The ViNe Approach to Software-Defined IP Overlays

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Software-Defined IP Overlays

- IP overlays are virtual networks built on top of another network (typically the Internet).
- Software-Defined Networking (SDN) is a network architecture in which network equipment can be configured through programmatic interfaces. In many implementations, forwarding (network data flow) and control (management) planes are decoupled, enabling a software controller to manage network flows.
- Software-Defined IP overlays are virtual networks providing programmatic interfaces to network virtualization components, enabling a software controller to manage overlays.

ViNe Approach

- Virtual Network architecture with clear separation between data and control planes.
- ViNe Infrastructure (ViNe-I) focus on connectivity recovery (establishment of tunnels) and fast transport of overlay packets/messages. ViNe-I consists of ViNe routers (VRs).
- ViNe Management (ViNe-M) consists of an overlay management system responsible for the operation and reconfiguration of VRs.

ViNe Features

- Establishes and manages tunnels to interconnect public and private networks.
- Only requires outbound Internet connectivity. VRs have built-in firewall traversal mechanisms to enable full connectivity.
- One or more VRs deployed on a broadcast domain (LAN) makes a site ViNe-enabled.
- No virtualization overhead on the traffic within a domain
- Measured VR packet processing capacity in excess of 820 Mbps in Core2 microarchitecture CPUs (@ 2GHz).
- Integrates well with LAN technologies (VLAN, OpenFlow).
- All components export APIs that can be accessed programmatically or through front-end systems (e.g., http)

ViNe Software

- Requirements:
  - Linux operating system (32- or 64-bit)
  - Java version 1.6 update 4 or newer
  - Outbound Internet connectivity.
- VR software can be downloaded from:
  http://vine.acis.ufl.edu/vine/lib/vine2.tgz
- ViNe Management web front-end available at:
 http://vine.acis.ufl.edu/ViNe/

ViNe Architecture

- Routing Infrastructure: collaborating virtual routers allows the deployment of isolated networks across administrative domains
- Management infrastructure: controls and drives the routing infrastructure
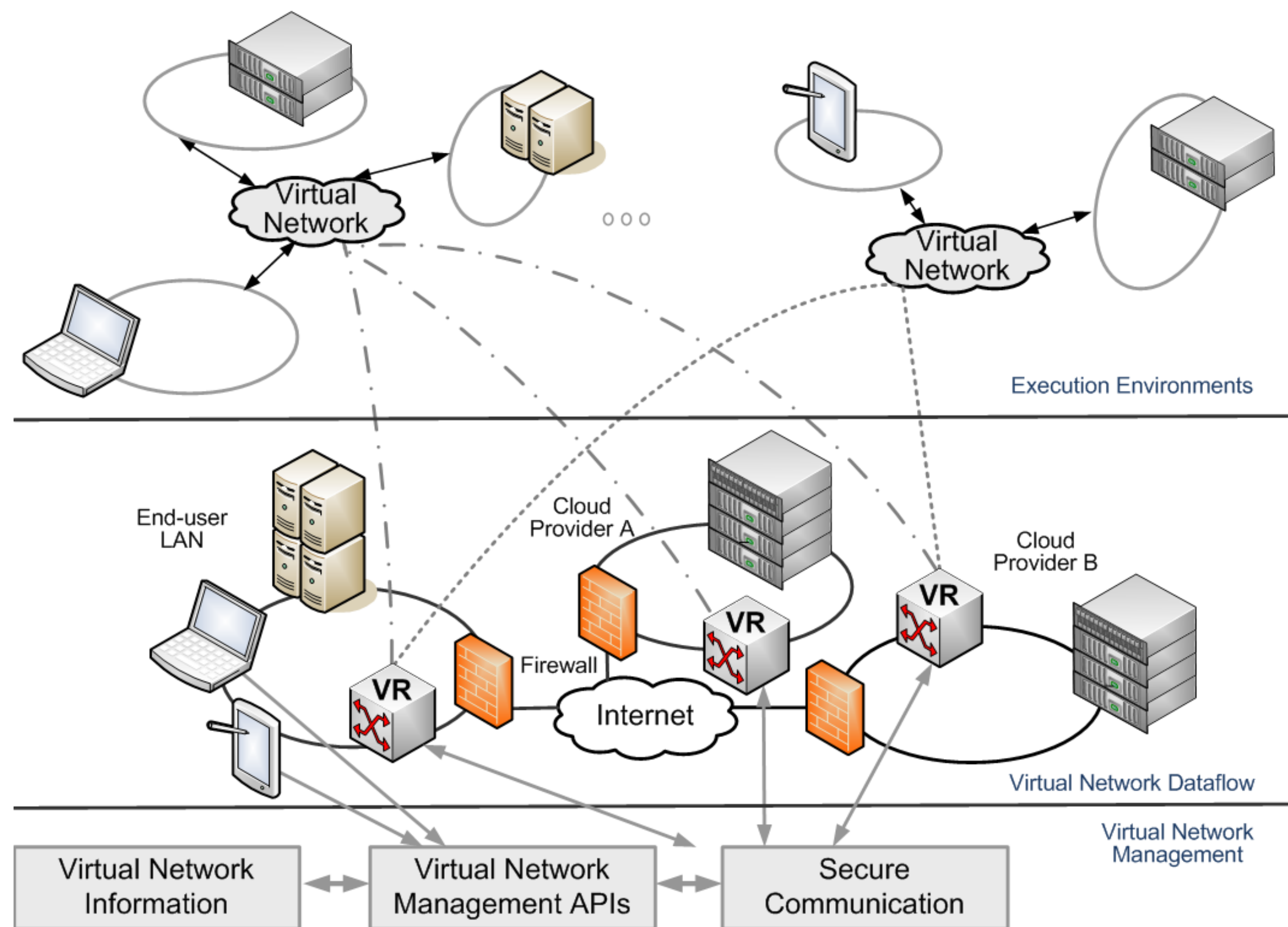
Multiple independent virtual networks (VNs) are overlaid on top of the Internet. Dedicated routers, the ViNe routers (VRs), control virtual network traffic. Management of VNs is accomplished by dynamically reconfiguring VRs.

