MOONv6:

The Road Ahead for DoD

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Agenda

- ➤ The JITC and UNH IOL Labs

- ➤ Moonv6 Phase I

- ➤ Preliminary Findings

- ➤ Moonv6 Phase II

The MOONv6 Demonstration

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

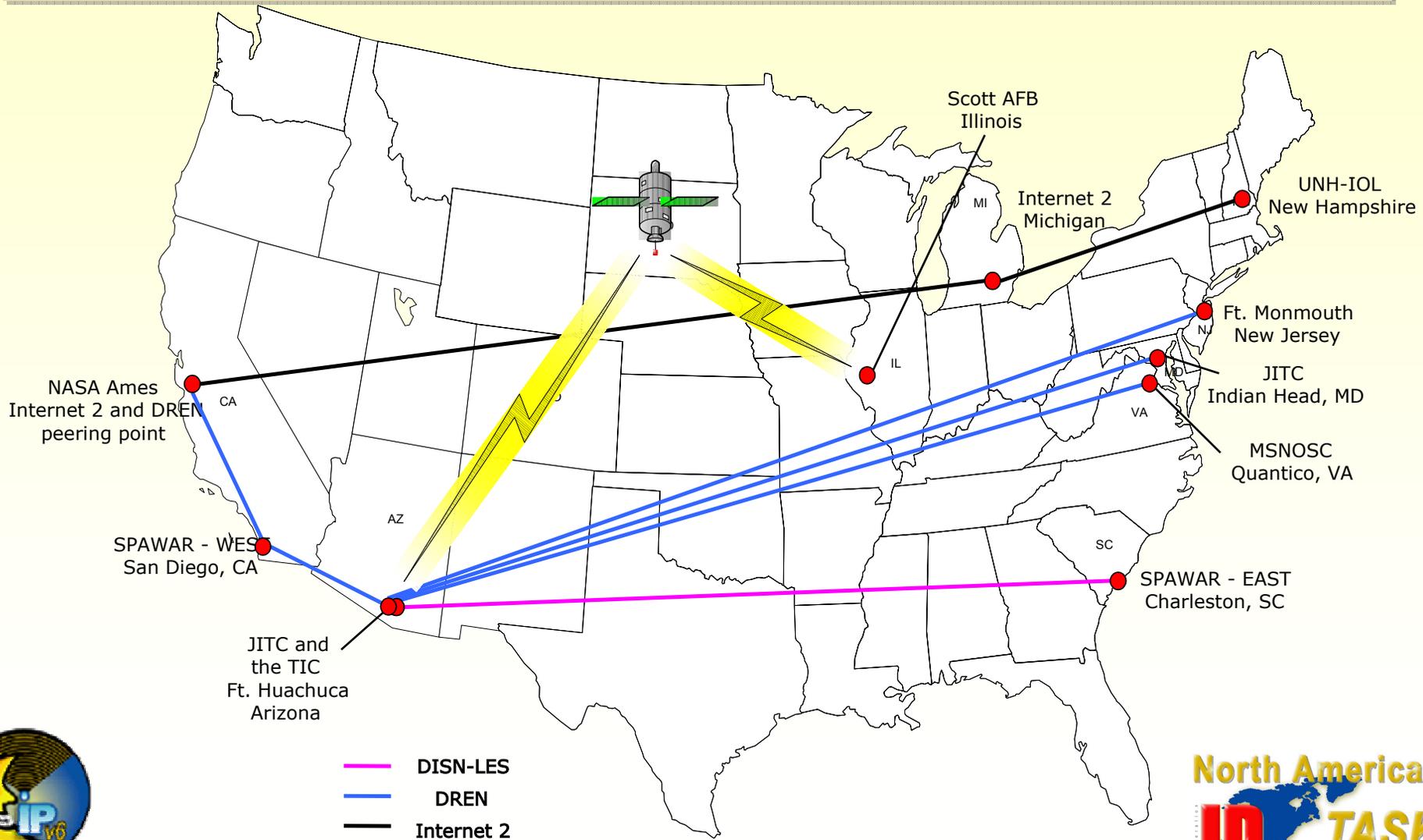➢ Offers access to services, combatant commands, and agencies within DoD

