CHAPTER 01
NETWORK PERFORMANCE DRIVES COMPETITIVE ADVANTAGE

CHAPTER 02
SDN IS SHAPING THE FUTURE OF NETWORK MANAGEMENT

CHAPTER 03
LEVEL 3SM ADAPTIVE NETWORK CONTROL SOLUTIONS

CHAPTER 04
THE LEVEL 3 DIFFERENCE
The network lives at the heart of today’s enterprise. Evolving the network has become a critical business decision. Enhance network performance, and you sharpen your competitive edge. Don’t, and you risk falling behind.

Delivering higher performance requires enabling greater visibility and more-granular control over network functions. It means providing the dynamic response needed to quickly and seamlessly adjust to shifting demand. All while controlling costs.

CIOs and their teams are aggressively seeking better ways to meet business goals by addressing the impact of organizational growth and its associated demands on the IT and networking environment.

**Level 3 Adaptive Network Control Solutions** apply innovative answers to these critical challenges, managing shifting network requirements in real time, quickly moving network functions in and out of service, scaling instantly and more efficiently—without the continual need for human intervention.

To get the most from your network, the network must work smarter, not harder. That can start with the evolution to software-defined networking (SDN) technologies.

Software-defined networking brings together management of applications and the network into a centralized, unified and easily extensible platform that allows for easy provisioning and configuration of an organization’s complete IT infrastructure.

Level 3 Adaptive Network Control Solutions combine SDN technologies with sophisticated analytics. The network itself—based on policies you determine—can make intelligent decisions on when, where and how to apply IT resources to meet shifting demand and planned events, while avoiding performance degradation.

In addition, Level 3 Adaptive Network Control Solutions deliver enhanced visibility into the organization’s network, applications and sites—a key to making data truly actionable in context.
Chapter 03

Simple Tools. Powerful Options.

Level 3℠ Adaptive Network Control Solutions

Developed based on direct customer feedback, Level 3℠ Adaptive Network Control Solutions include a range of simple-to-use yet powerful capabilities that enable automated, self-directed, end-to-end service delivery and assurance. Capabilities provided by Level 3℠ Adaptive Network Control Solutions include:

- **Enhanced Management**
  Provides real-time visibility into network performance segment by segment, across your complete IT infrastructure

- **Dynamic Capacity**
  Helps meet constantly changing demands with capacity that grows on an ad hoc, scheduled or events-based basis

- **Dynamic Connections**
  Delivers high-performance private connections to leading cloud providers
LEVEL 3SM ADAPTIVE NETWORK CONTROL SOLUTIONS

Through Level 3 Adaptive Network Control Solutions, enterprises have innovative tools designed to provide the visibility and flexibility they need, as well as on-demand control to help increase productivity and manage costs in a rapidly evolving IT environment. These include the ability to:

- Automate network changes to adapt network resources, increasing productivity and freeing up IT staff for higher-value projects
- Use intelligent data in real time to predict needs and proactively manage private, public and hybrid networks
- Reimagine how and when updates and services can be delivered—for example, scaling bandwidth on demand to enable frequent data backups throughout the day, rather than waiting until after hours
LEVEL 3SM ADAPTIVE NETWORK CONTROL SOLUTIONS

LEVEL 3SM ENHANCED MANAGEMENT

Command a clear view of virtually everything happening in your network. On demand, Level 3 Enhanced Management gives you visibility across a broad range of key metrics for network health and performance.

With granular end-to-end, segment-by-segment visibility, you’ll understand what’s happening in terms of latency, packet delivery, jitter and other critical metrics. And you’ll be able to review this information by location, product and class of service.

FEATURES
• Proactive alerts based on custom thresholds that you determine
• Easy-to-use reports that make critical data available by location and by class of service
• Key performance metrics that encompass delivery, variation, utilization, location and more

BENEFITS
• Enhances your ability to more efficiently manage your network
• Provides clear, intuitive, real-time visibility into network performance—end to end, segment by segment, across your entire network
• Improves troubleshooting, planning and network peak application performance

LEVEL 3 ENHANCED MANAGEMENT IS AVAILABLE FOR THE LEVEL 3® IP VPN, MANAGED SERVICES AND ETHERNET PRODUCT PORTFOLIOS.

SEE HOW ENHANCED MANAGEMENT PUTS YOU IN CONTROL

SEE HOW ENHANCED MANAGEMENT KEEPS YOU IN THE KNOW
LEVEL 3SM DYNAMIC CAPACITY

Change quickly and confidently to meet fluctuating network and bandwidth requirements—on demand and without the need for continual human intervention. Make unlimited changes, and instantly increase bandwidth up to 300 percent as needed, using intuitive, policy-based tools.

