Cisco's Cloud Services Router (CSR): Extending the Enterprise Network to the Cloud

BRKVIR-2016

Bopaiah Puliyanda, Technical Marketing Engineer
CSR 1000V is a Cloud ready IOS-XE powered Router
Agenda

- Cloud Deployment Models
- CSR Architecture
- Use-Cases
- Management
- Licensing
- Performance and Scale
- Closing (Q&A)
Cloud Deployment Models
Enterprise moving IT Services to Cloud

“43 % of the companies will run the majority of their IT in the cloud in the next four years”

Source: Gartner Executive Worldwide Survey, Jan 2011
Cloud Adoption Drivers

- Tremendous Compute
- Operational Savings
- Business Continuity
- Scalable & Elastic
- Pay As You Go
- Resiliency
Various Models

Models
- IaaS
- PaaS
- SaaS

Cloud Options
- Public
- Private
- Hybrid
Various Vendors

Models

IaaS

Vendors

Amazon

Rackspace

Focus

IT

PaaS

Google Engine

Microsoft Azure

Developers

SaaS

Google Apps

Salesforce

End Users
Will your Enterprise pursue a Hybrid Cloud strategy?

<table>
<thead>
<tr>
<th>Response</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>YES</td>
<td>67%*</td>
</tr>
<tr>
<td>NO</td>
<td>7%</td>
</tr>
<tr>
<td>MAYBE</td>
<td>26%</td>
</tr>
</tbody>
</table>

*Yes response last year was 47%*

Source: Gartner DC summit 2012
CSR 1000V Platform and Architecture
ASR 1K Architecture

- **RP (Route Processor)**
  - Handles control plane traffic
  - Manages system

- **ESP**
  - Handles forwarding plane traffic

- **SPA Interface Processor**
  - Shared Port Adapters provide interface connectivity

- **Centralized Forwarding Architecture**
  - All traffic flows through the active ESP, standby is synchronized with all flow state with a dedicated 10Gbps link

- **Distributed Control Architecture**
  - All major system components have a powerful control processor dedicated for control and management planes
CSR 1000V Architecture - virtualized IOS XE

- Virtualized IOS XE
  - Forwarding (ESP) and Control (RP) implemented as processes and mapped to vCPUs
  - SPAs mapped to VNICS
  - Bootflash: and NVRAM: are mapped into memory from hard disk
  - Hardware specifics abstracted through a virtualization layer
  - Generalized to work on any x86 system
  - No dedicated crypto engine – we leverage the Intel AES-NI instruction set to provide hardware crypto assist
  - Boot loader functions implemented by GRUB
Cloud Ready Router

- **IOS-XE code**
  - Comprehensive feature set
  - 4 month release cycle – 3.9 (March ‘13), 3.10 (July ‘13)…

- **Infrastructure Agnostic**
  - Cisco UCS, Dell, HP, etc
  - Runs on vSwitch, dVS, N1KV, etc. – no dependency
  - VMware ESXi 5.0 supported today

- **Footprint**
  - 4 vCPU (2 cores * 2 = 4 vCPU with Hyper Threading). CPU Affinity not reqd.
  - 4 GB DRAM
  - 8 GB HD – Local, SAN, NAS supported
Cloud Ready Router

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  - Comprehensive feature set
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- **Footprint**
  - 4 vCPU (2 cores * 2 = 4 vCPU with Hyper Threading). CPU Affinity not reqd.
  - 4 GB DRAM
  - 8 GB HD – Local, SAN, NAS supported
2 New Hypervisors supported: Citrix Xen Server 6.1, KVM – RHEL 6.3, RHEV 3.1

Amazon AMI image available (Beta mode). Official support in 3.11

New lower footprint – 1 vCPU (default)*

Memory elasticity – 2.5 GB (default) to 8 GB. New 8 GB license

AMD processor support

REST API support

New license options – 500 Mbps, 1 Gbps STD. 100 Mbps ADV. 100 Mbps PREM

*Only on ESXi
CSR VM Network Connectivity

- Up to 32 vNICs supported – effectively limited only by hypervisor. ESXi limit is 10.
- Sub-interfaces (dot1Q) supported. Up to 4000 / GE interface.
- G0 is default management interface. Placed in “Mgmt-intf” VRF. VRF cannot be deleted. *will be removed in 3.11*

