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QoE Congestion Management With Allot QualityProtector

Solution Brief

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Contents

1 Network Customer Satisfaction is all about QoE

Your customers' satisfaction is all about their quality of experience with your point of sale, your support center, and most importantly, with the data connectivity and value-added services your network delivers. The ever-increasing volume and complexity of data traffic poses a constant challenge to service providers who must provide enough capacity to fulfill bandwidth demand and Quality of Experience (QoE) expectations.

Service providers learned long ago that simply adding more bandwidth is not a cost-effective solution in the long run. No matter how much bandwidth you provide, today's applications and users will demand more. Furthermore, recurring capacity investments have not been backed by corresponding increases in revenue because ARPU is either stable or even declining in most markets. That's why most operators have implemented traffic management and congestion control solutions to optimize bandwidth utilization and network efficiency.

These solutions operate according to conventional wisdom that says - when network bandwidth is congested, users experience slow response time, excessive buffering, erratic video streaming, and other symptoms of poor service. However, using bandwidth utilization as the only indicator of Quality of Experience may not be sufficient in some cases. To effectively manage QoE, you need to monitor and measure indicators that best reflect QoE, and be able to adjust service delivery in tandem with a change in any of those indicators. That is precisely what the QoE Congestion Management technology in Allot QualityProtector does.

Armed with Allot QualityProtector in your network, you can maximize the quality of experience your deployed infrastructure is able to support, assure consistent QoE, and postpone or even obviate the need for expensive network expansion.

2 QoE Management with Allot QualityProtector

Allot QualityProtector QoE Congestion Management solution allows service providers to extract more value from network infrastructure and postpone or even obviate the need for expensive network expansion. Allot's real-time monitoring of critical QoE indicators plus policy-driven congestion control empowers service providers to automatically maximize the quality of experience their deployed network is able to deliver at any given moment.

QoE is personal. That's why Allot monitors the quality of individual connections (QoE indicators) together with specific locations in the network, such as within a mobile cell, a BRAS interface, DSL interface or a CMTS channel/bonding group. We call these locations "Network Units."

Every second, Allot QualityProtector samples key QoE indicators to ascertain the Quality of Experience being delivered in a given Network Unit. Based on the Network Unit's QoE score, Allot Service Gateway automatically adjusts the bandwidth demand to the current available capacity by re-allocating the bandwidth to applications and users according to the same QoS or service plan policy that the service provider had set in the system.

Let's take a closer look at how QoE Congestion Management with Allot QualityProtector works.

3 How it works

3.1 QoE Indicators

Since TCP Layer-4 transport is used in most communications over the network, TCP attributes are good indicators for monitoring congestion conditions that affect QoE. As the inline DPI probe inside Allot Service Gateway monitors network traffic in real-time, Allot QualityProtector samples QoE statistics every second in each Network Unit. Real-time congestion sensing is achieved by measuring and correlating Round-Trip Time and TCP Retransmissions. These statistics are also stored in Allot's data warehouse where they can be further analyzed using Allot ClearSee Network Analytics tools.

The available bandwidth is assessed based on QoE indicators sampled in real-time every second by Allot Congestion Detection & Control (CDC) technology.

QoE Indicator	What it means
Internal Round Trip Time	Internal Round Trip Time is the time elapsed from the first TCP packet sent to the client (internal) side of the connection to the ACK of this packet. RTT Latency is calculated as the average of all Round Trip Times measured on TCP connections over a 15-second interval, divided by the number of TCP connections actually measured. Internal Round Trip Time is **a leading indicator of QoE degradation on the internal network**.
Internal TCP Retransmissions	Allot monitors TCP sequencing on access links and counts internal retransmissions. An increase in TCP retransmissions **indicates QoE degradation** on the internal network.

3.2 Congestion Sensing and Management

To assess service quality, QoE indicators are sampled in real-time every second by Allot Congestion Detection & Control (CDC) technology in Allot QualityProtector. Based on the real-time assessment, your Allot solution automatically and accurately adjusts bandwidth allocations to applications and users in accordance with existing QoS policy (for applications) and/or service plan policy (for users).

Allot Congestion Detection & Control (CDC) technology employs five steps shown in the table below to accurately sense and manage network congestion that affects QoE.

