CloudNet: Enterprise Ready Virtual Private Clouds

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Vision and Research Direction

- We have been working towards making compute and storage resources location transparent for enterprises, and applications in general

- Enable Location of Compute and Storage resources across data centers
  - Ensure Transparency and Security
  - Minimize performance impact from having remote resources

- Facilitate Migration of Resources in a Transparent and Seamless manner
  - With as little application impact as possible

- Provide capability for Disaster Recovery
  - Remote resources need to be far enough away to avoid sharing of risk between local and remote resources
    - Minimum RPO/RTO – to minimize impact on enterprise operations

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Virtual Private Clouds

A Virtual Private Cloud is…

- A *secure* collection of server, storage, and network resources spanning one or more cloud data centers
- That is *seamlessly* connected to one or more enterprise sites

Enterprise Sites

Cloud Sites

VM VM VM VM
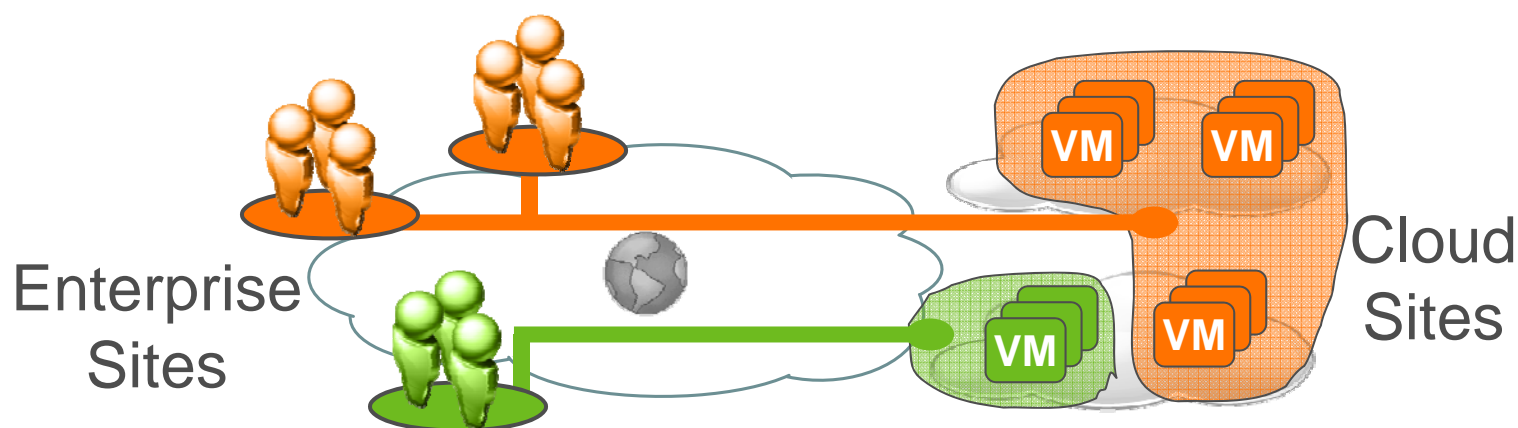
Virtual Private Networks (VPNs)

- Layer 3 and 2 MPLS based VPNs
- Created by network provider with no end host configuration
- Already used by many businesses!

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VPC Benefits

For the customer:

– Isolates network & compute resources

- Cloud resources are only accessible through VPN

– Simplifies deployment since cloud looks same as local resources

For the service provider:

– Provides mechanism for control over resource reservation within provider network

– Simplifies management of multiple data centers by combining them into large resource pools

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CloudNet

Cloud Manager

- Allocates computation and storage resources
- Manages VLAN assignment within cloud network