1:1 CSR to Host interface

N:1 CSR to Host interface

CSR dot 1Q trunking
Virtual Network Interfaces

- 3 vNICs automatically created during OVA deployment
- VMXNET3 driver
- vNIC Hot Add/Remove support
# Feature Support – IOS / Virtualization

<table>
<thead>
<tr>
<th>IOS-XE Technology</th>
<th>Supported Features</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Routing</strong></td>
<td>BGP, EIGRP, OSPFv3, RIPv2, ISIS, MPLS, LISP</td>
</tr>
<tr>
<td><strong>Security</strong></td>
<td>Zone Based Firewall, Site-to-Site VPN, EZVPN, DMVPN, FLEX VPN</td>
</tr>
<tr>
<td><strong>L2 Extension</strong></td>
<td>OTV, VPLS, L2TPv3, EVC</td>
</tr>
<tr>
<td><strong>High Availability</strong></td>
<td>HSRP, VRRP</td>
</tr>
<tr>
<td><strong>WAN Optimization</strong></td>
<td>WCCPv2, AppNav</td>
</tr>
<tr>
<td><strong>Management Instrumentation</strong></td>
<td>Flexible NetFlow , EEM, IP SLA</td>
</tr>
<tr>
<td><strong>Infrastructure &amp; Other</strong></td>
<td>NAT, ACL, QoS, GRE, Multicast, NBAR2 / AVC</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>VMWare ESXi Supported Features</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Supported</strong></td>
</tr>
<tr>
<td><strong>Unsupported</strong></td>
</tr>
</tbody>
</table>

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CSR 1000V Use-Cases
Single-Tenant Gateway in the Cloud

- Can be deployed by Enterprises or Cloud Providers

Current Use Cases
- MPLS CE Router (vCE)
- Network Services – VPN Gateway, Control Point
- Hybrid Cloud Connectivity - L2/ L3 Extension

Potential Use Cases
- MPLS PE Router (vPE)
- Control Plane Function – Route Reflector
- Military Apps – MANET/ Radio-aware Routing
Data Center Scale Challenge

<table>
<thead>
<tr>
<th>Issue</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 BGP peers/customer, 2 VRFs /customer</td>
<td>L3 Control Plane Scale</td>
</tr>
<tr>
<td>Separate devices to provide services – ACE, ASA, etc.</td>
<td>Operational Complexity</td>
</tr>
<tr>
<td>5 VLANs / customer. 4096 VLAN limit</td>
<td>L2 Scale</td>
</tr>
</tbody>
</table>
Data Center Architecture with CSR (vCE)

- Edge PE has a per-customer VRF subinterface
- 1 transport VLAN / customer from edge PE to CSR
- 1 eBGP session from edge PE to CSR (PE-CE peering)
- 1 CSR instance / customer – every CSR can terminate upto 4096 customer/server VLANs
- CSR implements rich services – Zone Based Firewall, IPSec based VPNs, etc.
- Horizontal elasticity – spin up CSR instances easily to scale tenants
- Potentially support up to 4000 tenants in a single POD
- **VXLAN L2 Gateway** functionality
- CSR directly participates in VXLAN networks
- L2 Bridging between VXLAN and untagged or 802.1q
- Based on EVC framework with BD (Bridge Domain) construct
- BDI interface provides L3
- Connect VMs to VXLAN networks without a specialized virtual switch
**CSR Secure VPN Gateway**

**VPN Challenges**
- Integrating Enterprise & Cloud VPN policies
- Backhaul to data center increases latency
- Each cloud imposes different VPN type and scale limits

**VPN Solutions**
- Common VPN Types: IPSec, DMVPN, EZVPN, FlexVPN
- Routing based VPNs and private addressing
- Firewall, ACLs, AAA

**CSR Benefits**
- Direct, secure access. Avoids backhaul to data center.
- Familiar, reliable, and scalable VPN
- Compatible with existing management tools
CSR Data Center Interconnectivity

Overlay Transport Virtualization (OTV)
- Layer-2 subnet extension
- Supports non-IP traffic
- Enables clustered applications across sites
- Enables live VM migration between sites

Locator/ID Separation Protocol (LISP)
- IP mobility allows VM to move between sites without worrying about subnet numbering
- Use in conjunction with OTV to optimize routing for extended subnets