CDC Process	What it does
Baseline Learning	**Collect** real-time QoE indicator statistics from Allot inline DPI probes over a 24 hour period and build a "normal" baseline for RTT and Retransmissions QoE Indicators, which is used as the reference for identifying congestion. Note: QoE Indicator statistics are collected only for traffic flows that are managed by a preconfigured traffic policy.
Quality Tracking	**Compare** baseline RTT and Retransmission statistics with real-time QoE statistics per Network Unit collected every 15 seconds (default) from Allot inline DPI probes and determine if there is a

CDC Process	What it does
	shift backed by statistical confidence. When one or more samples shift (increase) from the baseline, this indicates QoE degradation in the Network Unit. Note: QoE sampling rate (15 seconds), and the number of sample shifts that indicate bad QoE are configurable.
Congestion Sensing	**Detect** congestion conditions by evaluating aggregated QoE statistics per Network Unit to determine its QoE level. As RTT and Retransmission values increase, the QoE level decreases until it drops below a preconfigured threshold that indicates congestion conditions in the Network Unit. Once the threshold is breached, the CDC automatically triggers a QoE congestion management policy. Note: The QoE level threshold is configurable per Network Unit or per a group of all Network Units. For example, per specific BRAS unit, or per all BRAS units.
Dynamic Bandwidth Control	**Allocate** the available bandwidth in the Network Unit with the greatest possible efficiency and in accordance with preconfigured application-aware QoS and subscriber service plan policies. QoE indicators continue to be sampled, providing real-time feedback on how bandwidth adjustments are affecting the QoE level. Fine tuning continues until bandwidth adjustments are sufficient and congestion in the Network Unit is released. Note: Subscribers remain under their original policy/service plan while bandwidth is re-allocated. Bandwidth is controlled per traffic direction (upstream/downstream).
Congestion Clearance	**Activate** regular QoS policy and deactivate QoE Congestion Management policy automatically once the QoE level in a Network Unit has been restored for at least 3 sampling intervals (i.e., decrease in RTT and retransmissions). Re-allocate available bandwidth per regular QoS controls. Note: The number of consecutive sampling intervals to determine restored QoE is a configurable parameter.

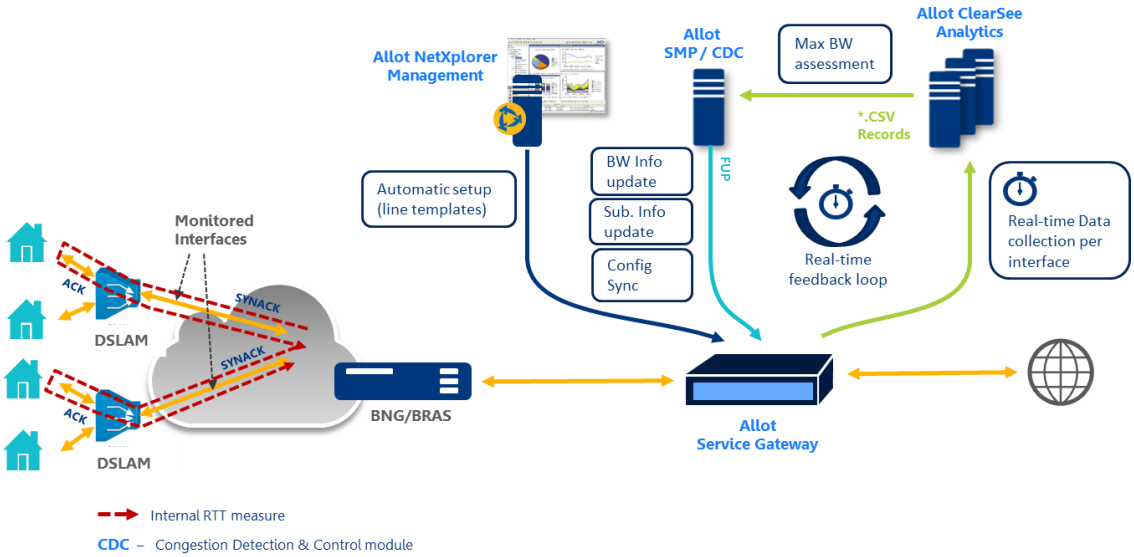

Figure 1: QoE Congestion Management architecture in DSL networks

3.3 Configuration and Intelligence

Allot NetXplorer central management allows network administrators to manage QoE congestion management settings for all their Allot Service Gateway inline platforms using simple network abstraction and policy templates.

Network Units are represented by corresponding policy elements that are dynamically generated by Allot NetXplorer based on control plane information it receives, such as SNMP MIB information and IPDR feeds in CMTS networks, or RADIUS provisioning information in mobile and fixed networks. Each policy element (i.e., each Network Unit) inherits each subscriber's service plan and QoS enforcement rules as globally set in the system so administrators do not have to worry about cumbersome configurations.