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
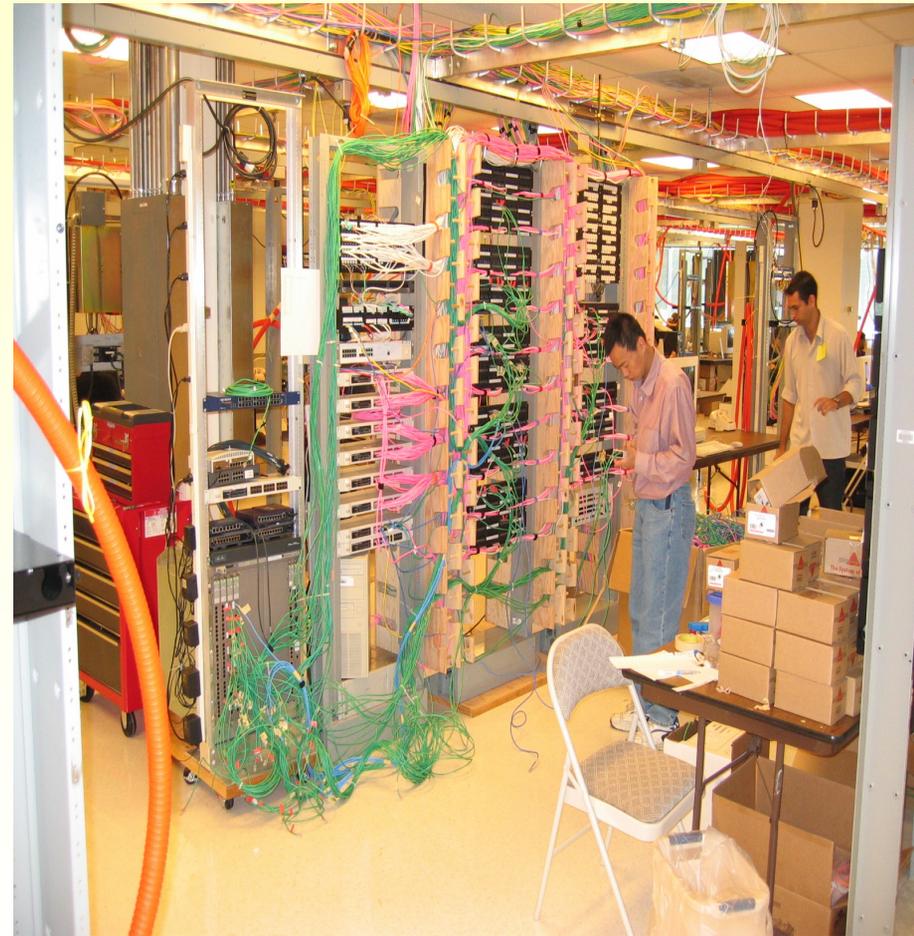
MOONv6 Participating Sites