Nexus 1000V InterCloud
- Extend Nexus 1000V subnets into public clouds
- Convert VMs and move them to the cloud
- Secures the cloud network
- CSR provides gateway functionality to the secured InterCloud network
- Allows L2 extension without vSwitch promiscuous mode
**Nexus 1000V InterCloud + CSR 1000V (3.11)**

- InterCloud extends and secures L2 subnets into public clouds
- CSR provides access into the secure InterCloud network
  - VPN for branch and remote users
  - Inbound and outbound direct Internet access for cloud applications
  - Routing and services within InterCloud network
CSR as Control Point – AppNav Controller

- Application-Based Flow Distribution
- Dynamic Status Reporting
- Intelligent failure mitigation
CSR on Public Clouds – Amazon (3.11)

Remote Users

- Direct access to applications in the cloud
- No per-tunnel VPN fees
- Use existing AAA system for VPN
- Application visibility

Amazon EC2

- Integration with existing VPN infrastructure
- Extend existing security policies
- Stateful zone-based firewalling
- All-you-can-eat VPN scalability
- Application visibility, and QoS

Remote Locations

- Direct access to applications in the cloud
- No per-tunnel VPN fees
- Use existing AAA system for VPN
- Application visibility
Where can I find the CSR?

In the **AWS Marketplace**!
How is it Licensed/ Purchased?

1. Deploy BYOL* AMI from Marketplace
2. Install Existing License

1. Deploy BYOL* AMI from Marketplace
2. Register Instance w/Cisco Smart Licensing

1. Choose CSR Performance and Features
2. Deploy Corresponding AMI from Marketplace
3. Billed Hourly by Amazon

*BYOL: Fancy acronym for “Bring Your Own License”
m1 large, m3 xlarge, etc are EC2 instance types – determined by CPU, storage, memory
CSR 1000V Management
**CSR 1000V Management**

<table>
<thead>
<tr>
<th>Self-Managed Environment</th>
<th>Automated Environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Cisco Prime</td>
<td>Cisco CSR 1000V RESTful API</td>
</tr>
<tr>
<td>- Cisco IOS CE CLI and SNMP</td>
<td></td>
</tr>
<tr>
<td>- 3rd Party Network Management</td>
<td></td>
</tr>
<tr>
<td>VMware vCenter Server</td>
<td>VMware vSphere Management API</td>
</tr>
<tr>
<td>VMware vCloud Director</td>
<td>VMware vCloud API</td>
</tr>
</tbody>
</table>

- Additional multi-tenant management options from Cisco will be available in the future
- Additional hypervisors and their management options will be available in the future
Automated CSR Provisioning – BDEO tool

- BDEO is Build Deploy Execute OVF
- Download CSR 1000V OVA from www.cisco.com
- A shell script (bdeo.sh) included in the CSR OVA (tar archive) – Unzip the OVA file
Automated CSR Provisioning – BDEO tool

- Currently supported only for VMware ESXi
- Takes OVA (or ISO) as input. Outputs custom OVA pre-provisioned with *basic IOS configuration* elements (mgmt. IP address, SSH, hostname, etc)
- Resulting OVA can be deployed to a Host
- Complete IOS config. (txt file) can also be applied – **must deploy to VCenter**, cannot reference host directly
- BDEO provides the intelligence to extract the config. info. and pass it to IOS
- Requires **VMware OVF tool** in the path for deployment
Automated CSR Provisioning – BDEO tool

$ ./bdeo.sh -i ultra.ova -iu cisco -ipw cisco -ip 10.1.1.1/24 -d 172.25.222.136/MLINE-DC/host/172.25.222.139 -u Administrator -pw roZes -s datastore1 -po poweron -b ultra.cfg

Basis IOS config. template parameters

Vcenter path and credentials

Complete IOS config. file (if more than template is reqd.)
**Management Options**
- CLI, SNMP, Syslog
- REST API
- vCloud Director
- Cisco Prime Infrastructure
- VNMC (CSR 3.11 Release)

**Initial Deployment**
1. Optional: Pre-configure with BDEO tool
2. vCenter: Deploy CSR OVF Template
3. vCenter: Power on CSR VM
4. CLI: Add any static configuration lines
5. vCenter/vCD: Create CSR template or add to catalog