QoE Congestion Management settings can be set globally or applied per Network Unit, such as per mobile cell, CMTS channel/bonding group, or DSL interface depending on the network infrastructure. QoE Congestion Management settings include:

- Enable/disable dynamic bandwidth control globally for all Network Units for each direction; inbound and outbound.
- Bandwidth control sensitivity including; minimum interval between bandwidth updates, bandwidth update steps
- Low limit on dynamic bandwidth control to prevent full throttling of Network Units
- Customize settings for a selected Network Unit including inbound and outbound maximum allowed bandwidth, inbound and outbound upper and lower limit bandwidth

3.3.1 Simple Admin Interface

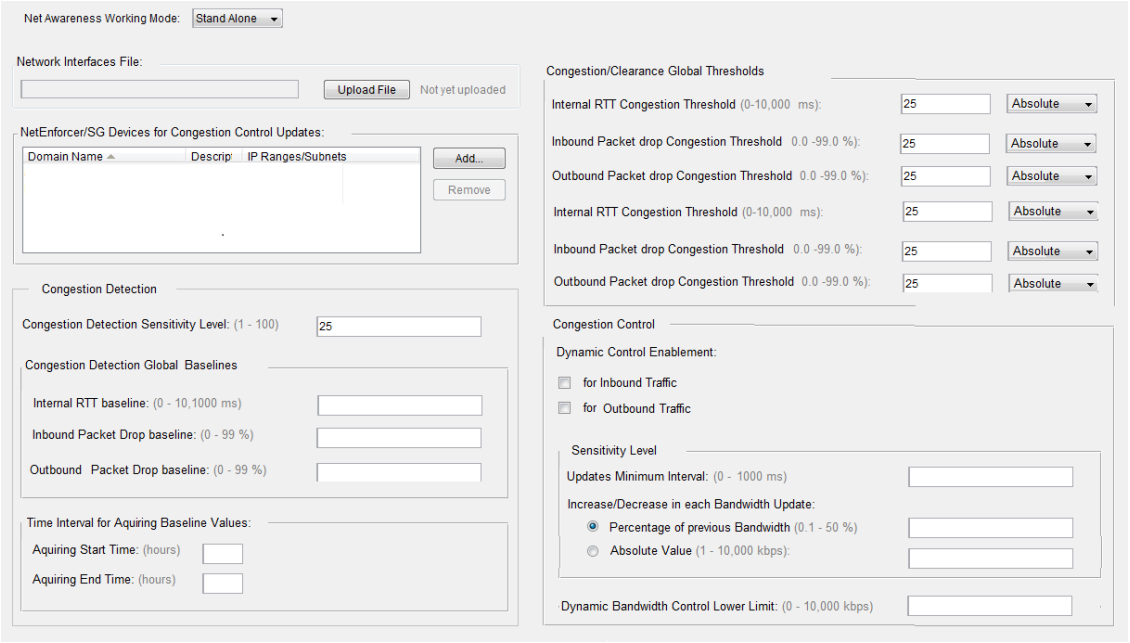

Figure 2: Allot QualityProtector provides a simple configuration and management interface

3.3.2 QoE Congestion Event Log

Congestion episodes and their clearance are logged by the system in a detailed event log. Each log entry includes the following attributes:

- Netunit Name – The Network Unit name as received from an external input file
- Netunit ID – The Network Unit unique identifier
- State information:
- Direction: Inbound/Outbound
- New state: Congested/Cleared
- Time of state update
- Internal RTT baseline (latest value) [ms]
- Inbound packet drop baseline (latest value) [%]
- Outbound packet drop baseline (latest value) [%]
- Internal RTT congestion threshold [ms]
- Internal RTT clearance threshold [ms]
- Inbound packet drop congestion/clearance thresholds [%]
- Outbound packet drop congestion/clearance thresholds [%]
- Internal window RTT (at the point of state change decision) [ms]
- Inbound window packet drop (at the point of state change decision) [%]
- Outbound window packet drop (at the point of state change decision) [%]

Admins also receive a real-time report of congested network elements.

4 Network Intelligence

QoE Congestion Management with Allot QualityProtector is complemented by Allot ClearSee Analytics, a powerful tool for complete network traffic visibility and root-cause analysis of unusual traffic volume, patterns and other online activity. The QoE indicator data that Allot uses to detect and alleviate congestion are also collected for viewing in our analytics dashboards where you can track QoE levels before and after Allot QualityProtector goes into action.

