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Signaling Using the NSIS Framework; Messaging and End-host Mobility Applications

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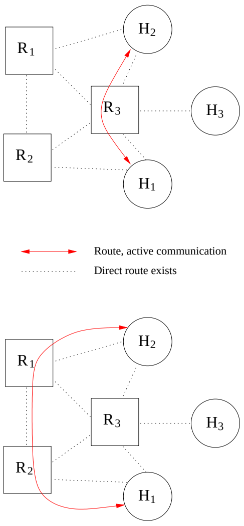
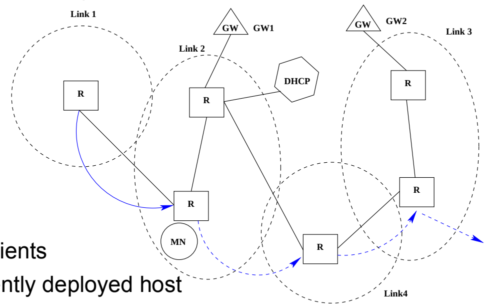
Scenario: Battery monitoring

- Network of battery powered (wireless) routers (R_1..R_3) and three hosts (H_1..H_3)
- Hosts H_1 and H_2 communicate very actively
- Router R_3 runs low on battery
- What about connectivity of H_3?
- We can keep H_3 connected, if we have:
  - Mechanism to alter routing
  - **<u>Battery status information</u>**



Scenario: Mobility



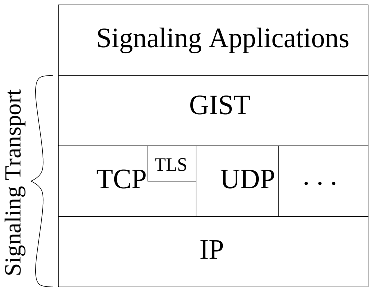
- Mesh access network
- Mobile Node (MN)
- Support for unmodified clients
  - Compatible with currently deployed host software
- Equal nodes in a decentralized topology
  - Co-operating, scalable, robust, autonomous

NSIS Framework

- Next Steps In Signaling WG @ IETF
- Signaling framework
- Signaling transport separated from application logic
  - GIST (General Internet Signaling Transport)
  - Uses existing protocols and methods (TCP, UDP, TLS...)
- NSLPs (NSIS Signaling Layer Protocol) make up the application layer (QoS, NAT/Firewall)
- Uses mainly TLV (Type – Length – Value) objects

GIST services

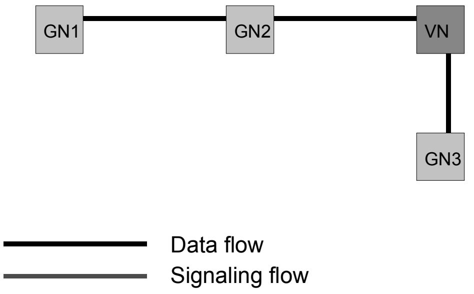
- GIST does all the 'dirty work'
- Next (NSLP level) node discovery
- Path-coupled transport
    - Reliable
    - Unreliable
- Channel security



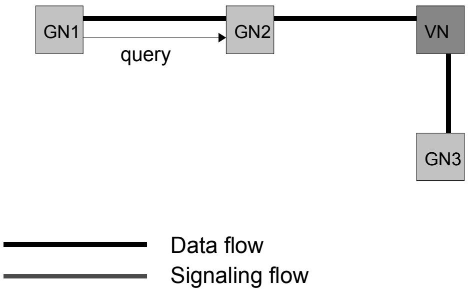
GIST NSLP node discovery

- When NSLP wants to send a message towards some host
- GIST finds the next GIST node on the path running the same NSLP
    - There may be multiple GIST (and non-GIST) nodes between sender and recipient

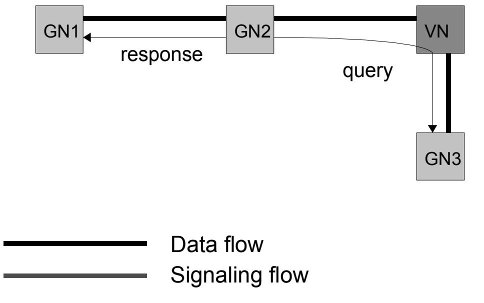
GIST NSLP node discovery



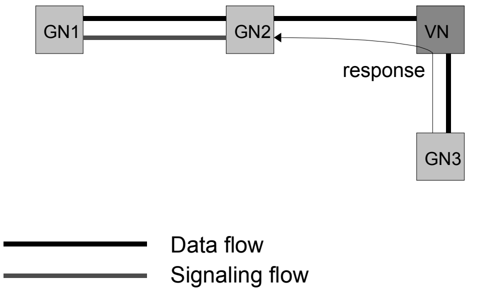
GIST NSLP node discovery



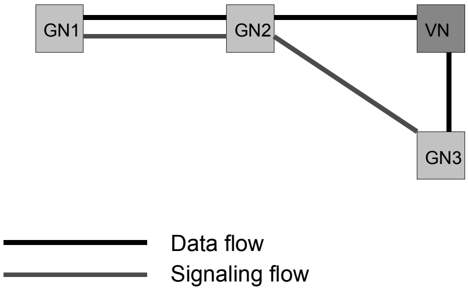
GIST NSLP node discovery



GIST NSLP node discovery



GIST NSLP node discovery



GN1

GN2

VN

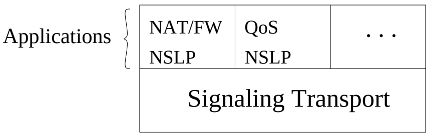
GN3

Data flow

Signaling flow

Signaling Applications (NSLPs)