**Tenant Provisioning**
- vCenter/vCD: Deploy CSR VM from template or catalog
- vCenter/vCD: Add network interfaces
- CLI/API: Add tenant-specific configuration
- CLI/API: Install CSR license
CSR REST API

- First supported in 3.10 (July 2013)
- REST is **Representational State Transfer**
- Based on HTTP, Client-Server Model
- Request & Response type: JSON
- Common Methods: PUT, POST, GET

**PUT  /api/v1/global/host-name**

Content-Type: application/json
Accept: application/json

```
{
  "host-name": "eng-router"
}
```

**200 Ok**

Content-Type: application/json

```
{
  "host-name": "eng-router"
}
```

**GET  /license/UDI**

Accept: application/json

```
{
  "link": "/license/UDI",
  "UDI": "ACRPSJAE9486R"
}
```

**200 Ok**

Content-Type: application/json

```
{
  "link": "/license/UDI",
  "UDI": "ACRPSJAE9486R"
}
```

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CSR REST API Architecture

- **Client 1**: C1 REST API calls
- **Client 2**: C2 REST API calls
- **Client 3**: C3 REST API calls

**HTTPS**

**Webserver**

**REST API**

**OneP SDK**

**OneP Python App**

**IOS-XE RP**

**IOSd**

**LXC Container**

**TIPC**
username cisco password cisco

interface GigabitEthernet0
  vrf forwarding Mgmt-intf
  ip address 172.25.222.105 255.255.255.0
  negotiation auto

  ip route vrf Mgmt-intf 0.0.0.0 0.0.0.0 172.25.222.1

virtual-service csr_mgmt activate

transport-map type persistent webui http-restapi
secure-server

transport type persistent webui input http-restapi
onep
transport type tipc
Verify that LXC container is running

CSR-RESTAPI#show virtual-service list

<table>
<thead>
<tr>
<th>Name</th>
<th>Status</th>
<th>Package Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>csr_mgmt</td>
<td>Activated</td>
<td>csrmgmt.1_0_0.20130514_143116.ova</td>
</tr>
</tbody>
</table>

CSR-RESTAPI#

Invoking REST API commands

1. Obtain a Token-id

2. Clients then access other APIs by including the token id as a custom HTTP header “X-auth-token”. If this token is not present or expired, then API access will return an HTTP status code of “401 Unauthorized”
cURL – command line tool to send and receive files using URL syntax. Included in several Linux distributions. Quick way to test REST API on CSR

- Authenticate and get a Token-ID


* About to connect() to 172.25.222.106 port 443
* Trying 172.25.222.106... connected
* Connected to 172.25.222.106 (172.25.222.106) port 443
* successfully set certificate verify locations:

<snip>

* Closing connection #0
  * SSLv3, TLS alert, Client hello (1):
  * {"kind": "object#auth-token", "expiry-time": "Fri May 31 16:01:31 2013", "token-id": "pstB8T05GWbFSFXyHMP5/wMENLxyljPVZKBnmCF9y0s", "link": "https://172.25.222.106/api/v1/auth/token-services/7937116122"}
 CSR REST API – Example with cURL

- Issue a POST request to create BGP process
  

- 200 OK Response received

  <snip>
  {"routing-protocol-id":"100"}HTTP/1.1 201 Created
  < Content-Type: text/html; charset=utf-8
  < Location: https://172.25.222.106/api/v1/routing-svc/bgp/100
  < Content-Length: 0
  < Date: Fri, 31 May 2013 15:53:55 GMT
  < Server: cisco-IOSd..
  * Connection #0 to host 172.25.222.106 left intact
  * Closing connection #0

SSLv3, TLS alert, Client hello (1):

- Verify

  CSR-RESTAPI#show run | i bgp
  
  router bgp 100
  bgp log-neighbor-changes

Token previously obtained. Use – H option with “x-auth-token: <token-id>”. Username/password not reqd.
CSR REST API – Feature support

- Interface level config.
- NTP
- DNS
- DHCP Server and Relay
- Routing Protocols: BGP, OSPF, EIGRP
- ACL
- NAT
- Zone Based Firewall
- IPsec site-to-site VPN (SVTI)

