Technical Dependencies: 
*Network Influence on Backup Centralization*

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Backup Buck Gets No Respect
Topics

• The Business Drivers of Data Protection

• Basic Concepts in Data Protection

• Network Impact: Technology Considerations

• The Verizon Data Center Practice: Putting the Pieces Together
The Business Drivers

Protecting Information

Network Impact

Verizon Data Center Practice
Business Considerations: Starts with Leadership!!
Technologies Dictated By RPO/RTO

- Full Volume Tape: Backup Nightly
- Tape Vaulting
- Database Journaling
- Consistent Recovery
- Restart
- Asynchronous "Point in Time" Copy
- Continuous Asynchronous
- Synchronous Mirror

Hours of Lost Transactions (RPO)

| Hours Required to Resume Business (RTO) | Cost Per Month
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>-24</td>
<td>20K</td>
</tr>
<tr>
<td>-12</td>
<td>30K</td>
</tr>
<tr>
<td>0</td>
<td>40K</td>
</tr>
<tr>
<td>12</td>
<td>60K</td>
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<tr>
<td>24</td>
<td>90K</td>
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<td>36</td>
<td>150K</td>
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<td>48</td>
<td>250K</td>
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<tr>
<td>60</td>
<td></td>
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<tr>
<td>72</td>
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</table>

- Transactions Not Captured
- Declaration
- Data Retrieval
- Transit
- System Restore
- IPL & Network
- Database Restore
- Transaction Recreation
RTO/RPO Drivers for Remote Protection Schemas

**• RTOs/RPOs coupled w/ Geographic Diversity dictate:**
  - Level Of Protection
  - Level Of Network Requirements
  - Level Of Application Requirements
The Business Drivers

Protecting Information

Network Impacts

VZ Data Center Practice

verizonbusiness
## Protection Level Distinctions

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>BACK-UP</th>
<th>ARCHIVE</th>
<th>MIRRORING</th>
</tr>
</thead>
<tbody>
<tr>
<td>DATA TYPE</td>
<td>• Secondary Copy</td>
<td>• Primary Copy</td>
<td>• Secondary Copy</td>
</tr>
<tr>
<td>RETENTION DURATION</td>
<td>• Long Term Overwritten Data</td>
<td>• Long Term Retention</td>
<td>• Short Term Retention</td>
</tr>
<tr>
<td>DATA ACCESS LAYER</td>
<td>• File Level Access</td>
<td>• Block and/or File*</td>
<td>• Block Level</td>
</tr>
<tr>
<td>RPO/RTO CHARACTERISTIC</td>
<td>• Long RPO/RTO*</td>
<td>• UNPROTECTED</td>
<td>• Typically Short RPO/RTO</td>
</tr>
<tr>
<td>CONTROLLER MECHANISM</td>
<td>• Appliance</td>
<td>• Host</td>
<td>• Host</td>
</tr>
<tr>
<td></td>
<td>• VTL</td>
<td>• Appliance</td>
<td>• Appliance</td>
</tr>
<tr>
<td></td>
<td>• Library</td>
<td>• Various Platforms</td>
<td>• Array</td>
</tr>
<tr>
<td>MEDIA</td>
<td>Tape/Disk/CD</td>
<td>• Tape/Disk/CD</td>
<td>• Disk</td>
</tr>
</tbody>
</table>
The Why’s Of Backup

WHY WE BACKUP:

• **We Have To!**
  – The Health Insurance Portability and Accountability Act of 1996 (HIPAA), Public Law 104-191
  – Sarbanes-Oxley
  – Various State E.O.s & Mandates

• **Long Term Roll Back**

• **Protection Against:**
  – Virus
  – Human Error
  – Disaster

WHY WE BACKUP SECURELY:

• **We Have To!**
  – CA Senate Bill 1386
  – Payment Card Industry (PCI) Data Security Standard
  – FISMA

• **Protection Against:**
  – Info Compromise
  – Law Suits
  – BAD Press
Why Backup is Changing (AGAIN!!)