For example, real-time reports can show which applications and devices are consuming the bandwidth in a chronically congested cell, while historical analysis can be used to identify traffic trends and the effect they have on network performance over time. Daily or weekly reports showing bandwidth consumption, usage volumes, video and HTTP QoE, signaling traffic, average bitrates, sessions opened, and other vital statistics enable operators to identify problematic areas and better plan around them.

In addition, QoE data records may be easily exported to other BI systems, enabling you to leverage this valuable data for more effective analysis and service planning.

5 Use Cases

5.1 Exploit "Excess Bandwidth" More Efficiently to Assure QoE

In DSL networks, ISPs often have to pay a premium price if they want to guarantee their bandwidth. Alternatively they can buy "excess bandwidth" which is carrier bandwidth shared by multiple ISPs. When network conditions change, the available excess bandwidth changes as well. ISPs who rely on excess bandwidth will suffer packet drops and poor subscriber experience when they attempt to consume more excess bandwidth than is available. At any given moment, ISPs need to know the excess bandwidth that is available to them and to manage their traffic within those resource limits in order to maintain good Quality of Experience.

Allot QualityProtector lets ISPs actively monitor QoE on the excess bandwidth capacity and automatically adjust their demand to what the carrier can supply at any given moment. The ability to exploit excess bandwidth more efficiently not only assures subscriber QoE, it can also reduce the volume of guaranteed bandwidth the ISP needs to buy at a premium, and thereby save significantly on bandwidth costs.

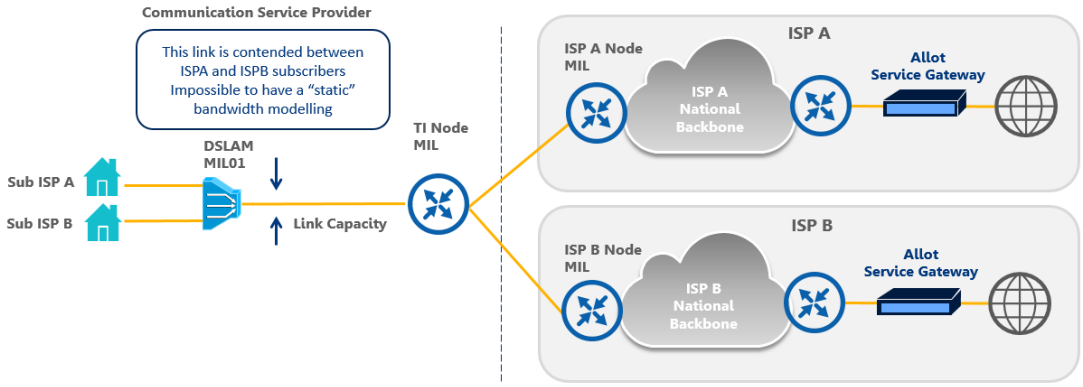

Figure 3: Allot QoE Congestion Management helps ISPs regulate "excess bandwidth" consumption more efficiently.

5.2 Real-Time QoE is the Best Predictor of Cell Congestion

While mobile operators have invested millions to deliver reliable QoE to their customers, every mobile cell has its limits. Ideally, traffic demand in a mobile cell should not exceed what the cell can deliver. Otherwise, voice and data sessions are dropped. Clearly, operators must monitor the available bandwidth in each cell and manage traffic flows so demand remains within those limits. But in real life, the available bandwidth in a given cell at any given time is practically unknown. Anything from IMS and video calls, which consume significant bandwidth, to changing weather conditions can reduce cell capacity in an instant, making cell service more susceptible to congestion and QoE degradation.

Allot QualityProtector provides a solution by enabling mobile operators to assess the available bandwidth in any given cell at any time, based on QoE indicators. It measures what users in the cell are actually experiencing in real time and automatically triggers QoE policy to shape consumption while allocating the available bandwidth according to the operator's traffic policy. Accurate assessment of the available bandwidth in a cell plus real-time QoS policy enforcement on the traffic of users in that cell, requires mobility information from the network. Allot Service Gateway obtains real-time mobility information over standard interfaces so it can enforce QoE Congestion Management policy per cell-user in tandem with changing cell conditions and users moving in and out of coverage.

In parallel, mobile operators can use Allot ClearSee Network Analytics to identify recurring patterns and possible trends involving TCP RTT and retransmission metrics, so that if a certain cell is frequently over-utilized it can be upgraded to accommodate the demand.