Phase I Interoperability Participants

MOONv6 Architecture

High Level Architecture
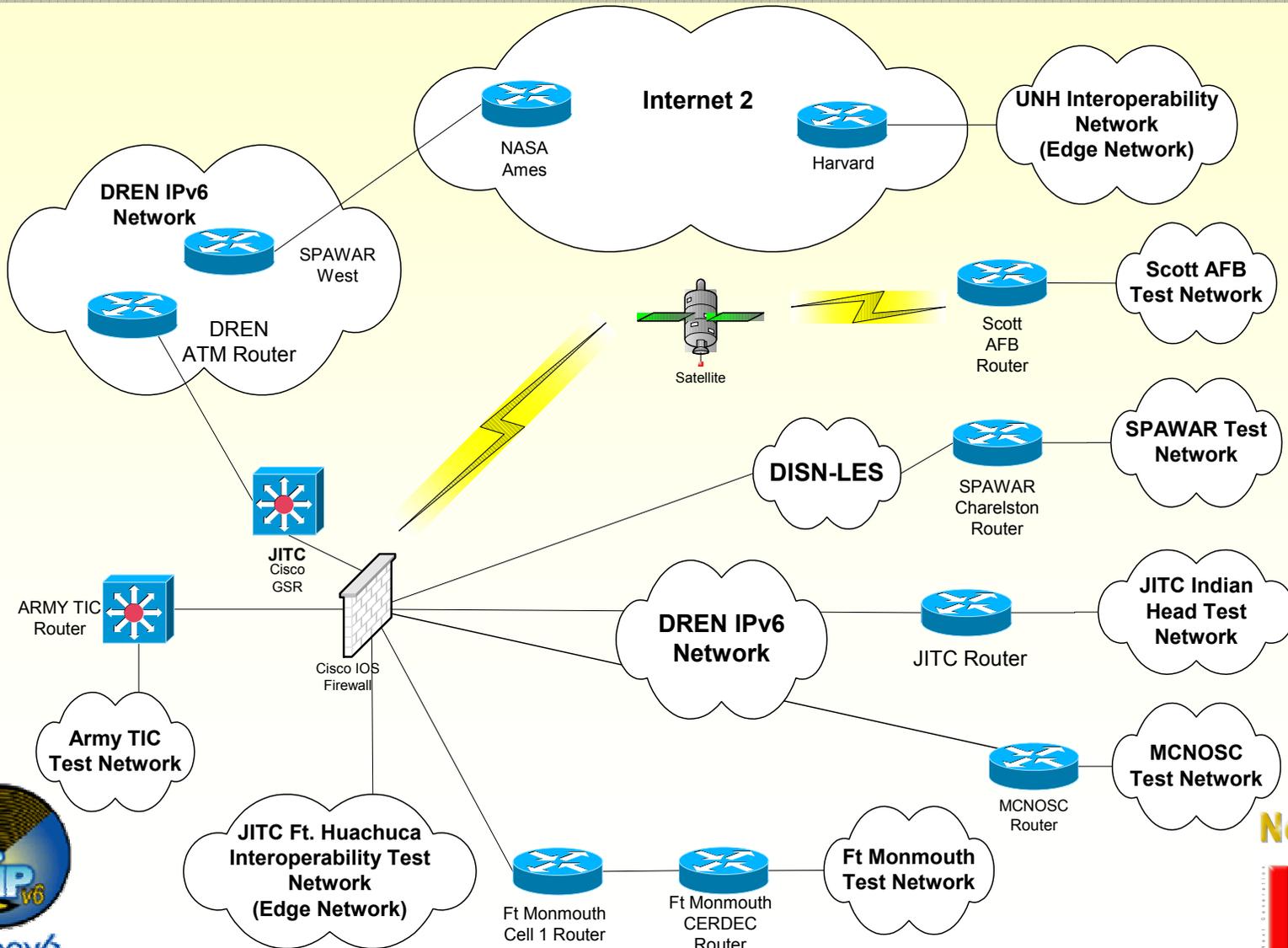
Final Topology Design
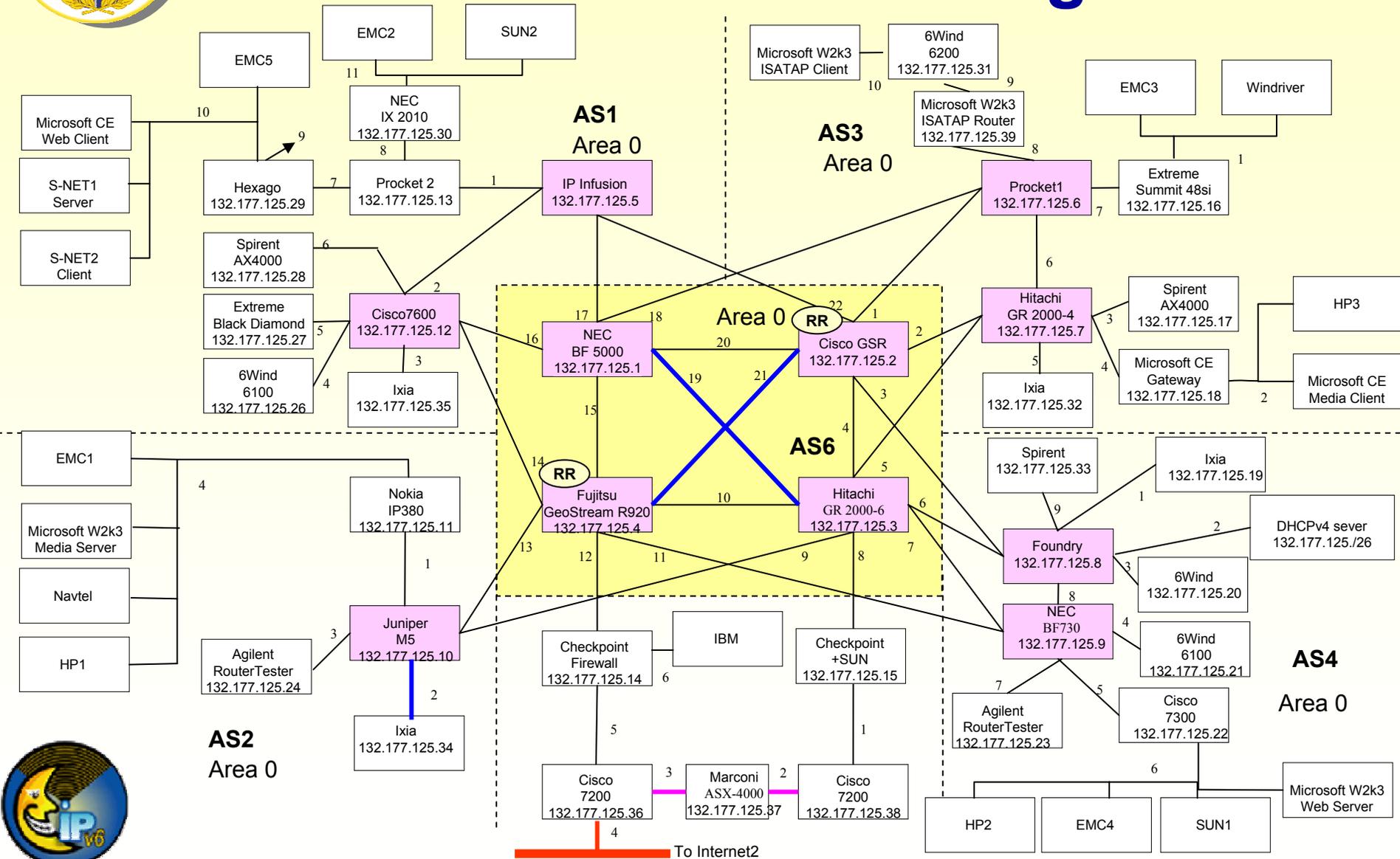
- **Protocol-specific interoperability testing completed**

