Product Approach Document

Bandwidth Management

Avistar Communications Corporation

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AVISTAR COMMUNICATIONS CORPORATION
1875 S. Grant Street
San Mateo, CA 94402
www.avistar.com

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1. Market Problem—Unified Communications

The emergence of *Unified Communications* (UC) represents the next step in the evolution of converged communications. Whereas the initial benefits of converging communications on the IP networks included toll charge reductions, the elimination of redundant communications infrastructure, and location independence, UC introduces the next level of improvement by reducing human latency which streamlines enterprise-wide business processes. By turning communications into a software application, UC provides a central platform that allows users to optimize how they communicate with each other (e.g. IM, voice, video, distributed application sharing) appropriate to the task at hand, in real time or store and forward modes. And most importantly, UC allows this communication to be integrated with Enterprise Application Software that supports an enterprise's business processes, which will speed transactions and enable quick and informed decision making.

Because of the real-time requirements of interactive communications, UC applications put a significant amount of strain on enterprise IP networks. More importantly, for UC applications to deliver on their full promise, they must embrace video communications and deliver face-to-face communications over the network. This further compounds this infrastructure stress.

For organizations to confidently deploy UC as an enterprise technology for audio and video communications, they need the necessary tools to manage the associated infrastructure stress. Without such tools, administrators will be reluctant to roll out UC at scale since they won't be able to guarantee that all users can access the system and that the communications traffic will not overwhelm other traffic sharing their networks.

Indeed the key to the market opportunity in UC is the management of associated infrastructure stress. Without this key component to the solution many UC promises frequently fall short in guaranteeing an acceptable experience to the end user, since they cannot manage quality end-to-end.

2. Dynamic Network Bandwidth Management

We introduce the term *Dynamic Network Bandwidth Management* to describe the collection of tools necessary to manage the stress that UC applications put on the underlying communications infrastructure. The main objectives of these tools are to:

1. Relegate decisions about audio/video bandwidth utilization from end-users to administrators. Administrators control bandwidth allocated to audio/video calls through centrally-provisioned call rate policies. Not only does this place responsibility for bandwidth allocations where it belongs—with the administrator—but it alsoresults in an improved end-user experience by hiding complexities of bandwidth and call rates from the user.
2. Reconcile bandwidth allocated to audio/video calls with the physical constraints of the underlying network. This is done to:
    1. *Constrain* the amount of bandwidth used by UC to limit the impact of Unified Communications on other network applications. For example, users making video calls shouldn't cause SAP to come to a grinding halt or stop Citrix applications from working.
    2. *Protect* bandwidth allocated to UC from other traffic sharing the network to optimize the Quality of Experience (QoE) to the end user. In essence, the system needs to ensure that the amount of bandwidth required for the conversation is available for the duration of that conversation to ensure a high quality-of-experience to the end user.
    3. *Police* access to available UC bandwidth in light of requests from various UC users and applications. This is done by integrating with the signaling infrastructure to allow application software to make intelligent decisions about how to deal with bandwidth shortages and how to communicate lack of bandwidth to the end-user.

Network bandwidth management software accomplishes these goals through an *integrated collection* of dynamic software mechanisms and policies that control and manage bandwidth used by Unified Communications. Bandwidth management policies allocate a certain amount of bandwidth to each UC session based on which users are involved in the session, the type of session or event, the capabilities of the endpoints used, the network constraints imposed by the administrator, and any other network activity going on at the same time. UC management infrastructure enforces these constraints, while UC applications attempt to optimize the overall end-user experience within the boundaries of these constraints.

This overall bandwidth management approach is shown in the following figure:

