, without requiring significant network changes to achieve either.

Capitalizing on its uniquely correlated, multi-layer information mashup view – analogous to the Google Maps™ service, on which seemingly unrelated information can be overlaid to create new insights – NetSocket's Session2Topology correlation engine creates a mashup of information from each communications layer. As a result, S2T technology enables network operators at enterprises, government agencies, and wireless carriers to perform real-time IP service assurance and resource control functions such as session admission control with priority and pre-emption, bandwidth management, and policy distribution.

NetSocket
Real-time IP Service Assurance

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