- **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**

Final JITC/UNH Topology Internet Exchange Model

Feedback to the Vendors and DOD

MOONv6
ASSESSMENT
REPORTS

DEC 2003

iol

White Paper

DEC 2003
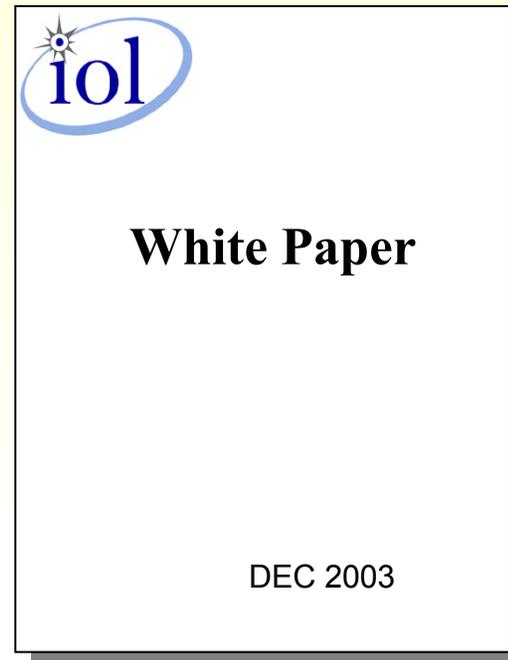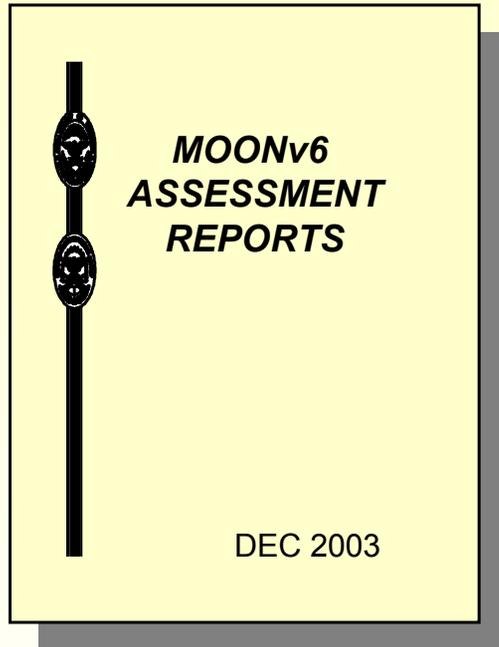
Preliminary Findings