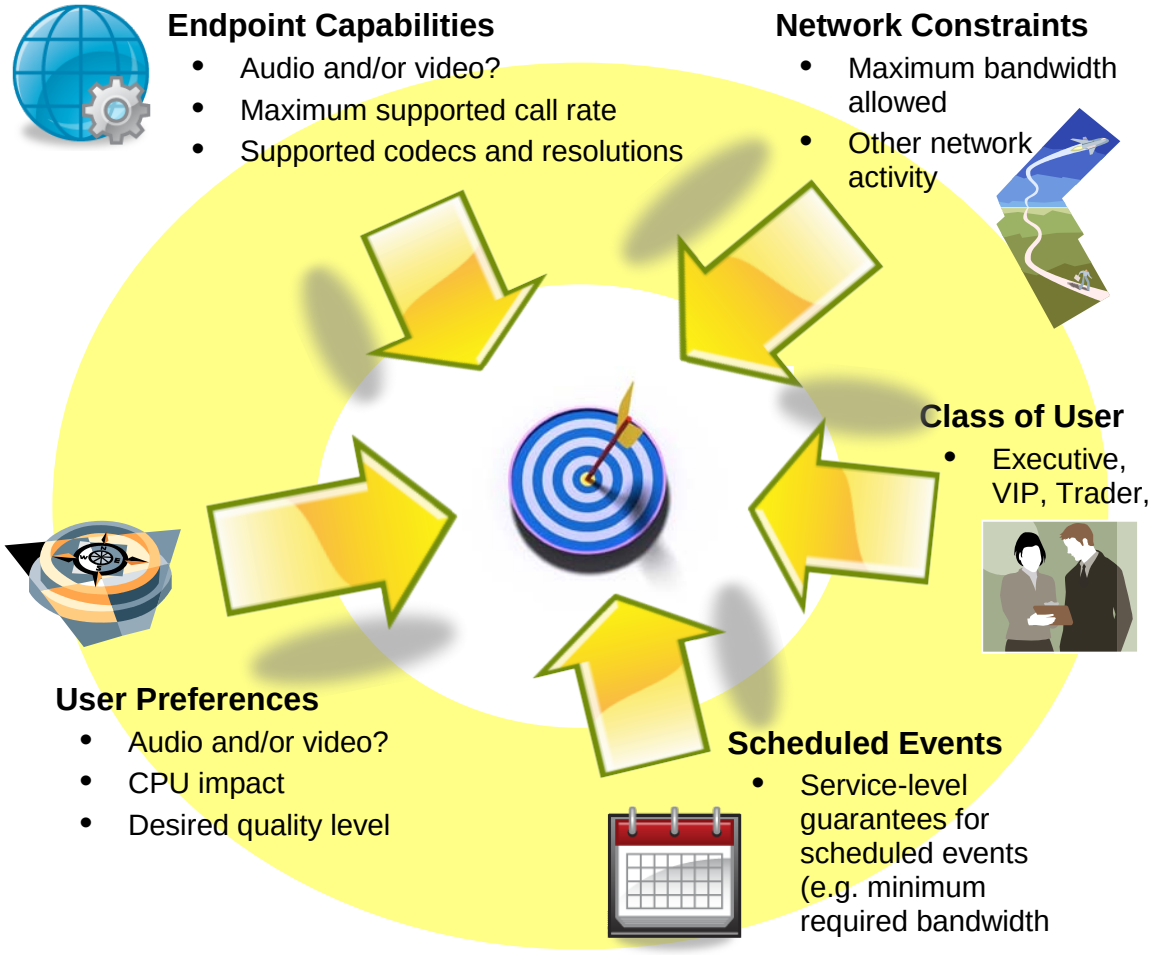

Figure 1. Dynamic Unified Communications Management Overview

3. Value Proposition

The value of Dynamic Unified Communications Management infrastructure is clear:

- Bandwidth controls *avoid the need for expensive network upgrades* before deploying UC. Instead, administrators can realize the ROI of UC immediately by adding network capacity where absolutely necessary, based on real usage data.
- Bandwidth controls limit the impact of UC on other network applications, which lets enterprises *protect their investment in Enterprise Application Software* and avoid expensive business interruptions.
- Bandwidth controls guarantee high level of Quality of Experience for UC applications, which *preserves the ROI of UC applications* by optimizing their effectiveness.
- Managing UC as a whole—rather than individual UC applications—enables bandwidth pooling ("pipesharing"), which *avoids the need for dedicated application bandwidth* and associated over-provisioning.
- Uniform policy management interfaces simplify dynamic network management administration

4. Competitive Approaches

There are no tools in the communications industry today that are designed explicitly to address the bandwidth management issues associated with Unified Communications. As a result, customers are forced to resort to network-oriented solutions or to deploy point solutions such as WAN acceleration devices or H.323 gatekeepers.

4.1 Network-Oriented Solutions

In the absence of tools to manage the bandwidth requirements of UC applications, customers often have no recourse other than to implement expensive network upgrades that are intended to avoid bandwidth issues in the first place:

- Companies are forced to do wholesale network upgrades and overprovision bandwidth to avoid congestion on their networks. This makes UC an expensive proposition, and negates a lot of the promised benefits of the UC market.
- Customers frequently also turn to QoS-based techniques to prioritize UC traffic on their networks with the intent of avoiding network congestion for UC applications. However, these techniques can adversely affect other traffic on the network while still not addressing the application requirements of UC applications. As such, they do not address the needs of the business processes UC enables and the productivity gains that these solutions provide.

In practice, network-oriented solutions are expensive and hard to manage. This is especially true in large, distributed organizations with many networks, WAN segments or remote offices. Modifying the network topology and associated infrastructure to accommodate expanding bandwidth requirements is also difficult to architect in the face of an increasing number of mobile workers.

4.2 WAN Acceleration Devices

WAN acceleration devices are networking appliances that are designed to optimize traffic over slow-speed links—e.g. the network connections to branch offices. These devices typically include rudimentary bandwidth management capabilities that allow administrators to split the available bandwidth into *virtual pipes* and route specific types of traffic over these pipes. The appliances use packet shaping and packet metering techniques to both protect and constrain traffic within these virtual pipes. Leading vendors of WAN acceleration devices are companies like Packeteer and Blue Coat.

