



JANET

IPv6 Hands-on Workshop

Module 3: **Introduction to IPv6 Mobility**

UKERNA, Lancaster University
and University of Southampton, 2006



Module Overview

- Mobile IPv6 Overview
 - Operation and Examples
 - Status + Available Implementations
 - Deployment Challenges
 - Deployment in 6NET
 - Summary
-
- I am: Chris Edwards
 - Thanks to: Martin Dunmore

MIPv6 Overview

- Routing protocol for mobile IPv6 hosts
 - Transparent to upper layer protocols and applications
- Uncommon protocol architecture...
 - Avoids actively involving routers!
 - Protocol state held in end-hosts
 - Mobile nodes
 - Correspondent nodes
 - One exception... the Home Agent

MIPv6 Operation

- Mobile Nodes 'Acquire'
 - Home agent address
 - Home address
- When away from home
 - Acquire care-of address
 - Register care-of address with home agent and any relevant correspondent nodes...
 - Mobile IPv6 ensures correct routing

MIPv6 Bindings Cache

- Maintains a mapping between the mobile node's home address and its current care-of address
- Held by home agents and correspondent nodes
- Provides info to allow correct routing of IPv6 packets to mobile node via IPv6 routing header...
- Provides a de-coupling between an IPv6 address and routing information

Mobile IPv6 Examples

- See animated version at: <http://www.ipv6.ac.uk/>
- Examples show:
 - Mobile Node on home network
 - Mobile Node on foreign network
 - Route Optimisation

Mobile IPv6 Example

- Okay, but what if we move again?
- Two cases
 - Move from one foreign network to another
 - Return home...
- Need to send more binding updates...

Mobile IPv6 Examples

- See animated version at: <http://www.ipv6.ac.uk/>
- Examples show:
 - Optimised MN-CN session
 - MN moving again

How to update CN?

- Bindings cache entry out of date...
- Solution
 - Maintain a list of active correspondent nodes in mobile node
 - Generated when a tunnelled packet received from home agent
 - Known as the binding update list

Mobile IPv6 Examples

- See animated version at: <http://www.ipv6.ac.uk/>
- Examples show:
 - MN maintaining BU list
 - MN using it's BU list
 - Optimised Route

What address do we use?

- When away from home what address does a mobile node use as its source address?

Its Home Address?

- But what about ingress filtering?
 - Implemented by many border routers to avoid spoofing attacks.
 - Any packets received by a router on an interface which do not match the source address of that packet are discarded.
- Can't source from home address, as its prefix doesn't match current location...

Its Care-Of Address?

- But what about TCP?
 - TCP uses the IP(v6) source address as an index
 - Without a device using a consistent IPv6 address, the TCP connection would break...
- Can't source from care-of address, for reasons of protocol stability...
- The solution?

Source from BOTH...

- New IPv6 destination option
- The Home Address Option
 - Included in EVERY outgoing packet
 - Understood by all correspondent nodes
 - Home address replaces source address on reception by destination (correspondent node)
- IPv6 packets
 - sourced from care-of address
 - Contain home address as an option

What about network errors?

- Mobile IPv6 bindings are ***soft state***
 - Refreshed periodically
 - Contain sequence numbers
 - Can be ack'd- ***binding acknowledgements***
 - ***Binding Updates and Acks are retransmitted (rate limited) until the protocol converges***

What Format are the Control Messages?

- New IPv6 extension header 'Mobility Header'
 - Binding Updates
 - Return Routability
 - BU, BA, CoTi, CoT, HoTi, HoT
- Home Address option is carried in an IPv6 destination option
 - Not reliant on higher level protocols
 - Multiple messages per IP packet
 - Messages can append existing packets
 - E.g. TCP connection requests...

Security and Privacy

- Authentication
 - Massive security / denial of service attack in MIPv6 as described so far
 - What's to stop an attacker sending bogus BU messages?
 - IPSec protects signalling between mobile node and its HA
 - 'Return Routability' test allows correspondent nodes to determine binding updates are authentic
- Privacy
 - IPSec between the mobile node and its home agent is control traffic only!

Mobile IPv6 Examples

- See animated version at: <http://www.ipv6.ac.uk/>
- Examples show:
 - MiTM Attack

Return Routability...

- Argument:
 - “All that really matters is that the optimized route is functionally equivalent to a non-optimized route”

Return Routability

- Home Agent implicitly trusted
 - Assumed it is hosted on secure site
 - Assumed that IPsec is used between mobile host and its home agent.
- Dynamic key distribution for use with correspondent nodes.
- Uses cookies to build session keys...