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

Area 1

Area 3

Metric 5

Metric 5

Metric 4

Area 0

Metric 4

IPv6 Traffic Flow

IPv4 Only Router

IPv4 Traffic Flow

Metric 4,
Link Pulled OR
Metric
Changed to 40

Metric 4

Metric 5

Area 2
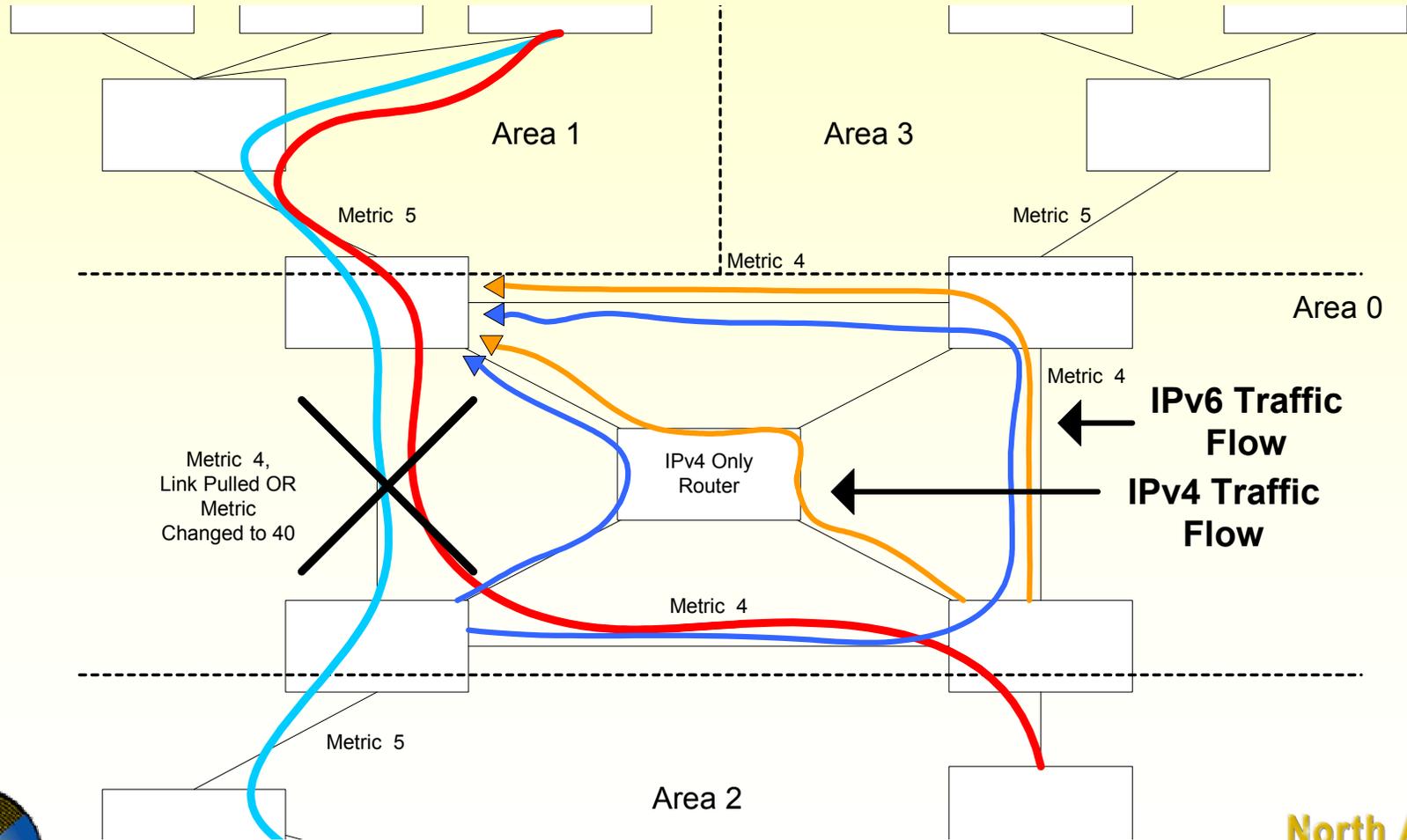
Additional Findings

➢ 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 <u>greatly</u> 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

DEC 2003

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White Paper

DEC 2003
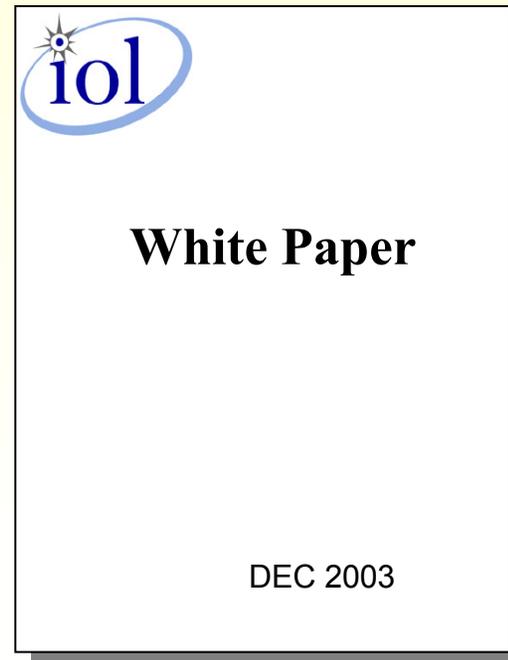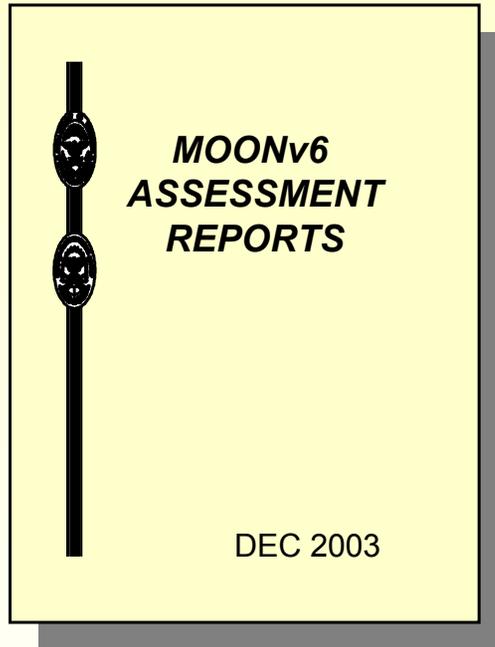
Moonv6 Phase II

Distributed Network

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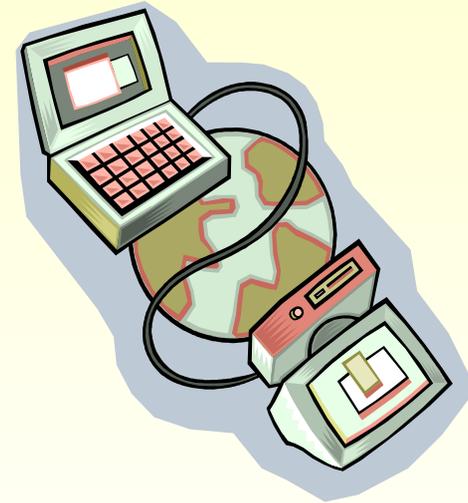
Local Network

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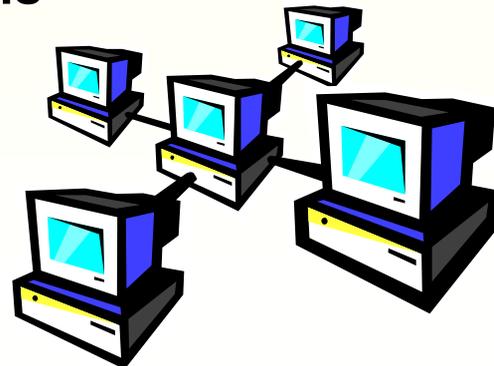
Possible Phase II Test Items