Issue: How We Protect Primary Data?
Answer: Tethered Tape Drives & Removable Media for Vaulting

Issue: Distributed Systems creating Server Tape Gophers
Answer: Centralize Backup Over the LAN (Backup Server plus Tape Library)

Issue: Backups over LAN clogging Network
Answer: Create LAN-Free Backups over Storage Area Network (SAN)

Issue: Restore Times taking painfully long
Answer: Backup to Disk

Issue: Backup Environment too Difficult to Manage
Answer: Virtual Tape Libraries

Issue: Tapes Being Compromised When Transporting Off-Site
Answer: AES based Encryption; Transport Data Over WAN

Issue: Too Much 411 to Backup Remote Offices &/or Pipeline for BCDR Over the WAN!!
Answer: Data De-duplication & Smart Policies
# Tape v. Disk Fundamental Comparisons

<table>
<thead>
<tr>
<th>MEDIA</th>
<th>TAPE</th>
<th>BACKUP 2 DISK</th>
</tr>
</thead>
</table>
| **Performance** | ▪ Limited throughput  
▪ No random access to data  
▪ Tape start/stop affects overall throughput  
▪ Handles multiple requests ineffectively | ▪ Disk based restores up to five times faster than physical tape  
▪ Very low seek time and does not require sequential read/write behavior |
| **Reliability** | ▪ Mechanical failures  
▪ Libraries, drives, and cartridges  
▪ Media has limited life  
▪ Media does not support RAID protection | ▪ RAID-protected storage  
▪ Redundancy in all touch points and paths between drives, switches and servers |
| **Management** | ▪ Cost of transporting tapes  
▪ Time to retrieve tape for restore  
▪ Risk of lost tapes | ▪ Less time spent tuning system  
▪ Less time retrieving/shipping media  
▪ Does not require backup application to be upgraded  
▪ Requires no change to operational processes  
▪ Data on disk can be remotely copied; no reliance on shipping  
▪ Offers compression for lower cost |
Backup Traps: Managing Growth & Complexity

1. Build Storage Network!
2. Software & VTL
3. Active Archive
4. SMART Policies
5. Dedupe!
Backup Traps: Tape Inflexibility
The Business Drivers

Protecting Information

Network Impact

VZ Data Center Practice
No Wheels, No Problem(?)
Why Centralize Backups Over the Network?

- SERVE Remote CLIENTS!!
- Unified Control
- More Secure
- Standardized Method
- Backup Administrative Headaches Gone
- More Robust & Predictable BCDR solutions
# Verizon’s VPN Portfolio

<table>
<thead>
<tr>
<th></th>
<th>Private IP (Layer 3 VPN)</th>
<th>Private IP – Layer 2</th>
<th>VPLS</th>
<th>EVPL (CPA)</th>
<th>EVPL (SES)</th>
<th>ELAN (SES)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Security</strong></td>
<td>Private network Routes shared</td>
<td>Private network Routes not shared</td>
<td>Private network Routes not shared (MAC addresses learned)</td>
<td>Private network Routes not shared</td>
<td>Private network Routes not shared</td>
<td>Private network Routes not shared (MAC addresses learned)</td>
</tr>
<tr>
<td><strong>Connectivity</strong></td>
<td>Any to Any</td>
<td>Point-to-Point</td>
<td>Any to any</td>
<td>Point-to-Point</td>
<td>Point-to-Point</td>
<td>Any to any</td>
</tr>
<tr>
<td><strong>Granularity</strong></td>
<td>1M to 1G</td>
<td>1M to 1G</td>
<td>1M to 1G</td>
<td>1M to 1G (10G ICB)</td>
<td>1M to 1G (10G ICB)</td>
<td>1M to 1G</td>
</tr>
<tr>
<td><strong>Class of Services</strong></td>
<td>6</td>
<td>6</td>
<td>4</td>
<td>1 (4 in 2009)</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td><strong>Layer 3</strong></td>
<td>IP Protocol</td>
<td>Flexible protocols</td>
<td>Flexible protocols</td>
<td>Flexible protocols</td>
<td>Flexible protocols</td>
<td>Flexible protocols</td>
</tr>
<tr>
<td><strong>Access</strong></td>
<td>TDM, Ethernet, DSL</td>
<td>TDM; Ethernet</td>
<td>Ethernet</td>
<td>Ethernet</td>
<td>Ethernet</td>
<td>Ethernet</td>
</tr>
<tr>
<td><strong>Familiarity</strong></td>
<td>IP familiarity</td>
<td>Legacy protocol familiarity</td>
<td>Ethernet familiarity</td>
<td>Ethernet Familiarity</td>
<td>Ethernet Familiarity</td>
<td>Ethernet Familiarity</td>
</tr>
<tr>
<td><strong>Network Technology</strong></td>
<td>MPLS Based</td>
<td>MPLS Based</td>
<td>MPLS Based</td>
<td>Ethernet Based (MPLS Based in 2009)</td>
<td>Ethernet Based</td>
<td>Ethernet Based</td>
</tr>
</tbody>
</table>
Challenges Backing Up Over the WAN