Network Manager

- Creates and configure VPN endpoints
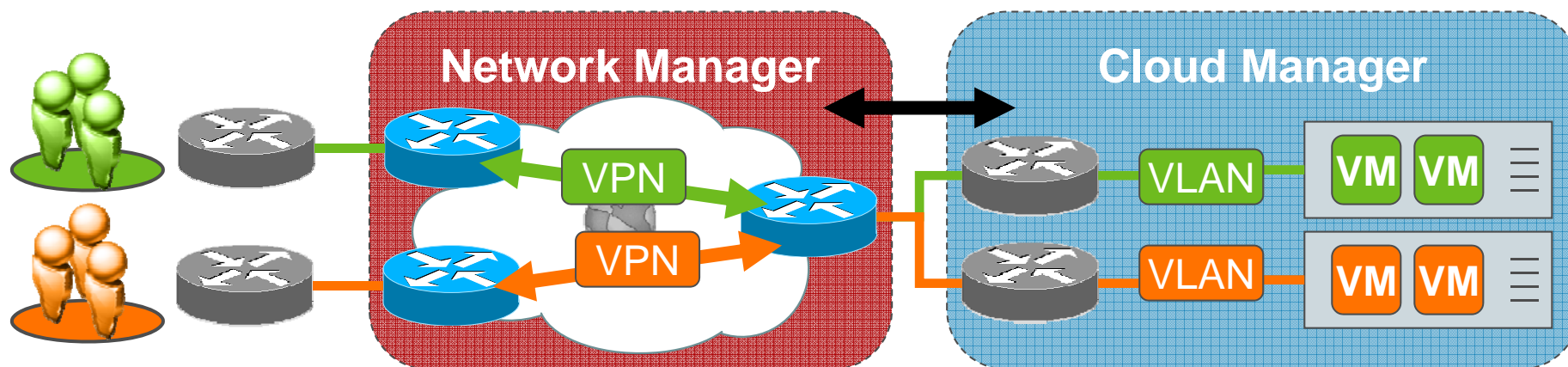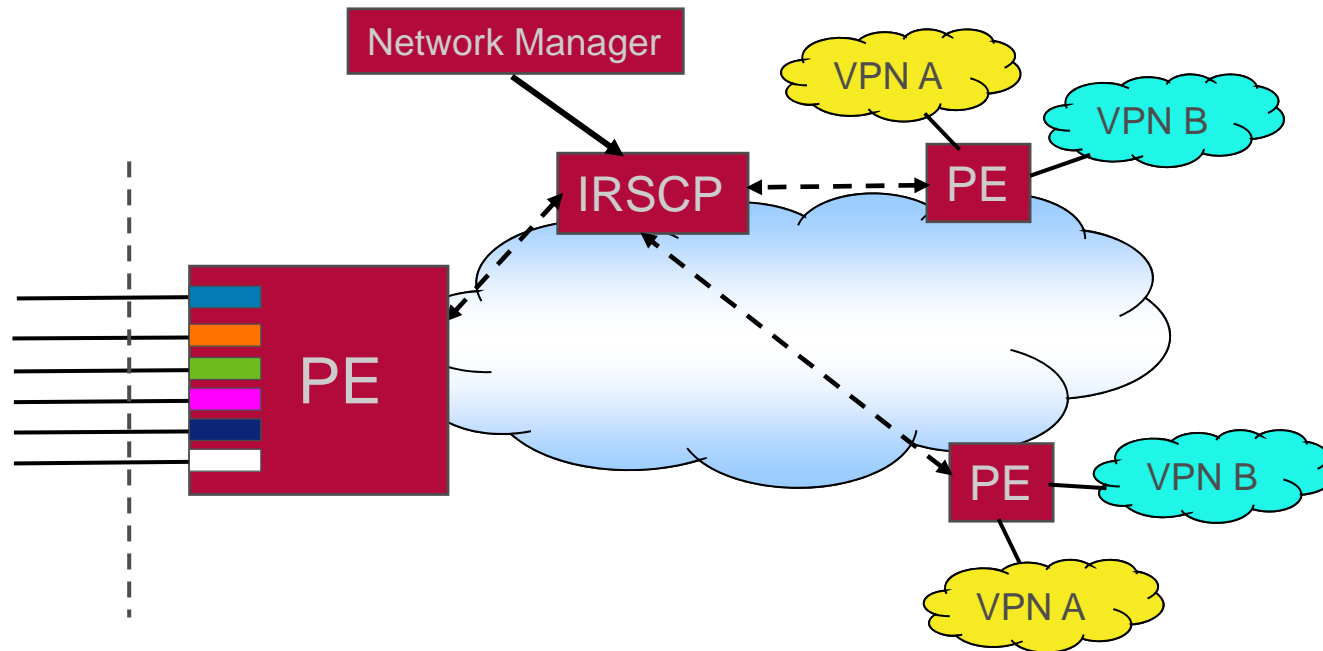- Reserves network resources