- ➢ 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**

ID	Task Name	Start	End	Duration	Feb 2004				Mar 2004					Apr 2004			
					2/1	2/8	2/15	2/22	2/29	3/7	3/14	3/21	3/28	4/4	4/11	4/18	
1	E-mail	2/2/2004	2/6/2004	5d	▬												
2	PKI	2/2/2004	2/6/2004	5d	▬												
3	WWW	2/2/2004	2/6/2004	5d	▬												
4	PPP	2/9/2004	2/13/2004	5d		▬											
5	VTC	2/9/2004	2/13/2004	5d		▬											
6	DCTS	2/16/2004	2/20/2004	5d			▬										
7	Mobility	2/23/2004	3/5/2004	10d				▬▬									
8	Security	3/1/2004	3/5/2004	5d					▬								
9	Performance/Network Load	3/15/2004	3/19/2004	5d							▬						
10	Link Failures	3/22/2004	3/31/2004	8d								▬					
11	Router Conformance and Interop	4/1/2004	4/9/2004	7d										▬			
12	Data Analysis	4/12/2004	4/16/2004	5d											▬		
13	Report	4/16/2004	4/29/2004	10d												▬▬	

Phase II Keys to Success

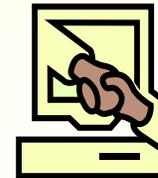- **Validate network stability prior to test**

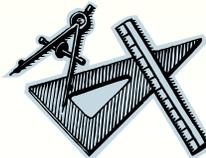- **Provide appropriate access to *all participating vendors***

- **Isolate intrusive testing from non-intrusive testing**

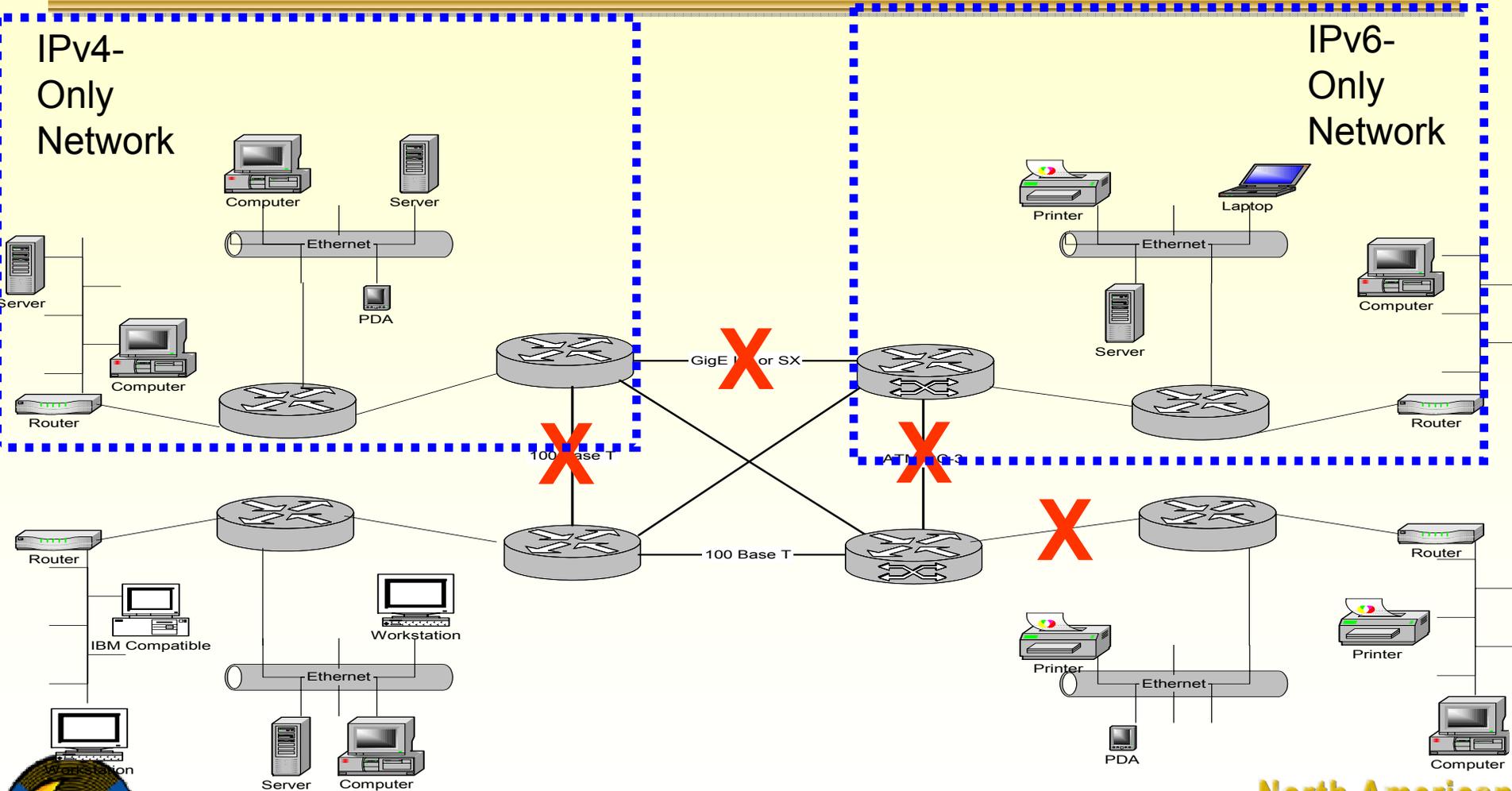- **Tune participation at remote sites to their capacity/willingness**

- **Manage scope creep**

Questions?