Level 3 Dynamic Capacity provides an easy self-service portal through which you can define criteria for scaling bandwidth on an ad hoc, planned or events-based basis. Grow capacity as network traffic increases, and return to normal when peak demand is past, seamlessly and cost effectively.

FEATURES
Make unlimited changes:
• **Ad hoc**: Instantly access additional bandwidth for unexpected traffic spikes, disaster recovery and seasonal fluctuations, with predictable, controlled costs.
• **Scheduled**: Scale as needed for rolling out software updates; backup and replication; and other regularly scheduled, high-demand requirements.
• **Events based**: In conjunction with Enhanced Management, allow network demand to trigger increased capacity automatically for high traffic events.

Employ Level 3 Dynamic Capacity application program interfaces (APIs) to embed the control of circuits into customer control systems.

BENEFITS
• Controls costs—pay for only what you need.
• Improves flexibility and agility by triggering bandwidth changes automatically based on defined performance thresholds.
• Saves time by making changes instantly and without the need for human intervention.
• Provides cost predictability through a clear, predetermined fee structure.
• Enhances visibility through comprehensive reports on all current and scheduled transactions, with detailed transaction history.

LEVEL 3 DYNAMIC CAPACITY IS AVAILABLE FOR THE LEVEL 3® IP VPN, MANAGED SERVICES AND ETHERNET PRODUCT PORTFOLIOS.

SEE HOW DYNAMIC CAPACITY MAKES SCHEDULING EVENTS SIMPLE
SEE HOW DYNAMIC CAPACITY DELIVERS SCALABILITY WITH SIMPLIFIED MANAGEMENT
LEVEL 3SM ADAPTIVE NETWORK CONTROL SOLUTIONS

LEVEL 3SM DYNAMIC CONNECTIONS

Change happens quickly in today’s business. You must be agile and responsive to capture emerging opportunities. Level 3 Dynamic Connections gives you the power and control needed to quickly add connections to private networks, locations, cloud partners or data centers. Anytime, on demand.

Planning a major software rollout? Add the connections you need, for as long as you need them. Expanding into new geographies? Use the cloud to connect with the people, data and applications you need, wherever they reside.

Through our relationships with today’s leading cloud services providers, including Amazon Web Services, Microsoft Azure and Google Cloud Platform, Level 3 can give your organization the application availability and performance you want, with proven network-based security you can trust.

FEATURES

- Establish private, high-performance connections to leading cloud partners
- Add or change cloud providers quickly—virtually anywhere, anytime
- Respond to sudden increases in demand for new cloud services

BENEFITS

- Enhances application and data accessibility and performance
- Saves time by enabling you to add connections rapidly, regardless of where those connection points are globally
- Saves money by minimizing up-front capital expenditures and reducing costs by using a shared infrastructure

LEVEL 3 DYNAMIC CONNECTIONS IS AVAILABLE FOR THE LEVEL 3 ETHERNET PRODUCT PORTFOLIO.
WE COULD BACK UP APPLICATIONS ONLY ONCE A DAY. NOW, WE CAN PERFORM DATA REPLICATIONS EVERY 15 MINUTES WITHOUT ANY SERVICE IMPACT OR LATENCY WITH SCHEDULING. DYNAMIC CAPACITY FUNCTIONS COMPLETELY ‘HANDS OFF,’ LIKE A MANAGED SERVICE.”

—Mike Somers, Director of IT at Brock White

THE SITUATION
United States–based construction materials supplier Brock White needed to increase the frequency of its business continuity and disaster recovery (BCDR) and data replication efforts, while reducing latency. With variable replication sizes and limited bandwidth, the enterprise struggled to perform replication as often as desired, because replication significantly eroded the experience of other users who were trying to access applications that shared network bandwidth.

Fluctuating demands and latency-sensitive applications meant that Brock White needed more than additional bandwidth; it needed a solution with dynamic, flexible bandwidth capabilities.

THE SOLUTION
Level 3 Adaptive Network Control Solutions, including Enhanced Management and Dynamic Capacity, were implemented. Providing dramatically enhanced granular visibility into network operations and the agility to automatically expand critical bandwidth as requirements shifted, the Level 3 solution delivered greater network capacity and performance.
AT LEVEL 3, WE’RE DEDICATED TO DELIVERING PROVEN SOLUTIONS—AND IMPROVING USER EXPERIENCES—FOR OUR CUSTOMERS.