Additional features will be added in future releases
CSR 1000V Licensing
CSR 1000V Licensing Structure
For Enterprises, Cloud Providers, Managed Service Providers, Government

- **Premium**
  - (Advanced + MPLS + Application Experience + Data Center Interconnect)

- **Advanced**
  - (Standard + Security)

- **Standard**
  - (Routing)

- **Technology Package**
  - (Standard, Advanced, Premium)

- **Throughput**
  - (10 Mbps – 1 Gbps)

- **Scale**
  - (2.5 - 8 GB)

- **Payment Options**
  - (Term, Usage, Perpetual)

- **Performance/Scale**
  - (Throughput/ RAM)

- **Term**
  - (1, 3, 5 Year)

- **Usage**
  - (Per Hour, Per GB of Data)

- **Perpetual**
## CSR Feature Packages

<table>
<thead>
<tr>
<th>Package</th>
<th>IOS Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>STANDARD</td>
<td>BGP, OSPF, EIGRP, RIP, ISIS, IPv6, NTP, HSRP, VRRP, GLBP, NAT, ACL, GRE, VRF-LITE, DHCP, DNS, SSH, FLEXIBLE NETFLOW, AAA, RADIUS, TACACS+, SNMP, EEM</td>
</tr>
<tr>
<td>ADVANCED</td>
<td>STANDARD + ZONE BASED FIREWALL, S2S VPN, EZVPN, DMVPN, FLEX VPN, MULTICAST, IGMP, PIM</td>
</tr>
<tr>
<td>PREMIUM</td>
<td>ADVANCED + QoS, MPLS, L2TPv3, OTV, EoMPLS, VPLS, LISP, WCCPv2, APPNAV, BFD, IP SLA, NBAR2, AVC</td>
</tr>
</tbody>
</table>
Throughput - Measurement

- All traffic (except G0 mgmt.) is subjected to a shaper
- The shaper is implemented in the ESP/QFP data path – throughput limits are checked “globally”, not on per-interface basis
- Max. rate parameter (derived from license) is programmed into the shaper
- Shaper does not distinguish between different types of traffic (IPsec, NAT, etc)

G1->G3: 15 Mbps
G2->G4: 20 Mbps
G3->G2: 10 Mbps
G4->G3: 15 Mbps

**Total: 60 Mbps**
Throughput - Verifying

CSR1000V#show platform hardware qfp active datapath utilization summary

<table>
<thead>
<tr>
<th></th>
<th>5 secs</th>
<th>1 min</th>
<th>5 min</th>
<th>60 min</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Input:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total (pps)</td>
<td>59232</td>
<td>59234</td>
<td>59237</td>
<td>59234</td>
</tr>
<tr>
<td>(bps)</td>
<td>58757104</td>
<td>58757824</td>
<td>58760840</td>
<td><strong>58757880</strong> &lt;- Input rate close to 60Mbps</td>
</tr>
<tr>
<td><strong>Output:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total (pps)</td>
<td>48839</td>
<td>48835</td>
<td>48833</td>
<td>48833</td>
</tr>
<tr>
<td>(bps)</td>
<td>50011264</td>
<td>50012072</td>
<td>50009312</td>
<td><strong>498768736</strong> &lt;- Output rate close to 50Mbps</td>
</tr>
<tr>
<td>Processing: Load (pct)</td>
<td>33</td>
<td>34</td>
<td>34</td>
<td>34</td>
</tr>
</tbody>
</table>

CSR1000V#show platform hardware qfp active statistics drop clear | exc _0_

<table>
<thead>
<tr>
<th>Global Drop Stats</th>
<th>Packets</th>
<th>Octets</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TailDrop</strong></td>
<td>2018258</td>
<td>256333010</td>
</tr>
</tbody>
</table>

Syslog message: Jun 6 20:48:16.633: %BW_LICENSE-5-THROUGHPUT_RATE: F0: cpp_ha: Current Throughput Rate 47500000 kbps approaching bandwidth license 50000000 kbps during 3 5 minute intervals in last 24 hours

QoS policies at interface level can guarantee that high-priority traffic is not dropped!
CSR 1000V Performance and Scale
## CSR 3.10 Performance and Scale - Uncapped