Routers

Customer Edge

Provider Edge

CloudNet System Components – Network Domain

- Network side: Dynamic VPN mapping with IRSCP
- On PE connected to cloud platform
  - Pre-configure VPN interfaces with Route-targets
- IRSCP re-writes the RTs as needed to dynamically map these interfaces into specific VPNs
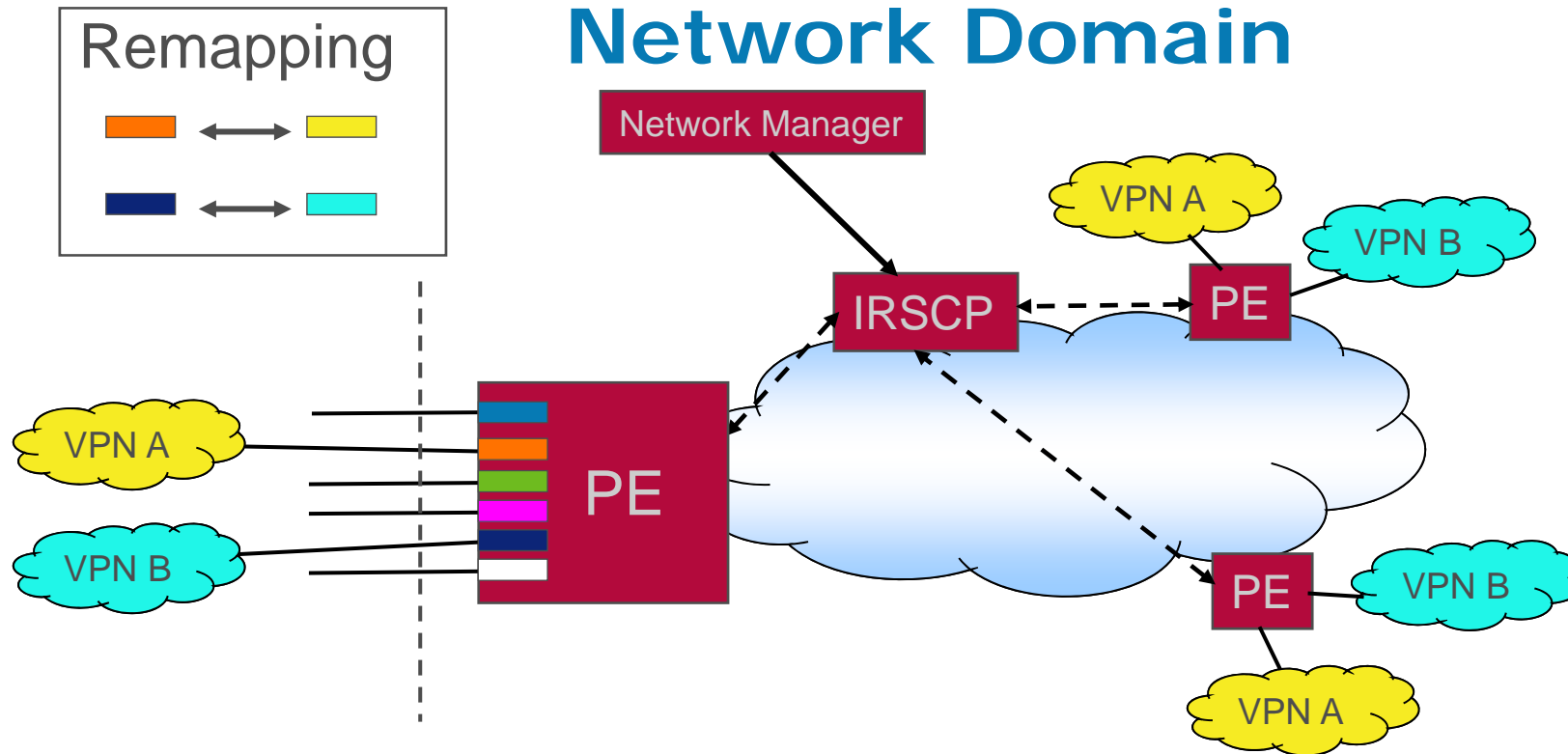
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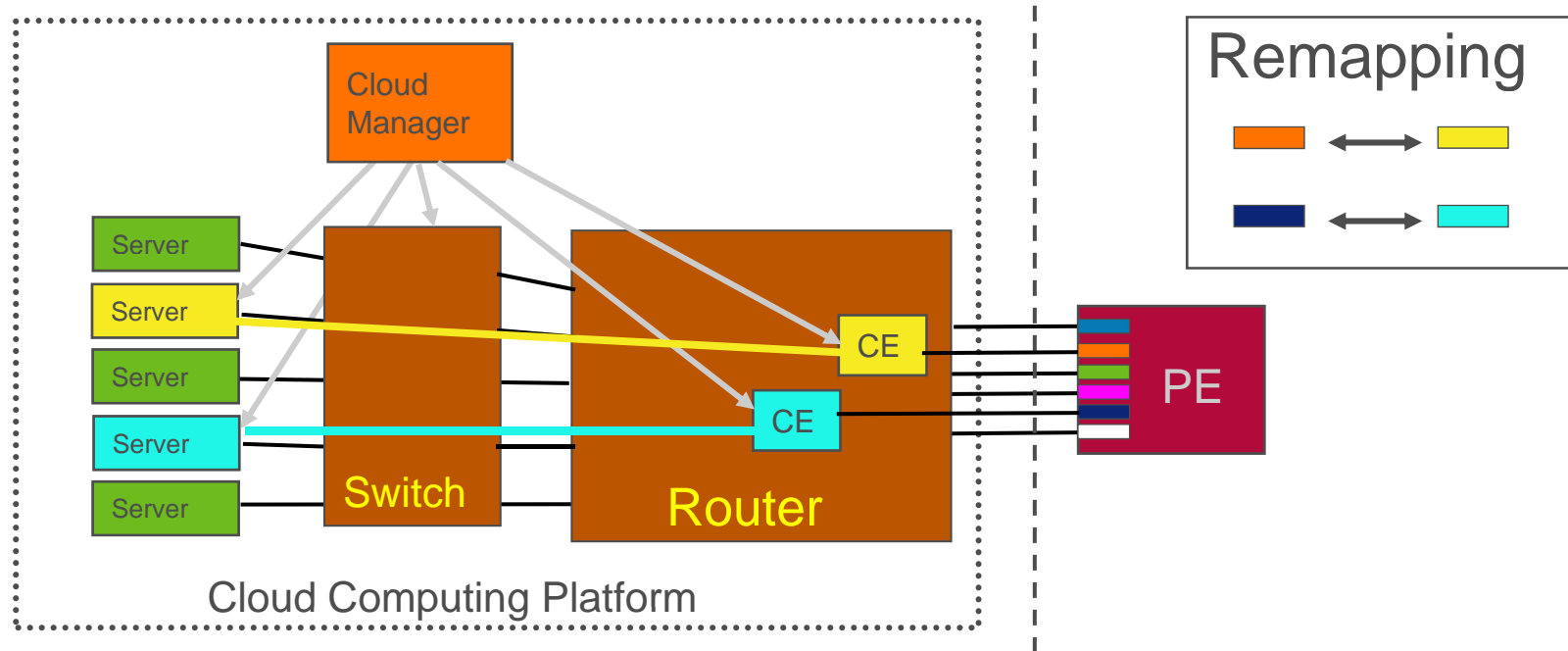# CloudNet System Components – Network Domain