Level 3 Adaptive Network Control Solutions were developed based on direct input from our customers about their real-world challenges. Designed to put new levels of power and control into your hands, these solutions provide enhanced visibility and simpler, more intuitive management of your complete network infrastructure. Highly scalable and widely available, they’re built on Level 3’s comprehensive data services platform and integrated systems architecture, which deliver outstanding efficiency and reliability.

WE’RE NETWORK EXPERTS
Level 3 built its reputation on developing networking technologies and brings rich insights and expertise to network evolution.

WE’RE CUSTOMER FOCUSED
Our focus on the user experience—not just network performance—gives Level 3 an enhanced perspective on how to evolve IT infrastructure to maximize the positive impact of technology on end users.

WE’RE INNOVATORS
In 2013, Level 3 successfully implemented an instance of SDN and made it available for direct use by our customers. The lessons learned from that effort continue to inform Level 3 Adaptive Network Control Solutions deployments.

WE’RE PROVEN
Level 3 has proven global expertise with SDN. We can provide commentary on how these technologies are relevant to marketplace trends.

WE’RE ALL ABOUT SECURITY
Increasingly virtualized environments need greater protection. Level 3 customers have access to a full range of security capabilities to help protect them from the world’s ever-evolving threats.

LEARN MORE ABOUT LEVEL 3 ADAPTIVE NETWORK CONTROL SOLUTIONS.
CHAPTER 03
LEVEL 3 ADAPTIVE NETWORK CONTROL SOLUTIONS

DYNAMIC CAPACITY AUTOMATES EVENT-BASED BANDWIDTH CHANGES

SCHEDULING IS SIMPLE

QUICK COMPARISONS

ACTIVATE WITH CONFIDENCE

KNOW WHERE YOU STAND

DYNAMIC CAPACITY AUTOMATES EVENT-BASED BANDWIDTH CHANGES

SCHEDULE or Recurring Event

Schedule Title: Schedule 07/25/2016

Pattern: Time Time Daily Weekly

Time: * Start: 1:49 PM * Duration: 3 Hrs (GMT - 07:00) Mountain Time

Range: * Start Date: 07/25/2016

Send additional notification to:

DYNAMIC CAPACITY AUTOMATES EVENT-BASED BANDWIDTH CHANGES

Change my bandwidth for: 180 PEACHTREE ST NW-ATLANTA GA, USA 30303 - 7 MASON-IRVINE CA, USA 92618

Service Address EVC

180 PEACHTREE ST NW-ATLANTA GA, USA 30303 - 7 MASON-IRVINE CA, USA 92618

VLXX140162/DEMO

Subscribed 100.0Mbps My Maximum Bandwidth

Cost for 100.0Mbps is $7.34 per hour.

Monthly DC billing cap at 2x: 144 hr(s) OR Monthly DC billing cap at 3x: 72 hr(s)

At 2x you reach your cap in: 144 hr(s) At 3x you reach your cap in: 72 hr(s)

Your next billing cycle for DC starts on: 8/24/2016 10:00:00 AM.

The Total Cost for your selected Capacity is $22.01.
The Rate Cap or "Get Started Hours" displayed have not been applied to your estimated cost.

Proceed with Activation
DYNAMIC CAPACITY AUTOMATES EVENT-BASED BANDWIDTH CHANGES

SCHEDULING IS SIMPLE
Choose event frequency, date, time and duration in just a few clicks.

QUICK COMPARISONS

ACTIVATE WITH CONFIDENCE

KNOW WHERE YOU STAND

The Total Cost for your selected Capacity is $22.01.
The Rate Cap or "Get Started Hours" displayed have not been applied to your estimated cost.
DYNAMIC CAPACITY AUTOMATES EVENT-BASED BANDWIDTH CHANGES

SCHEDULING IS SIMPLE

QUICK COMPARISONS
Slider tool allows you to easily compare costs, so you can make the right decision quickly.

KNOW WHERE YOU STAND

ACTIVATE WITH CONFIDENCE

The Total Cost for your selected Capacity is $22.01.
The Rate Cap or "Get Started Hours" displayed have not been applied to your estimated cost.

Proceed with Activation
SCHEDULING IS SIMPLE

QUICK COMPARISONS

ACTIVATE WITH CONFIDENCE

KNOW WHERE YOU STAND
Summary of current status against your cap helps guide your decision.
DYNAMIC CAPACITY AUTOMATES EVENT-BASED BANDWIDTH CHANGES

- **SCHEDULING IS SIMPLE**

- **QUICK COMPARISONS**

- **KNOW WHERE YOU STAND**

- **ACTIVATE WITH CONFIDENCE**
  See the cost for the event before you commit.
DYNAMIC CAPACITY AUTOMATES EVENT-BASED BANDWIDTH CHANGES

Change my bandwidth for:

Schedule Title: Activate Now 07/27/2016

To change bandwidth by location, select one or more locations, expand the view, and use the slider to choose your desired bandwidth, then select "Proceed with Activation". If you would like to create a scheduled or recurring event, select the "Schedule Event" tab on the left.