With Allot solutions, cell congestion is kept under control and mobile operators are able to deliver a consistently good user experience that keeps subscribers satisfied and loyal.

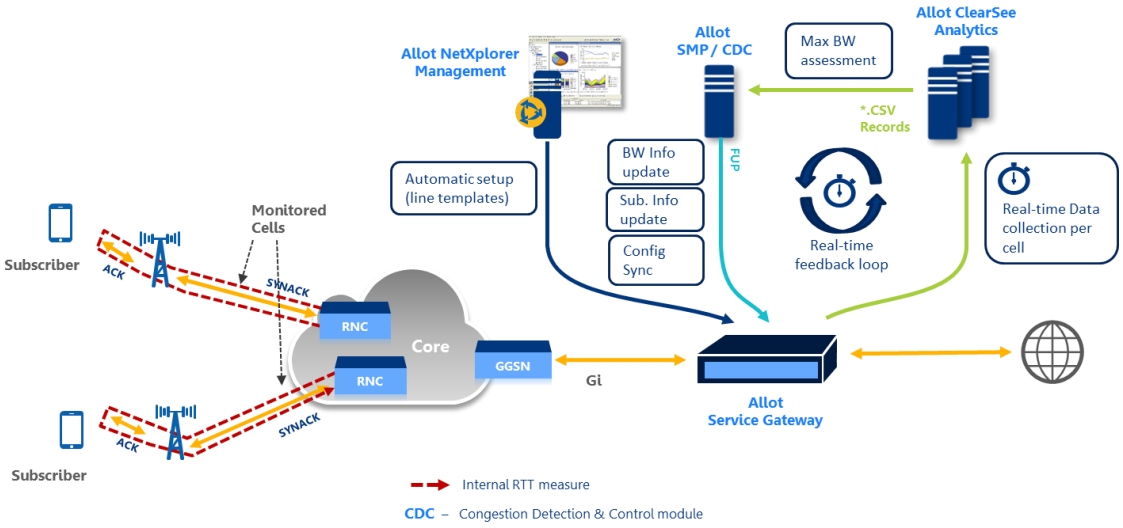

Figure 4: Managing QoE Congestion in 3G and LTE mobile/fixed wireless cells with Allot QualityProtector

5.3 Assuring QoE on over-subscribed CMTS Channels

Cable networks have a unique congestion challenge which is fueled by commonly used oversubscription models. It is not unusual for high bandwidth demand from a few people using P2P, video streaming, or file sharing applications to degrade cable service on a particular street or in a whole neighborhood, ruining the online experience for everyone sharing the cable access resource.

Unlike DSL and wireless networks, the available bandwidth in cable network is known at every given moment and can be obtained from CMTS elements in order to adjust bandwidth demand accordingly.

Allot QualityProtector is able to monitor available bandwidth at the most granular level of a CMTS channel and/or CMTS bonding group. These represent various groupings of multiple homes, multiple streets, subdivisions, neighborhoods, etc. Allot monitors and measure the discrepancy between available bandwidth and demand on each channel or bonding group, and automatically triggers application-aware and user-aware QoS controls until congestion is alleviated and quality of experience is restored.