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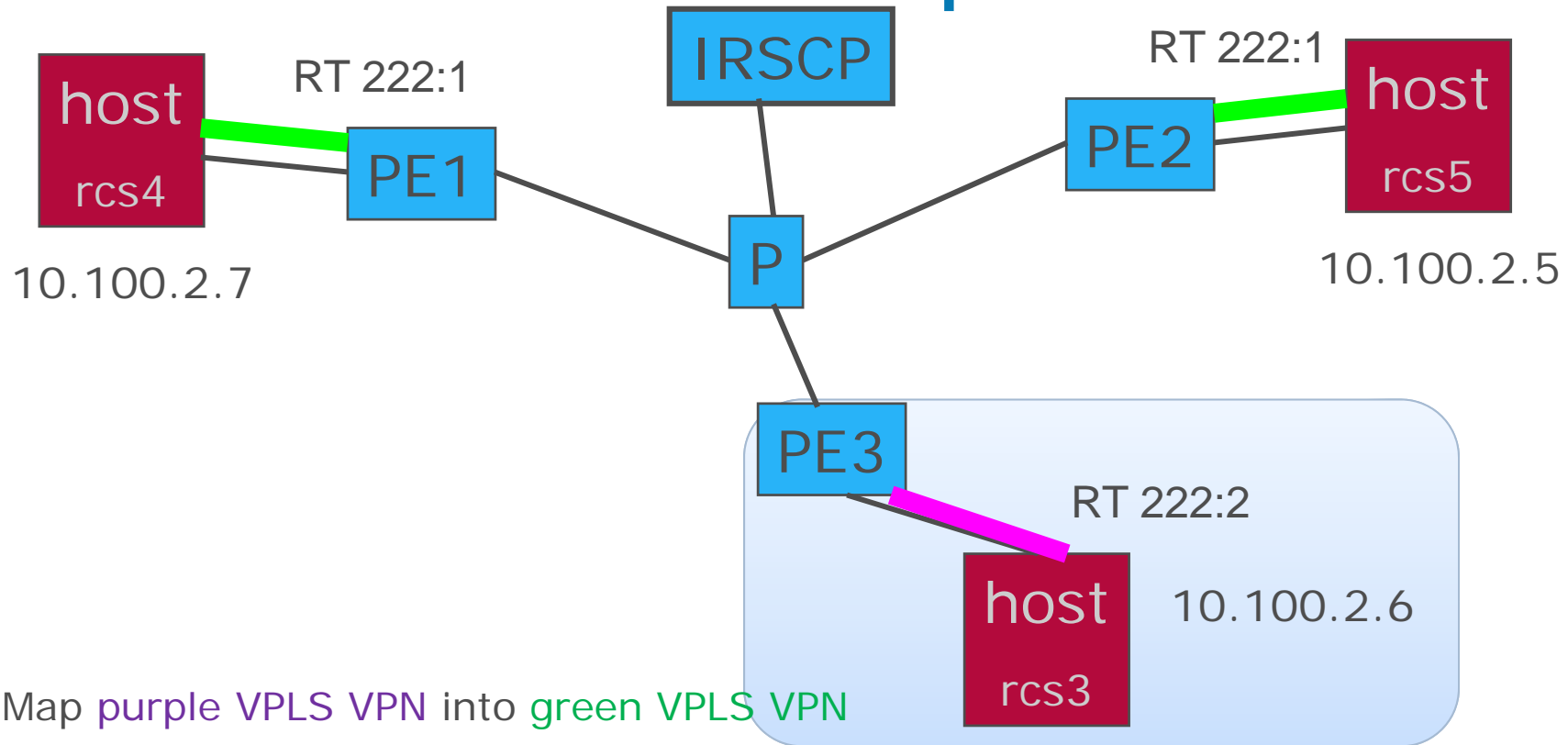
System Components - Cloud Domain