Service Address

<table>
<thead>
<tr>
<th>Subscribed</th>
<th>State</th>
<th>POP</th>
<th>Circuit ID</th>
</tr>
</thead>
<tbody>
<tr>
<td>1125 CHAMBERS RD, COLUMBUS, 43212</td>
<td>OH</td>
<td>KEFN/110424/DEMO</td>
<td></td>
</tr>
<tr>
<td>1150 REGAL ROW, DALLAS, 75247</td>
<td>TX</td>
<td>KEFN/124849/DEMO</td>
<td></td>
</tr>
</tbody>
</table>

Cost for 40.0Mbps is $5.99 per hour.

Monthly DC billing cap at 2x: 144 hr(s)
At 2x you reach your cap in: 144 hr(s)

Monthly DC billing cap at 3x: 72 hr(s)
At 3x you reach your cap in: 72 hr(s)

Your next billing cycle for DC starts on: 8/24/2016 10:00:00 AM.

The Total Cost for your selected Capacity is $20.36.

Proceed with Activation

WHERE YOU NEED IT

AS YOU NEED IT

KNOW BEFORE YOU COMMIT
Dynamic Capacity Automates Event-Based Bandwidth Changes

Immediate access to scale up bandwidth on the fly (2x or 3x) for as little as an hour at a time.

Where You Need It

Know Before You Commit
DYNAMIC CAPACITY AUTOMATES EVENT-BASED BANDWIDTH CHANGES

AS YOU NEED IT

WHERE YOU NEED IT
Apply bandwidth changes to multiple circuits from a single screen.

KNOW BEFORE YOU COMMIT
The Total Cost for your selected Capacity is $20.36.
The Rate Cap or "Get Started Hours" displayed have not been applied to your estimated cost.

Proceed with Activation

To change bandwidth by location, select one or more locations, expand the view, and use the slider to choose your desired bandwidth, then select "Proceed with Activation". If you would like to create a scheduled or recurring event, select the "Schedule Event" tab on the left.
Cost transparency means no billing surprises — and events can be traced to business critical needs for accounting purposes.
Enhanced management provides granular network visibility and control.

NOW AND THEN

DIG DEEPER

NETWORK PULSE

<table>
<thead>
<tr>
<th>Location</th>
<th>Location</th>
<th>CoS</th>
<th>E-to-E Latency</th>
<th>E-to-E Jitter</th>
<th>E-to-E Packet Delivery</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Z</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14200 E JEWELL AVE AURORA</td>
<td>1125 CHAMBERS RD COLUMBUS</td>
<td>Basic</td>
<td>36.90 ms</td>
<td>0.10 ms</td>
<td>100.00%</td>
</tr>
<tr>
<td>Section</td>
<td>From</td>
<td>To</td>
<td>Bandwidth</td>
<td>SLA</td>
<td>Latency</td>
</tr>
<tr>
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<td>----------</td>
<td>-----</td>
<td>-----------</td>
<td>-----</td>
<td>---------</td>
</tr>
<tr>
<td>CPE to POP</td>
<td>14200 E JEWELL AVE AURORA</td>
<td>Denver, CO, USA</td>
<td>30M</td>
<td>Yes</td>
<td>1.20 ms</td>
</tr>
<tr>
<td>POP to POP</td>
<td>Denver, CO, USA</td>
<td>Columbus, OH, USA</td>
<td>34.75 ms</td>
<td>No</td>
<td>0.00 ms</td>
</tr>
<tr>
<td>POP to CPE</td>
<td>Columbus, OH, USA</td>
<td>1125 CHAMBERS RD COLUMBUS</td>
<td>20M</td>
<td>No</td>
<td>0.95 ms</td>
</tr>
<tr>
<td>14200 E JEWELL AVE AURORA</td>
<td>1150 REGAL ROW DALLAS</td>
<td>Basic</td>
<td>21.86 ms</td>
<td>0.10 ms</td>
<td>100.00%</td>
</tr>
<tr>
<td>Section</td>
<td>From</td>
<td>To</td>
<td>Bandwidth</td>
<td>SLA</td>
<td>Latency</td>
</tr>
<tr>
<td>----------</td>
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<td>---------</td>
</tr>
<tr>
<td>CPE to POP</td>
<td>14200 E JEWELL AVE AURORA</td>
<td>Denver, CO, USA</td>
<td>30M</td>
<td>Yes</td>
<td>1.20 ms</td>
</tr>
<tr>
<td>POP to POP</td>
<td>Denver, CO, USA</td>
<td>Dallas, TX, USA</td>
<td>19.54 ms</td>
<td>No</td>
<td>0.00 ms</td>
</tr>
<tr>
<td>POP to CPE</td>
<td>Dallas, TX, USA</td>
<td>1150 REGAL ROW DALLAS</td>
<td>40M</td>
<td>No</td>
<td>1.13 ms</td>
</tr>
</tbody>
</table>