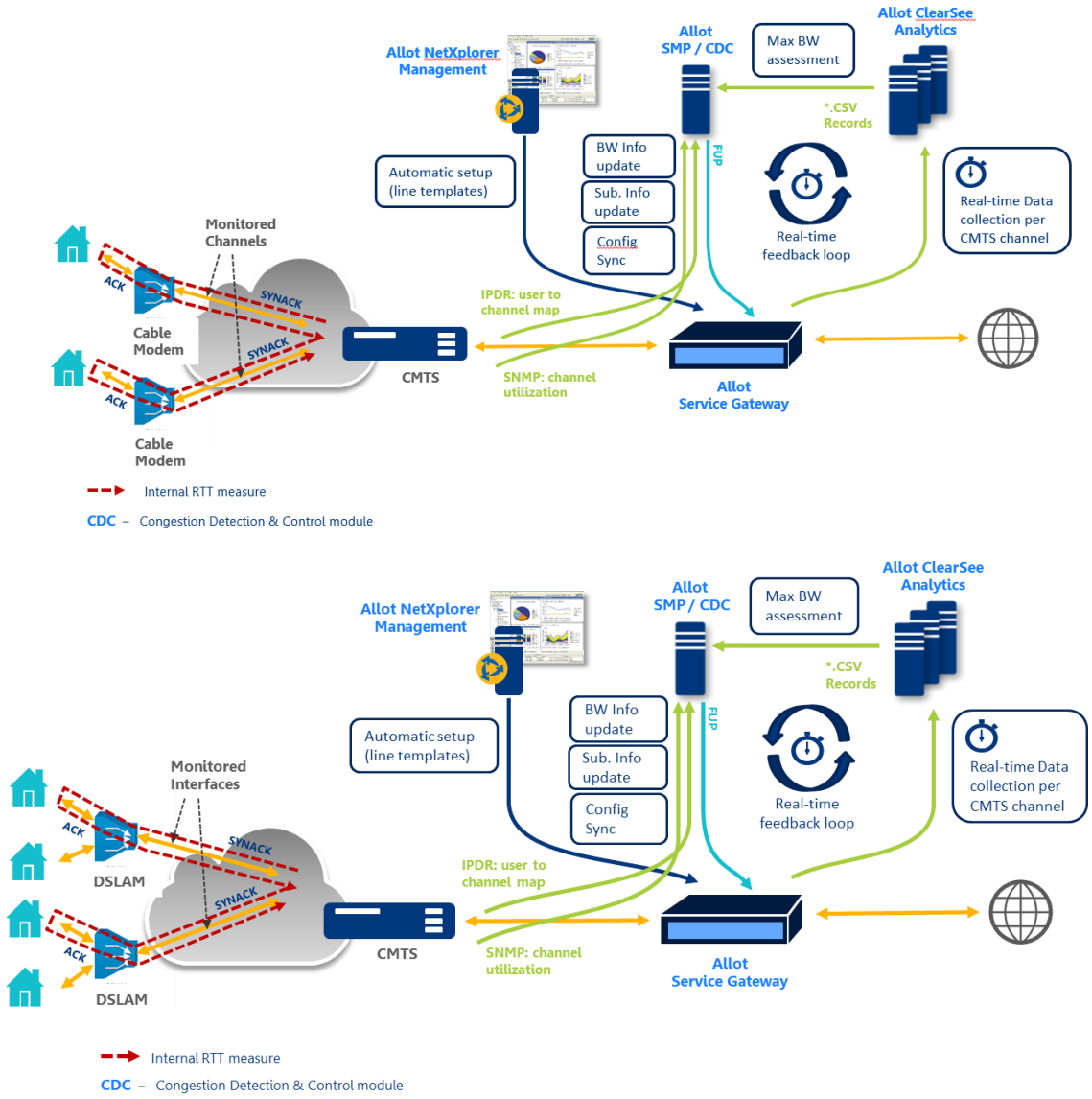

Figure 5: CMTS congestion visibility and management with Allot QualityProtector

6 Allot Advantage

With Allot, you can detect QoE degradation caused by congestion in any part of the network, and dynamically control bandwidth consumption to alleviate congestion precisely where it occurs. Only Allot offers:

- Simple policy management that you can configure by yourself to assure the quality of experience your network delivers to every user.
- Ability to assure QoE on any network access and across converged networks
- Carrier-grade scalability that assures QoE for millions of users
- Multiservice platform that also provides Network Intelligence, Policy and Charging Control, Traffic Management, Network Security, and VAS Delivery.

7 Find Out More

Let us show you how to optimize your network and protect customer QoE. Contact sales@allot.com to set up a personal briefing, and visit our website to learn how QoE Congestion Management with Allot QualityProtector can advance your business.

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www.allot.com sales@allot.com

Americas: 300 TradeCenter, Suite 4680, Woburn, MA 01801 USA - Tel: +1 781-939-9300; Fax: +1 781-939-9393; Toll free: +1 877-255-6826
Europe: NCI–Les Centres d'Affaires Village d'Entreprises, 'Green Side' 400 Avenue Roumanille, BP309 06906 Sophia Antipolis, Cedex France - Tel: +33 (0) 4-93-001160; Fax: +33 (0) 4-93-001165
Asia Pacific: 25 Tai Seng Avenue, #03-03, Scorpio East Building, Singapore 534104, Tel: +65 6749-0213; Fax: +65 6848-1015
Japan: 4-2-3-301 Kanda Surugadai, Chiyoda-ku, Tokyo 101-0062 - Tel: +81 (3) 5297 7668; Fax: +81 (3) 5297 7669
Middle East & Africa: 22 Hanagar Street, Industrial Zone B, Hod Hasharon, 4501317 Israel - Tel: 972 (9) 761-9200; Fax: 972 (9) 744-3626