On Cloud Computing Platform side, the Cloud Manager :

- Dynamically creates and configures a logical router on a physical router platform

- Create virtual machine with requested images and configuration

- Hook all of them together with appropriate VLANs
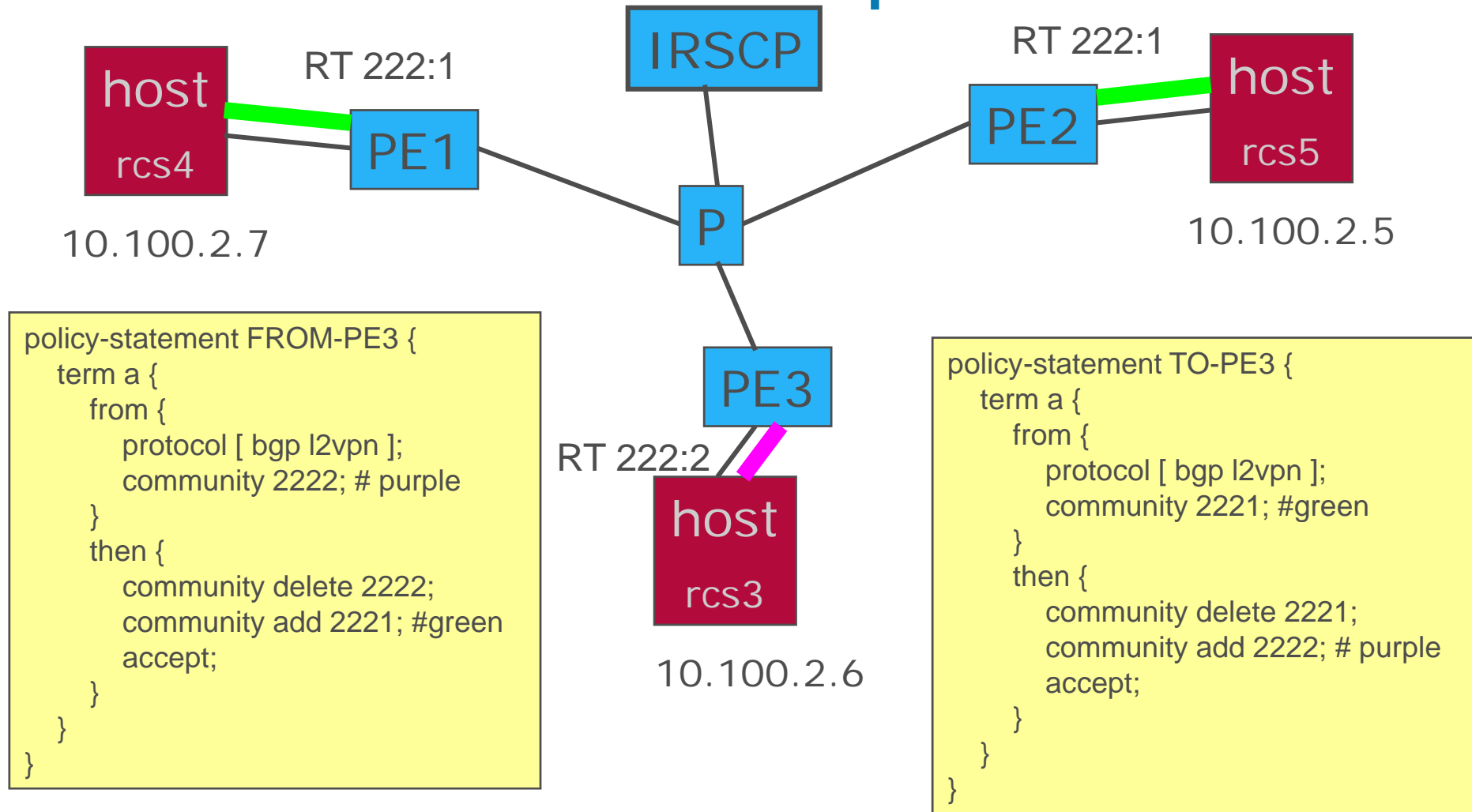
Dynamic VPN re-mapping
VPLS example

- Map purple VPLS VPN into green VPLS VPN

- VPLS VPN information distributed between PEs using BGP via IRSCP (acting as a route-reflector)

- VPLS VPN membership determined by route-targets associated with the VPN interfaces and distributed via BGP

- IRSCP re-writes route-targets as needed to facilitate mapping

Dynamic VPN re-mapping
VPLS example

IRSCP

RT 222:1

host
rcs4

RT 222:1

PE1

host
rcs5

PE2

10.100.2.7

P

10.100.2.5

```
policy-statement FROM-PE3 {
    term a {
        from {
            protocol [ bgp l2vpn ];
            community 2222; # purple
        }
        then {
            community delete 2222;
            community add 2221; #green
            accept;
        }
    }
}
```

PE3

RT 222:2

host
rcs3

10.100.2.6

```
policy-statement TO-PE3 {
    term a {
        from {
            protocol [ bgp l2vpn ];
            community 2221; #green
        }
        then {
            community delete 2221;
            community add 2222; # purple
            accept;
        }
    }
}
```

community 2221 members target:222:1; #green
community 2222 members target:222:2; # purple

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WAN Migration Optimization

- Once connectivity is setup, migration requires
  - Storage Migration
  - Live Memory Migration
- **Storage Migration** is done through a combination of
  - Asynchronous Copy of disk storage to remote site initially
  - Synchronous copy of incremental updates subsequently during live memory migration
- **Live Memory Migration** needs to balance multiple needs
  - Total Migration Time for live memory (reduced application performance)
  - Pause Time (application has to be quiescent for final transfer)
  - Amount of Data Transfer (Bandwidth Requirement)

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Summary

Cloud Computing for enterprises requires:

- Security

- Transparency

- Flexibility

CloudNet can help provide these features

- Defines interface between cloud platform and network provider

- Uses VPNs for secure, seamless connections

- Employs virtualization at server, router, and network levels to improve agility and efficiency

Current Work

- Algorithms to optimize migration time, pause time and network bandwidth requirements for WAN migration

- How CloudNet can help Disaster Recovery and Business Continuity

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