Lacks Convergence/Multi Circuits Required
Traffic Shaping Over Core Non-Existent
Security Over Public Network Routing
Scalability Complexity with Separate Interconnects
Availability/Resiliency Near Non-Existent without Complex Routing Tables

Traditional Frame Relay, ATM, or Private Line Networks

Verizon Private IP
Efficiency: MPLS Creates Convergence of Protocols

- CE Router assigns Diff Serv
- PE Router Uses Diff Serv Queuing
- Core Uses Experimental Bit to Queue Core Traffic
Traffic Shaping: Private IP Global QoS

Ubiquitous Global Six CoS Offering
QoS Granularity and Design capable of Supporting Voice, Video and Multiple Levels of Data Apps

The Data Classes of Service: AF4x, AF3x, AF2x, AF1x and Default are all Burstable to Port Speed Ingress/Egress

Private IP Backbone is QoS aware and NOT part of a Common/Shared Backbone with the Public IP network.
Private IP Architecture and Security

- Private IP is a Globally Separate MPLS Network from the VzB Global Public IP MPLS Network
- Traffic utilization anomalies on the Public IP network do not affect the Private IP MPLS Backbone

= Additional Security and Reliability
= Predictable Quality of Service

Verizon Business Private IP MPLS Architecture Design

No Shared or Common MPLS Cores between Public IP and Private IP Services

Other MPLS Providers: Shared or Common Core MPLS Architecture Design

VzB Private IP MPLS

VzB Public IP

Shared or Common MPLS Core
Security: Secure Gateway Architecture

Private IP Site w/Retail and Remote Office Backup

Private IP Site HQ/Data Center

Private IP or other Verizon Network Service

Secure Gateway 1 – Primary

Secure Gateway 2 – Fail-over

Secure Gateway’s MPLS Network

Verizon’s IP Network Internet

3rd Party IP Network Internet

Retail and Remote Office

Mobile User

Wireless Access (Wi-Fi, EVDO)

Wired Access (Broadband, Dial, Dedicated)

Encrypted Tunnel
Private VPN
Firewall Approved Traffic
Scalability: Any-to-any VPN (Default Design)

- All sites configured as Hubs with Any-to-Any routing within the VPN

  - **PE VRFs at All Customer VPN Sites:**
    - Exports site’s routes with Route Target = Dark Blue
    - Imports site’s routes with Route Target = Dark Blue

Remote Site’s Import and Export Route Targets are equal to all other sites, Remotes and Hubs, so any-to-any routing is allowed across the VPN.

Hub Site’s Import and Export Route Targets allow for Any-to-Any routing between all sites within the VPN.
PIP Example: Building Scalable, Resilient Networks
Meeting the WAN Backup Challenges

1. Data Outpacing Network

2. Add On Clients

3. Remote Offices Growing

### Time to transfer Calculator

<table>
<thead>
<tr>
<th>Bytes to Transfer</th>
<th>350.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enter (0, 1, 2, 3)</td>
<td>1</td>
</tr>
<tr>
<td>TeraBytes = 0</td>
<td></td>
</tr>
<tr>
<td>GigaBytes = 1</td>
<td></td>
</tr>
<tr>
<td>MegBytes = 2</td>
<td></td>
</tr>
<tr>
<td>Bytes = 3</td>
<td></td>
</tr>
<tr>
<td>Native Link Speed (bits):</td>
<td>47,185,920</td>
</tr>
<tr>
<td>Amount of Latency (ms)</td>
<td>50</td>
</tr>
<tr>
<td>Maximum Possible Throughput Bits/sec</td>
<td>46,242,202</td>
</tr>
<tr>
<td>Window Size per Port</td>
<td>1</td>
</tr>
<tr>
<td>Default 1MByte (1,2,4,8)</td>
<td></td>
</tr>
<tr>
<td>Actual Window Size Kbytes</td>
<td>1024</td>
</tr>
<tr>
<td>Number of Ports</td>
<td>2</td>
</tr>
<tr>
<td>Default 1</td>
<td></td>
</tr>
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</table>