Mobile IPv6 Examples

- See animated version at: <http://www.ipv6.ac.uk/>
- Examples show:
 - Return Routability

Status of the Protocol

- Reached RFC status in in June 2004
 - RFC 3775 Mobility Support in IPv6 (165 pages!)
 - RFC 3776 Using IPsec to protect signalling between MN and HA
- MOBILEIP wg now finished, BUT...
- MIP6 wg
 - continuing work required for wide-scale deployments
- MIPSHOP wg
 - Signalling and HO optimisation

Available Implementations

(RFC 3775 compliant)

- Linux
 - MIPL <http://www.mobile-ipv6.org/>
 - Up to v1.1 for 2.4 kernels
 - v2.0 onwards for 2.6 kernels (latest is v2.02)
- BSD
 - KAME stack <http://www.kame.net>
 - FreeBSD 4.9 and beyond, NetBSD 1.6.2 and beyond, OpenBSD 3.4 and beyond

Available Implementations

(RFC 3775 compliant)

- Cisco
 - Home Agent functionality only
 - Minimum required IOS release
 - 12.3(14)T, 12.4, 12.4(2)T
- Microsoft
 - Obsolete (pre RFC 3775) CN support only in XP and Server 2003!
 - There was a non-public technology preview but is no longer available
 - “Microsoft will consider making a version of Mobile IPv6 available for use in the future if there is sufficient customer demand.”

Deployment Challenges

Things to think about if you wish to deploy MIPv6 services

- Bootstrapping
- Security and Privacy
- AAA
- Handover Latencies
- Firewalls and NATs
- IPv4 / IPv6 co-existence
- Other Issues

Bootstrapping

- How does the MN discover...
 - its Home Address?
 - static home address assignment is really the only home address configuration technique compatible with the current specification
 - dynamic assignment is more desirable
 - its Home Agent?
 - the SA with its Home Agent?

Security and Privacy

- RR gives some protection as described
- RFC 4285 alternative authentication between MN and HA
 - negates the need to have IPSec SA
- Privacy between MN and CN
- Location privacy concerns

AAA

- 2 different types
 - mobility service provider (home network)
 - network service provider (at foreign network)
- AAA for MSP needs to be integrated with MIPv6
 - has implications for bootstrapping
 - procedure for bootstrapping away from home needs to be defined
- AAA for foreign networks can be transparent to MIPv6
- Or integrate both types?

Handover Latencies

- HO times in the order of seconds!
 - no good for real-time services
- Fast Handovers for MIPv6 (RFC 4068)
 - Enables MN to pre-configure new address before moving
 - Requires cooperation between ‘previous’ and ‘next’ access routers
- Hierarchical Mobile IPv6 (RFC 4140)
 - Uses a ‘Mobility Anchor Point’ to reduce HO times when roaming within same foreign network

NATs and Firewalls

- The Care of Address MUST be global!
 - thus obtaining a private address behind a NAT is problematic
- Firewalls will block BUs until user has been authenticated
- Stateful Firewall at CN site may block traffic from MN
 - new CoA not recognised

IPv4 / IPv6 Coexistence

- How does MIPv6 work with transition mechanisms?
 - Provided MN obtains a globally routable CoA things 'should' work
- What about IPv4 only networks?
 - Possibilities:
 - CN is in an IPv4 only network
 - HA is in an IPv4 only network
 - MN moves into an IPv4 only network

Other Issues

- DHCPv6 vs SLAAC
 - SLAAC faster
 - can even fine tune RA intervals
 - DHCPv6 gives more control
- SSIDs should be broadcasted
 - how else can MN seamlessly associate with new APs?
 - any manual intervention affects HO times!
- The CN problem!
 - not mandated in IPv6 stacks!
 - thus non-optimised routing