However, these devices operate almost entirely at the network level and use network-specific information (such as IP addresses and ports) to make decisions about application traffic. They require a certain amount of *application-awareness* at the network level in order to classify network traffic appropriately. As a result, they are complex to manage and are limited in their capabilities:

1. These devices work at the network level and are not integrated with application-level session management functionality; as a result, the application software is not made aware of any bandwidth shortages, which results in an inferior end-user experience. For example, these devices will start dropping VoIP packets when voice traffic exceeds configured limits, but since the Call Manager is not aware of these configured limits, it cannot provide users with a busy signal.
2. Configuration of these devices tends to be static, while the requirements of Unified Communications are much more dynamic. For example, bandwidth requirements may change based on time of day or based on a specific event taking place.
3. These devices manage bandwidth policies on a per-link basis. UC applications require end-to-end treatment of bandwidth management policies in order to offer an acceptable user experience.
4. WAN acceleration devices manage bandwidth associated with virtual pipes, but make it difficult to police how bandwidth for each pipe is allocated to individual users and applications. As a result, they do not address the requirements of an overall UC bandwidth management solution.
5. While these devices offer bandwidth management and WAN acceleration policies, they often duplicate mechanism that is readily available in existing networking equipment such as routers. A better approach would be to offer software-only solutions that leverage existing networking infrastructure and avoid the expense associated with additional devices.

In summary, we believe that an application-aware networking approach does not address the dynamic bandwidth management requirements associated with Unified Communications. A better approach is to make UC applications network-aware and introduce just enough network information into the application level to allow application-level bandwidth management policies. Of course, implementation and enforcement of these policies will continue to be done at the networking level, either by these WAN acceleration devices or by general-purpose networking infrastructure.

4.3 H.323 Gatekeepers

H.323 gatekeepers are another category of products that include capabilities to limit the amount of traffic associated with Unified Communications. While these products manage bandwidth use at the application level, they have a number of other shortcomings:

- They are closely tied to the H.323 protocol, which is a legacy telecommunications protocol used primarily for video conferencing. Unified Communications are built around internet-based protocols such as SIP.
- These technologies associate bandwidth limits and call admission control with administrative concepts such as zones, dial plans, and user groups, without regard for the underlying network topology. Zones and dial plans are administrative concepts with no relationship to underlying network topology, which makes accurate network bandwidth management impossible. More importantly, in a Unified Communications

world, dial plan management and call routing functionality becomes largely unnecessary, rendering these legacy solutions useless.

Again, these technologies have a narrow focus that makes them ill-suited as a general-purpose UC bandwidth management platform.

5. Bandwidth Management Product Approach

Dynamic Network Bandwidth Management consists of software infrastructure that lets administrators control the communications traffic between their users. At the core of this infrastructure is the ability for administrators to specify the amount of bandwidth used by each call or session.

While UC sessions are defined by many possible parameters, UC management infrastructure focuses on bandwidth almost exclusively, for the following reason: bandwidth is the primary shared resource that needs to be managed across the entire user population. Few other communications attributes affect the end user experience as much as bandwidth does. Once bandwidth has been allocated to a UC session, many other communications attributes can be derived from this allocated bandwidth.

One communications attribute that can be derived directly from bandwidth is the quality of the end-user experience. In any audio/video communication system, there are four main parameters that determine audio/video quality:

1. Bandwidth/call rate
2. Resolution and/or frequency response
3. Frames per second
4. Selected audio/video codecs

Once a certain amount of bandwidth has been allocated to a call or session, user agents can automatically and dynamically select the three other quality parameters to guarantee the highest possible Quality of Experience with the constraints of the allocated bandwidth. As a result, the introduction of a bandwidth management component in Unified Communications infrastructure simplifies other UC components tremendously:

1. *End-users do not need to have direct control over their audio/video quality*. Specifically, there must not be any end-user settings that let end-users specify call rate, resolution, and frames per second directly.
2. *Audio/video quality is configured exclusively through administrator policies*.
3. *The only video quality parameter that needs to be configured directly through administrator policies is the call rate*. Administrators have no direct control over resolution and frame rate used by video endpoints. Instead, user agents will use built-in dynamic algorithms to optimize resolution and frame rate based on the specified call rate.
4. *User agents' built-in quality algorithms may be parameterized*. User agents may provide administrator and end-user settings that affect these parameters, which would allow end-users to indirectly affect video quality. For example, Avistar may provide a preference setting that specifies the maximum percentage of the CPU that can be made available to Avistar audio and video compression

In short, bandwidth management infrastructure provides administrators with a single “dial” that can be used to tune the experience for individual users or groups of user. In addition, bandwidth management infrastructure relieves the end user from the burden of having to configure and manage their own UC quality attributes, which significantly improves their overall experience.

Contact Information

For more information on Avistar or its suite of industry leading and award winning solutions, please contact us via email: info@avistar.com or:

1875 South Grant Street
10th Floor
San Mateo, CA 94402
Tel: +1.650.525.3300