#### Link Type to Size:
- T1 1.5 Mbits
- T3 45 Mbits
- OC3 155 Mbits
- OC12 655 Mbits
- OC48 2.5 Gbits
- OC192 4.6 Gbits

#### Throughput Rate Bits/Sec:
- 3,500,000,000,000 Bytes/Sec
- 44,826,624 Bits/Sec
- 5,603,328 Bytes/Sec

#### Transfer Time

<table>
<thead>
<tr>
<th>Compression Ratio</th>
<th>Minutes</th>
<th>Hours</th>
<th>Days</th>
</tr>
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<tr>
<td>1:1</td>
<td>1,301</td>
<td>21.7</td>
<td>0.9</td>
</tr>
<tr>
<td>2:1</td>
<td>651</td>
<td>10.8</td>
<td>0.5</td>
</tr>
<tr>
<td>3:1</td>
<td>434</td>
<td>7.2</td>
<td>0.3</td>
</tr>
<tr>
<td>4:1</td>
<td>325</td>
<td>5.4</td>
<td>0.2</td>
</tr>
<tr>
<td>5:1</td>
<td>260</td>
<td>4.3</td>
<td>0.2</td>
</tr>
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</table>
The Business Drivers

Protecting Information

Protecting the Network

VZ Data Center Practice
Private IP Key Service Differentiators

• **Verizon’s depth of MPLS experience**
  – Private IP has been in-service since January 2000
  – Over 6,775 customers with over 200,300 customer ports in-service as of Sept 2008

• **Very broad national and global footprint**

• **Dedicated private MPLS core**
  – No sharing of public IP infrastructure or connectivity to Internet

• **End-to-end QoS including core**
  – Not just “edge” QoS; enforced per hop end-to-end
  – 6 classes / 6 queues

• **Full suite of Layer 2 encapsulations and access methods**

• **Strong industry leading SLAs**
  – Measured per PE site pair; no network-wide averages

• **Strong emphasis in reducing network convergence times (reroute, failure detection time, …)**
Verizon End-to-end solutions

Solving Storage Challenges for Enterprise Customers

Networking

- Storage Networking and Access (MPLS, WDM, SONET, Ethernet, SAN, IP)

Services

- Business Planning
  - Business Continuity/Disaster Recovery
  - HIPAA
  - Sarbanes-Oxley
  - Homeland Security

- Storage Services
  - Data Center co-location
  - Assessment
  - Data Replication
  - SAN Management
  - Remote Backup and Restore
  - Hosted Storage

Storage Hardware

CPE

Storage Switches and Peripherals
The California Strategic Sourcing Initiative (CSSI)

DGS Contract #: 1S-05-70-10 (Open Systems Hardware, Software & Services)
DGS Contract #: 1S-05-70-11 (Mainframe Systems Hardware, Software & Services)

<table>
<thead>
<tr>
<th>Features</th>
<th>Benefits</th>
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<tbody>
<tr>
<td>• Competitively bid Contracts</td>
<td>• Reliable storage solutions</td>
</tr>
<tr>
<td>• Pre-negotiated rates for EMC</td>
<td>• In alignment with Integrated IT</td>
</tr>
<tr>
<td>solutions</td>
<td>Governance Approach</td>
</tr>
<tr>
<td>• Guaranteed Small Business</td>
<td>• No cap on contract/order value</td>
</tr>
<tr>
<td>Participation</td>
<td>• Allows use of design/build</td>
</tr>
<tr>
<td>• EMC-accredited pre-sales</td>
<td>approach</td>
</tr>
<tr>
<td>engineering support</td>
<td>• Reduced time and cost in</td>
</tr>
<tr>
<td>• No requirement to use traditional</td>
<td>procurement</td>
</tr>
<tr>
<td>RFP, RFQ or FSR process</td>
<td></td>
</tr>
</tbody>
</table>

References

Storage Networking Industry Association:  www.snia.org

EMC Corporation:  www.emc.com


*Using SANs and NAS*, W. Curtis Preston, O’Reilly Publishing

*Designing Storage Area Networks*, Tom Clark, Addison Wesley Publishing

*Storage Area Networks for Dummies*, Christopher Poelker & Alex Niktin, Wiley Publishing, Inc.