Dynamic Reconfiguration

- All ViNe software components are designed and implemented to be dynamically reconfigurable.
- A command-line interface (CLI) exposes internal APIs.
  - Heavy use of Java Reflection mechanisms.
  - Addtion/Removal/Change of commands do not require code recompilation.
- Commands can be invoked remotely (through UDP communication).
- Combines self-management (execution of commands by ViNe-M) and user-defined management (execution of commands by end users or other middleware).
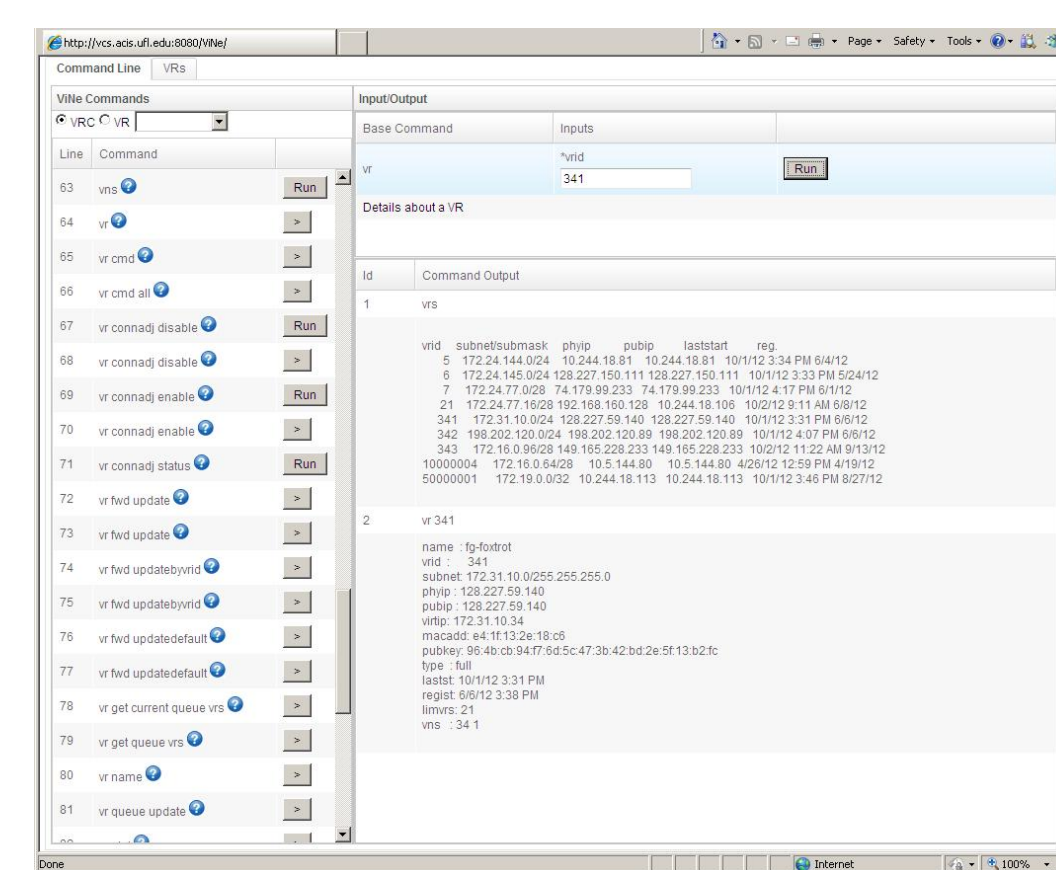
Through a web-based front-end, users can interact with ViNe-M and VRs.

ViNe on PRAGMA

- Offer a virtual network solution to interconnect PRAGMA grid/cloud resources in different countries without the need for public IP addresses.
- Investigate network virtualization combining IPv4 and IPv6 technologies.
- Investigate integration with software-defined network technologies (e.g., OpenFlow).

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