The JITC and UNH IOL Labs
Moonv6 Phase I
Preliminary Findings
Moonv6 Phase II
The MOONv6 Demonstration

iol InterOperability Laboratory
Part of the University of New Hampshire Research Computing Center

The Joint Interoperability Test Command (JITC)
JITC Advanced Technology IP Laboratory

- Certifies equipment for Joint Interoperability
- Provides the capability to replicate Joint C4 Architectures
- Offers access to services, combatant commands, and agencies within DoD
UNH InterOperability Lab (IOL)

- Operates as a non-profit lab as part of the University of New Hampshire
- Fully funded by the commercial communications industry and thus market driven
- Tests 15 different technologies, including IPv6
Phase I Interoperability Participants

Joint Interoperability Test Command Site
Fort Huachuca, Arizona
Final Topology Design

• Protocol-specific interoperability testing completed
• The final design has included
  – Dual Stack Transition
  – Multi-homed topology
  – BGP Route aggregation and hierarchical addressing design
  – Argument about /64 addressing scheme for point-to-point links, concluded to add both types, per AS to the network
Feedback to the Vendors and DOD

MOON\textsuperscript{v6} ASSESSMENT REPORTS

White Paper

DEC 2003
Preliminary Findings
Preliminary Findings

• Common network applications
  – Simple applications such as FTP, TFTP, HTTP, HTTPS, Telnet, SSH, DNS worked in most cases
  – Limited implementation with DoD apps

• Base specifications
  – Mature specs and implementations

• Transition mechanisms
  – Very important part of the DoD transition phase
  – RFC 2893, RFC 3056 and ISATAP worked in most cases
Mobility and Security

- Basic Mobility proof of concept
- Limited number of vendor implementations
- IP Security was successful with limited number of mandated RFC’s addressed
  - Security was proven to work with ICMP and TCP in a Host to Host scenario
- Extra time needed to execute extensive testing for Security and Mobility
  - Must be further investigated in Phase II
Routing Protocols

- BGP Interoperability was tested in small and larger network scenarios. Rerouting was demonstrated to work in most cases.
- Larger OSPFv3 networks were built.
- Dual IPv4 (OSPFv2) and IPv6 (OSPFv3) operation was enabled.
- In the center of these networks a IPV4/OSPFv2 only router was installed.
- Rerouting testing was performed with link-down and link metric increase scenarios.
- It was discovered that IPv4 packets route through networks differently than IPv6 packets. Network designers need to exercise care in mixed IPv4/IPv6 architectures.
Reroute Test Topology for OSPFv2 and OSPFv3 Network

IPv6 Traffic Flow
IPv4 Traffic Flow
Additional Findings

- The Government-Academia-Commercial partnership is working well to advance IPv6 implementations.

- The cooperation of all participants helped
  - Create the final network design and addressing architecture.
  - In test item selection for writing of Phase II test plans.

- Inter-vendor cooperation at both JITC and UNH greatly facilitated identification and resolution of interoperability issues.

- We’re building a solid technical database, not reflected in findings, of how to configure IPv6 systems and architectures.

- VTC significantly facilitates distributed testing.
Feedback to the Vendors and DOD

MOONv6 ASSESSMENT REPORTS

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Moonv6
Phase II
Phase II Testing

Distributed Network
1. E-Mail, PKI, WWW,
2. PPP, VTC, DCTS,
3. IP Security, Mobility,
4. Performance, Anomalies

Local Network
1. Node Specifications
2. Routing Protocols
3. Conformance
4. Anomalies
Possible Phase II Test Items

- More Detailed Security and Mobility Testing
- More Detailed Routing Protocol Testing, possibly IS-IS
- Network Stability – clearly define (routing convergence, delay, reordering, long-term traffic forwarding)
- Network Management
- Multicast and Multimedia Streaming
- VoIP and Video Teleconferencing
- DNS Performance Testing
- Content Delivery Network
- PPP
- Edge and Tactical Network Testing
- Commercial Carrier Connectivity and Peering tests
- MPLS Services for IPv6
Moonv6 Phase II Timeline