*Storage Virtualization*, Tom Clark, Addison Wesley Publishing

*Principles of SAN Design*, Josh Judd and Dan Kruger, Infinity IO Publishing
Contact Info

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  - Office: 916-779-5695
  - Cell: 916-803-0478
Thank you for your time!
The Private IP MPLS Network is RFC 2547/4364 Compliant

CE = Customer Edge Router
PE = Provider Edge Router

OC-12 POS/ATM Encapsulation
OC-48 POS Encapsulation
OC-48/OC-192/OC-768 POS Encapsulation
Private IP End-to-End Core QoS

VzB PE Ingress
6 CoS

Real Time / Voice
CS5, EF

Video / Priority Data
CS4, AF41/42/43

Mission Critical Data
CS3, AF31/32/33

Business Data
CS2, AF21/22/23

General Data
CS1, AF11/12/13

Default
CS0, Other DSCP Values

MPLS
EXP Set by the PE

EXP=5
Priority Queuing

EXP=4
CBWFQ

EXP=3
CBWFQ

EXP=2
CBWFQ

EXP=0
CBWFQ

Private IP QoS
Aware Core

VzB PE Egress
6 CoS
6 Queues

Priority Queuing

CS5, EF

CBWFQ

EXP=5
Priority Queuing

CBWFQ

EXP=4
CBWFQ

EXP=3
CBWFQ

EXP=2
CBWFQ

CBWFQ

EXP=0
CBWFQ

WRED High – CS6, CS7
WRED Med – CS3, AF31
WRED Low – AF32, AF33

WRED High – CS2, AF21
WRED Low – AF22, AF23

WRED High – CS1, AF11
WRED Low – AF12, AF13

CBWFQ

WRED –
CS0, Other DSCP

CE
Egress
QoS

CE
IPv6 support on the Private IP MPLS network is planned for availability in the 2Q/3Q 2009 timeframe pending IOS certification and deployment within the Verizon Business Provider Edge routers.

IPv6 support will be based on RFC 4659, an extension of RFC 4364, which allows for the distribution of IPv6 routes.

Connectivity via IPv4 or dual stack v4/v6 will be supported on EBGp and Static routing (Customer Edge Router) CE to Provider Edge Router PE links.
Connectivity Options and Access Methods for Private IP

- Port speeds range from DS0 to GigE
- Ethernet Port Speeds range from 1Mbps to 1Gbps
- Access methods:
  - TDM Private Line Local Access
    » DS0 to OC-12 (Standard)
  - DSL (48 Contiguous U.S)
  - Indirect Frame Relay and ATM access
  - Private Satellite
  - MLPPP NxE1/T1
  - Sub-Rate DS3
  - Sub-rate OC-3 and OC-12
    » Via Dynamic Port
  - Ethernet Fast-E and Gig-E
  - Wireless Access
    » Private Verizon Wireless EVDO Access

- Future access methods:
  - MLFR NxE1/T1 (Multilink Frame)
    » Interface support for Multi-VPN designs
    » Targeted for 1st Half 2009
  - Subrate OC-48 Access
    » 1st Half 2009
  - Subrate 10 GigE Access
    » 1st Half 2009

- Layer 2 Encapsulations Supported:
  - Frame Relay, ATM, POS, PPP, HDLC, Ethernet

- Routing Protocols Supported:
  - BGP, RIPv2, Static
  - OSPF (Individual Case Basis)
  - EIGRP (Individual Case Basis)
Network Diversity: VSAT

22,300 miles

VSAT Antenna
Building

VSAT Modem with built in router

Customer Remote Site

6.1M Antenna
Andover, ME

Private IP

ESR

Customer PIP Site

verizon
business