Back-up Slides

Local Test Network
(FHU and/or UNH)

Network Segregation

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

Indian Head

Node Specs., Routing Protocols, Transition Mechanisms

UNH

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

MCNOSC

Addressing, DNS, SNMP, Security

DNS, DCTS, E-Mail, Web, Wireless Mobile Nodes off JITC HA, Correspondent Nodes, IP Security, Node Specs. , Routing Protocols, Transition Mechanisms, Link Layer, Physical Layer

JITC

DNS, DCTS, E-Mail, Web

CECOM

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

Additional Distributed Nodes as participation grows.

Scott

- - - - - Native v6 over MPLS-AT&T Red Net · · · · · ·

- - - - - Native v6 over MPLS-AT&T Blue Net - - -

———— Existing Transport (Phase I) ————

Phase II Transition Mechanism Architecture

Indian Head

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

UNH

Node Specs., Routing Protocols, Transition Mechanisms

MCNOSC

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

JITC

DNS, DCTS, E-Mail, Web, Wireless Mobile Nodes off JITC HA, Home Agent, Correspondent Node, Security

CECOM

DNS, DCTS, E-Mail, Web

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DMS, DCTS, Web, E-Mail, Mobile Nodes off JITC HA
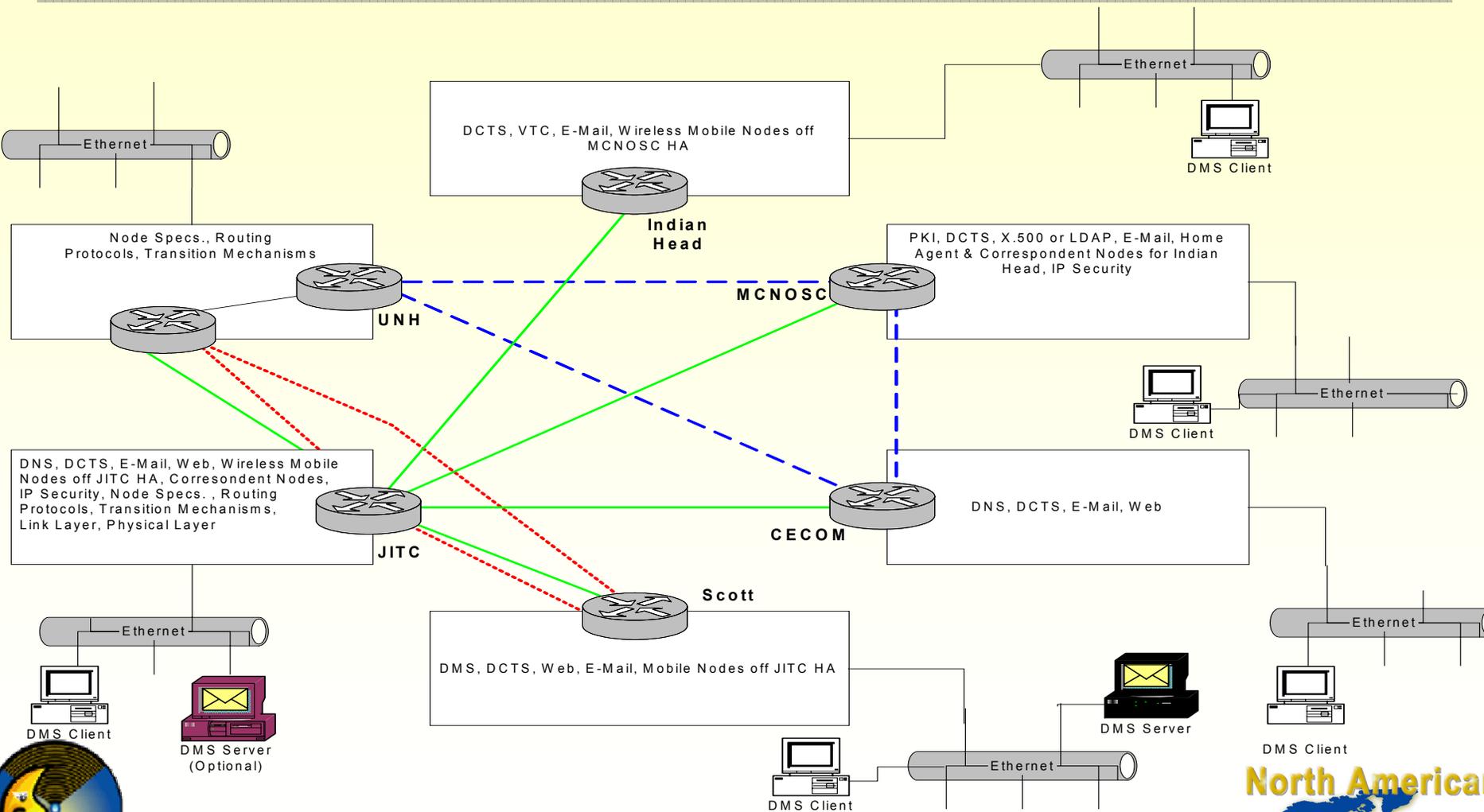
Legend:
- Native v6 over MPLS-AT&T Red Net
- Native v6 over MPLS-AT&T Blue Net
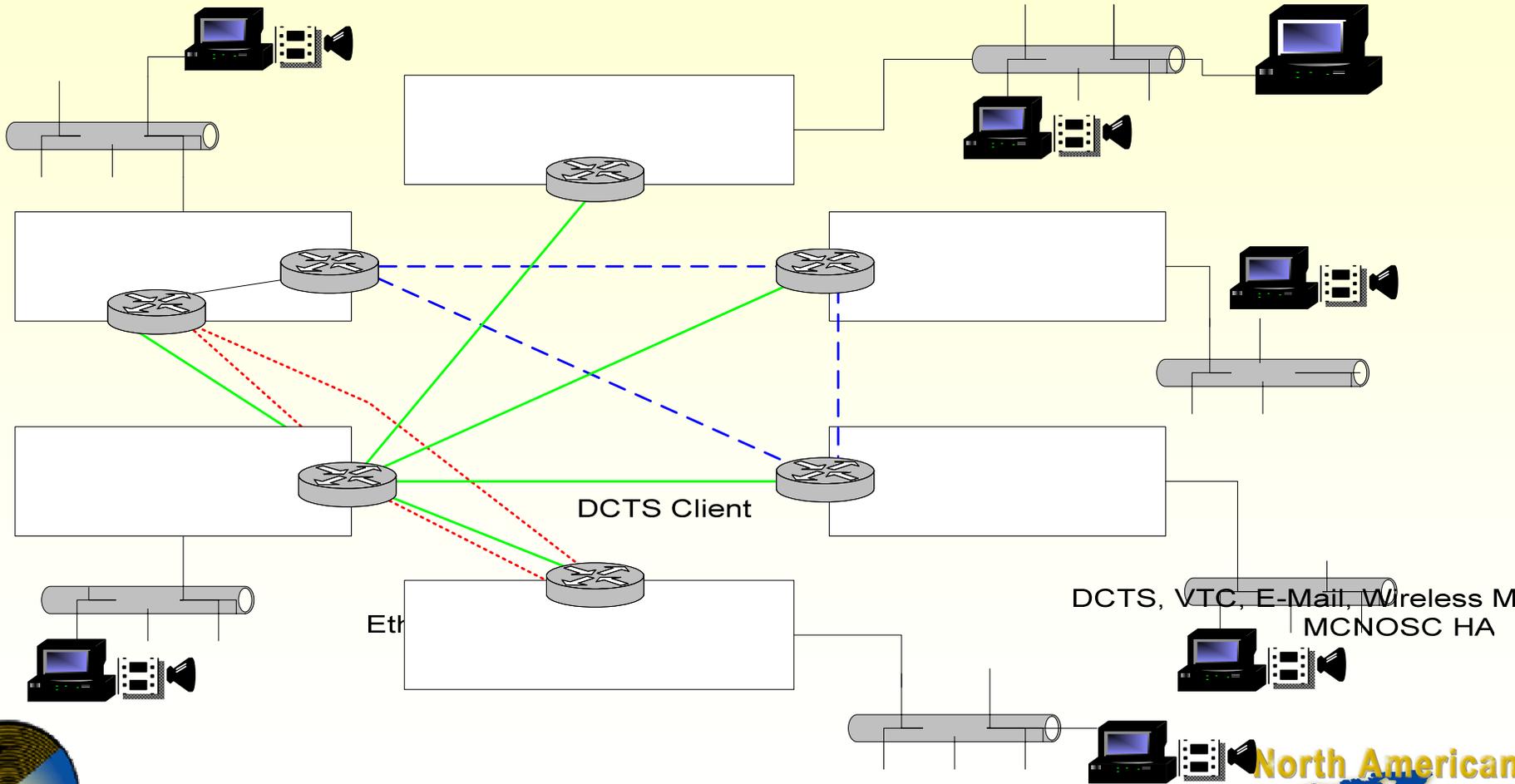- Configured Tunnel
- Automatic Tunnel
- Encapsulated v4

North American IPv6 TASK FORCE

moonv6

Moonv6 Phase II WWW and E-mail

MOONv6 PKI Architecture

Phase II DMS Architecture

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

Indian Head

Ethernet

DMS Client

Node Specs., Routing Protocols, Transition Mechanisms

UNH

MCNOSC

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

Ethernet

DMS Client

DNS, DCTS, E-Mail, Web, Wireless Mobile Nodes off JITC HA, Correspondent Nodes, IP Security, Node Specs., Routing Protocols, Transition Mechanisms, Link Layer, Physical Layer

JITC

CECOM

DNS, DCTS, E-Mail, Web

Scott

Ethernet

DMS Client

DMS Server (Optional)

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

Ethernet

DMS Client

DMS Server

Ethernet

DMS Client

Phase II VTC Architecture

Indian

TS, VTC, E-Mail, W
MCN

Node Specs., Routing
Protocols, Transition Mechanisms

UNH

North American

DCTS Architecture

DCTS Client

Eth

DCTS, VTC, E-Mail, Wireless M
MCNOSC HA

Node Specs., Routing
Protocols, Transition Mechanisms

Phase II Mobility Architecture