- Test success requires a stable network prior to beginning testing

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Phase II Keys to Success

- Validate network stability prior to test
- Provide appropriate access to *all participating vendors*
- Isolate intrusive testing from non-intrusive testing
- Tune participation at remote sites to their capacity/willingness
- Manage scope creep
Questions?
Moonv6 Phase II WWW and E-mail

- WWW Server
- Web/Mail Client
- Ethernet
- Mail Server
- DCTS, VTC, E-Mail, Wireless Mobile Nodes off MCNOSC HA
- Node Specs., Routing Protocols, Transition Mechanisms
- DNS, DCTS, E-Mail, Web, Wireless Mobile Nodes off JITC HA
- Correspondent Nodes, IP Security
- IP Security
- DNS, DCTS, E-Mail, Web
- DMS, DCTS, Web, E-Mail, Mobile Nodes off JITC HA
- Scott
- UNH
- MCNOSC
- Indian Head
- PKI, DCTS, X.500 or LDAP, E-Mail, Home Agent & Correspondent Nodes for Indian Head, IP Security
- DNS, DCTS, E-Mail, Web
- DMS, DCTS, Web, E-Mail, Home Agent & Correspondent Nodes for Indian Head, IP Security
- WWW Server
- Web/Mail Client
- Mail Server
- Ethernet
- WWW Server
- Web/Mail Client
- Mail Server
- Ethernet
MOONv6 PKI Architecture

- UNH
- JCTC
- CECOM
- Indian Head

- DNS, DCTS, E-Mail, Web

- Native v6 over MPLS-AT&T Red Net
- Native v6 over MPLS-AT&T Blue Net
- Configured Tunnel
- Automatic Tunnel
- Encapsulated v4

North American Task Force

- PKI
Phase II DMS Architecture

DCTS, VTC, E-Mail, Wireless Mobile Nodes off MCNOSC HA

PKI, DCTS, X.500 or LDAP, E-Mail, Home Agent & Correspondent Nodes for Indian Head, IP Security

DNS, DCTS, E-Mail, Web

Node Specs., Routing Protocols, Transition Mechanisms

UNH

MCNOSC

Indian Head

JITC

CECOM

DMS, DCTS, Web, E-Mail, Mobile Nodes off JITC HA

DMS Client

DMS Server (Optional)

DMS Client

DMS Server

North American Task Force
Phase II VTC Architecture
DCTS Architecture

Node Specs., Routing Protocols, Transition Mechanisms
Phase II Mobility Architecture

- **UNH**
  - Node Specs., Routing Protocols, Transition Mechanisms
  - DNS, DCTS, E-Mail, Web, Wireless Mobile Nodes

- **JITC**
  - DNS, DCTS, E-Mail, Web, Wireless Mobile Nodes
  - Correspondent Node, Security

- **Indian Head**
  - DCTS, VTC, E-Mail, Wireless Mobile Nodes
  - MCNOSC HA

- **MCNOSC**
  - PKI, DCTS, X.500 or LDAP, E-Mail, Home Agent & Correspondent Nodes
  - for Indian Head

- **CECOM**
  - DNS, DCTS, E-Mail, Web

- **Scott**
  - DMS, DCTS, Web, E-Mail, Mobile Nodes
  - off JITC HA

**Native v6 over MPLS-AT&T Red Net**
**Native v6 over MPLS-AT&T Blue Net**
**Configured Tunnel**
**Automatic Tunnel**
**Encapsulated v4**

**Wireless Mobile Nodes**
**Ethernet**
Phase II IP Security Testing

- Ethernet
- PKI, DCTS, X.500 or LDAP, E-Mail, Home Agent & Correspondent Nodes for Indian Head, IP Security
- DNS, DCTS, E-Mail, Web
- DMS, DCTS, Web, E-Mail, Mobile Nodes off JITC HA

MCNOSC
- IP Sec Enabled Host

UNH

JITC

CECOM
- IP Sec Enabled Host

North American IP V6 TASK FORCE