<table>
<thead>
<tr>
<th>Feature</th>
<th>Throughput* (Mbps)</th>
<th>Feature</th>
<th>Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEF</td>
<td>1300</td>
<td>VLANs/port</td>
<td>4000</td>
</tr>
<tr>
<td>Firewall (FW)</td>
<td>535</td>
<td>IPSec tunnels</td>
<td>400</td>
</tr>
<tr>
<td>IPSec</td>
<td>280</td>
<td>Firewall sessions</td>
<td>25000</td>
</tr>
<tr>
<td>ACL + NAT</td>
<td>548</td>
<td>IPv4/BGP routes</td>
<td>400K</td>
</tr>
<tr>
<td>ACL + NAT + QoS</td>
<td>500</td>
<td>VRFs</td>
<td>245</td>
</tr>
<tr>
<td>FW + NAT + ACL + IPSec + QoS</td>
<td>125</td>
<td>BGP Route Reflector</td>
<td>13M IPv4 routes (8 GB mem.)</td>
</tr>
</tbody>
</table>

*IMIX traffic. RFC 2544 Test. 4 vCPU, 4 GB DRAM
Cisco Virtualized DC Ecosystem

Physical Infrastructure

WAN Router
Distribution & ToR Switch

Servers

WAN Router

CSR 1000V

vWAAS

ASA 1000v

VSG

Nexus 1000v

Tenant A

Department A

Department B

VSG

Hypervisor

Virtual Infrastructure

CSR 1000V
- WAN gateway
- Routing and VPN

vWAAS
- WAN optimization
- Application traffic

ASA 1000v
- Edge firewall
- WAN-to-LAN traffic

VSG
- Inter-VM firewall
- Intra-LAN traffic

Nexus 1000v
- Distributed switch
- LAN connectivity

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# CSR 1000V Roadmap

<table>
<thead>
<tr>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Features</strong></td>
<td>Committed</td>
<td>Committed</td>
<td>Committed</td>
<td>Committed</td>
</tr>
<tr>
<td><strong>Virtualization</strong></td>
<td>Routing, NAT, DHCP, IPSec, DMVPN, FlexVPN, QoS, NetFlow, AVC, WCCP, Full IPv6</td>
<td>VMware vSphere Ent. (vMotion, DRS, ..)</td>
<td>Citrix XenServer, Red Hat KVM</td>
<td>VXLAN, Suite-B, Integration with Nexus 1000V InterCloud</td>
</tr>
<tr>
<td><strong>Management</strong></td>
<td>VMware vCenter</td>
<td>Cisco Prime NCS VMware vCloud Director</td>
<td>Citrix XenCenter</td>
<td>Amazon (AMI)</td>
</tr>
<tr>
<td><strong>API</strong></td>
<td></td>
<td>License, Interface, IPSec, Routing, FW, NAT, DHCP</td>
<td></td>
<td>Cisco VNMC</td>
</tr>
<tr>
<td><strong>Elasticity</strong></td>
<td>4-vCPU /4-GB 50 Mbps</td>
<td>4-vCPU/ 4-GB 10/25/ 50 Mbps</td>
<td>1-vCPU/ 2-GB 10/25/50 Mbps, 2.5 to 8-GB</td>
<td>2-vCPU/ 2-GB 10 Mbps to 1 Gbps, 2.5 to 8-GB</td>
</tr>
<tr>
<td><strong>Licensing</strong></td>
<td>Term (1, 3, 5 year)</td>
<td></td>
<td></td>
<td>Usage, Perpetual</td>
</tr>
</tbody>
</table>

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CSR 1000V @ Cisco Live

- **CSR Demo.** booth @ World of Solutions – Routing
  - HA, FLEX VPN

- **Techtorial: TECVIR-2002** - Enabling the Cloud: Data Center Virtualization - Applications, Compute, Networking and Best Practices
  - LISP on CSR

- Smart Licensing
  - **Breakout** Session: **BRKARC-2010**: Smart Licensing: Simplifying Cisco Software
  - **Walk-in-Lab**: LABARC-1000
  - **Demo** booth: #1537
  - SMART LIC.

- Joint **Demo.** with Verizon Terremark
  - REMOTE VPN
More Information

Customer resources:
http://www.cisco.com/go/cloudrouter/

Email: bopaiah@cisco.com, csr1000v-external@external.cisco.com
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