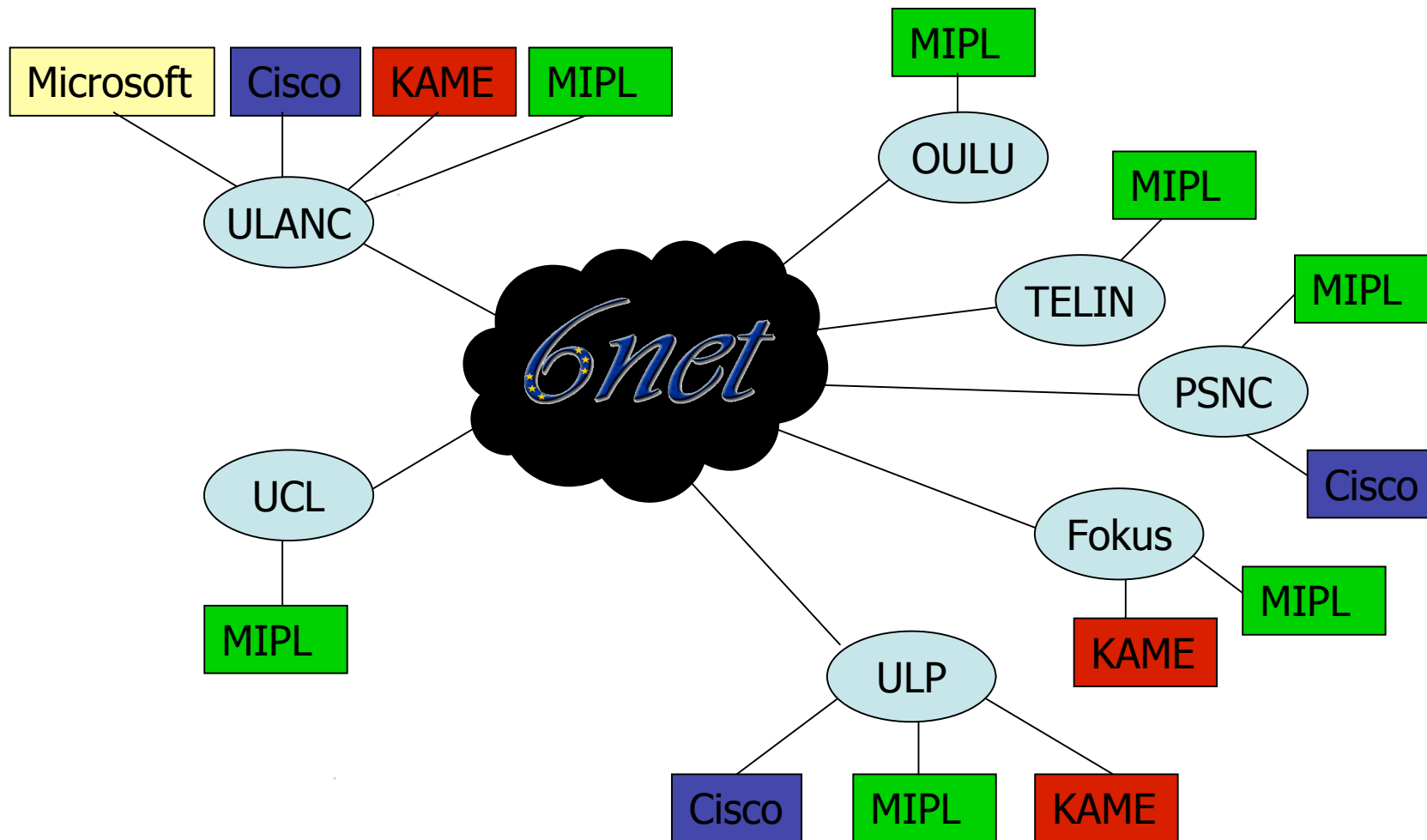
Deployment in 6NET

- Several MIPv6 Testbeds
 - Various implementations
 - Different focus for each testbed
- Overall goal was to investigate deployment issues for both small and large scales
 - implementation issues
 - ease of setup
 - interoperability
 - autoconfiguration / bootstrap
 - handover performance
 - privacy, security
 - multicast

MIPv6 Testers

Partner	MIPv6 Nodes	Implementations
ULANC	HA, MN, CN	Microsoft, Cisco, KAME, MIPL
UCL	HA, MN, CN	MIPL
Fokus	HA, MN, CN	MIPL, KAME
OULU	HA, MN, CN	MIPL
ULP	HA, MN, CN	Cisco, MIPL, KAME
TELIN	HA, MN, CN	MIPL
PSNC	HA, MN, CN	MIPL, Cisco

6NET MIPv6 Home Agents



Related 6NET Deliverables

<http://www.6net.org/publications/>

- D4.1.1 Survey and Evaluation of MIPv6 Implementations
 - somewhat out of date!
- D4.1.2 Initial MIPv6 Support Guide
- D4.1.3 Mobile IPv6 Handovers: Performance Analysis and Evaluation
- D4.1.5 Multicast with Mobile Hosts: Analysis and Performance Evaluation
- D4.1.4 Final MIPv6 Support Guide
- Condensed info also in 6NET book

Trials and Testing

- TAHI test suite
 - <http://www.tahi.org/mipv6/>
 - also used in Connectathon
 - <http://www.connectathon.org/>
 - Useful for testing any pilot deployments

Summary

- MIPv6 allows IPv6 hosts to be mobile without breaking apps
 - Mobile Nodes can perform RO to avoid triangular routing problem
 - RR test provides protection against 3rd party attacks
 - Handover latencies do not support real-time services (yet)
 - Implementations available
 - Further problems to be solved!
-
- Next up: A look at IPv6 transition and deployment