Report Information
Performance metrics are derived from continuous active tests between Level 3’s POP and the customer’s location every five seconds for each network traffic class. The results of these tests are averaged every 90 seconds.

SLA metrics are based on one month durations.
NOW AND THEN
Select the duration-based view that’s right for your needs.

ENHANCED MANAGEMENT PROVIDES GRANULAR NETWORK VISIBILITY AND CONTROL

NOW AND THEN
Select the duration-based view that’s right for your needs.

DIG DEEPER

NETWORK PULSE

### Data

Select the duration-based view that’s right for your needs.

#### Network Pulse

**Location A**

<table>
<thead>
<tr>
<th>Direction</th>
<th>From Location</th>
<th>To Location</th>
<th>CoS</th>
<th>E-to-E Latency</th>
<th>E-to-E Jitter</th>
<th>E-to-E Packet Delivery</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPE to POP</td>
<td>14200 E JEWELL AVE AURORA</td>
<td>Denver, CO, USA</td>
<td>Basic</td>
<td>30M</td>
<td>1.20 ms</td>
<td>0.10 ms</td>
</tr>
<tr>
<td>POP to POP</td>
<td>Denver, CO, USA</td>
<td>Columbus, OH, USA</td>
<td>24.75 ms</td>
<td>0.00 ms</td>
<td>100.00%</td>
<td></td>
</tr>
<tr>
<td>CPE to POP</td>
<td>Columbus, OH, USA</td>
<td>1207 CHAMBERS RD COLUMBUS</td>
<td>20M</td>
<td>No</td>
<td>0.95 ms</td>
<td>0.09 ms</td>
</tr>
</tbody>
</table>

**Location B**

<table>
<thead>
<tr>
<th>Direction</th>
<th>From Location</th>
<th>To Location</th>
<th>CoS</th>
<th>E-to-E Latency</th>
<th>E-to-E Jitter</th>
<th>E-to-E Packet Delivery</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPE to POP</td>
<td>14200 E JEWELL AVE AURORA</td>
<td>Dallas, TX, USA</td>
<td>Basic</td>
<td>21.86 ms</td>
<td>0.10 ms</td>
<td>100.00%</td>
</tr>
</tbody>
</table>

**Location C**

<table>
<thead>
<tr>
<th>Direction</th>
<th>From Location</th>
<th>To Location</th>
<th>CoS</th>
<th>E-to-E Latency</th>
<th>E-to-E Jitter</th>
<th>E-to-E Packet Delivery</th>
</tr>
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<tbody>
<tr>
<td>CPE to POP</td>
<td>14200 E JEWELL AVE AURORA</td>
<td>Dallas, TX, USA</td>
<td>Basic</td>
<td>19.54 ms</td>
<td>0.00 ms</td>
<td>100.00%</td>
</tr>
</tbody>
</table>

### Report Information

Performance metrics are derived from continuous active tests between Level 3's POP and the customer's location every five seconds for each network traffic class. The results of these tests are averaged every 90 seconds.

SLA metrics are based on one month durations.
Enhanced visibility into circuit segment performance reveals network congestion points faster, for more effective communication during troubleshooting.
ENHANCED MANAGEMENT PROVIDES GRANULAR NETWORK VISIBILITY AND CONTROL

NOW AND THEN

NETWORK PULSE
Roll up of network performance metrics allows monitoring at a glance.
SET METRICS-BASED THRESHOLDS AND ALERTS

Performance metrics are derived from continuous active tests between Level 3 and the customer's location every five seconds for each network traffic class. The results of these tests are averaged every 60 seconds.

SLA metrics are based on one month durations.
IP VPN insights: IP VPN customers can set thresholds and alerts across Class of Service in addition to the four standard metrics.

Set metrics-based thresholds and alerts.
Select the combination of performance metrics that you want to monitor—choose from latency, utilization, jitter and packet delivery.
For circuits with both Dynamic Capacity and Enhanced Management, utilization thresholds can be set to automate bandwidth changes on demand.