- Use services provided by GIST
- May use services provided by other NSLPs
  - NAT/FW traversal
- Forwards its own messages (identified by NSLP ID) along the path towards signaling end host



Applications

NAT/FW NSLP

QoS NSLP

. . .

Signaling Transport

NSIS Framework and GIST

- Anything to ask about NSIS or GIST?

Messaging NSLP: Outline

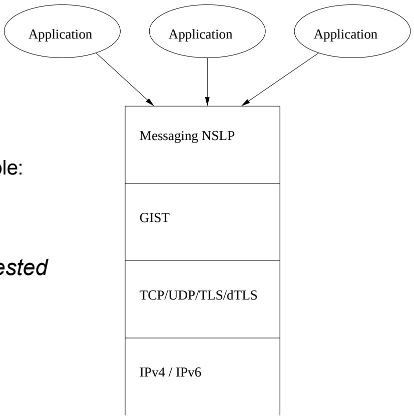
- Motivation
- Architecture
- Protocol Messages
- API
- Messaging Sessions
- Status and Next Steps

Messaging NSLP: Motivation

- A new kind of generic messaging protocol could have a lot of use cases
  - Router-to-Router communications
  - Host-to-Router communications
  - Router-to-Host communications
- New NSLP to provide generic messaging service to Messaging applications

Messaging NSLP: Layers

- Layered architecture
  - Messaging NSLP provides transport to messaging applications
  - Application of the first example: Monitoring application
- Messaging NSLP is *not interested* in content it carries – it is just transport

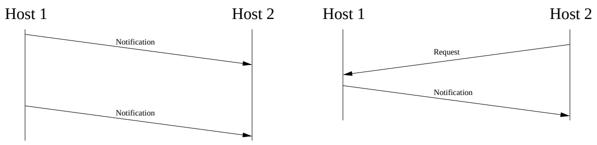


Messaging NSLP

- While GIST provides quite nice tools to signaling application developers, it still has some limitations
  - NSLP ID reservation bureaucracy
  - Quite complex API
- Messaging NSLP needs only one NSLP ID
  - Multiple messaging applications share the same GIST level identifier (NSLP ID)

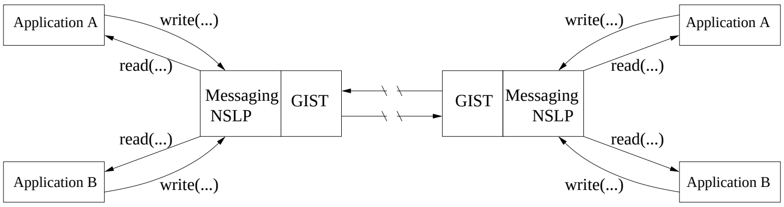
Messaging NSLP: Messages

- Just three types of messages
  - Request
  - Notification
    - May be sent with or without request
  - Error



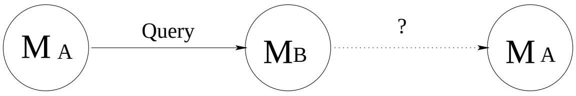
Messaging NSLP: API

- Simple API for Signaling Application development
  - Open(..) to open new messaging session
  - Write(..) to send data to remote application
  - Read(..) to read data sent by remote application
  - Close(..) to end messaging session



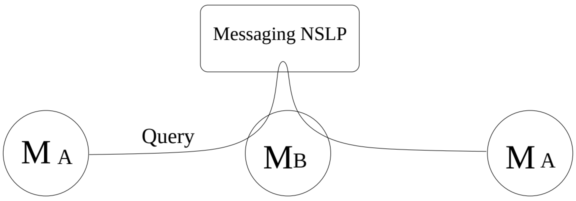
Messaging NSLP: Messaging Sessions

- Session opened by calling *Open(..)*
  - New Session identifier allocated
  - Triggers eventually GIST Query
  - The GIST peering process is invisible to application
- What if nodes running Messaging NSLP do not have the same Messaging applications?
- GIST decision whether to peer or not is based on NSLP IDs



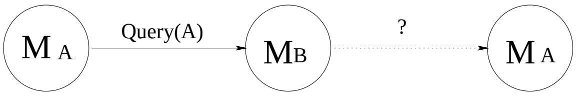
Messaging NSLP: Conditional peering

- Vanilla GIST can NOT always carry data within query messages
- Each Messaging NSLP node must act as relays
  - Works, but is very inefficient



Messaging NSLP: Conditional peering

- To get conditional peering really working, we need to modify GIST
  - Additional GIST object
  - We can use solution shown at previous slide as a backup



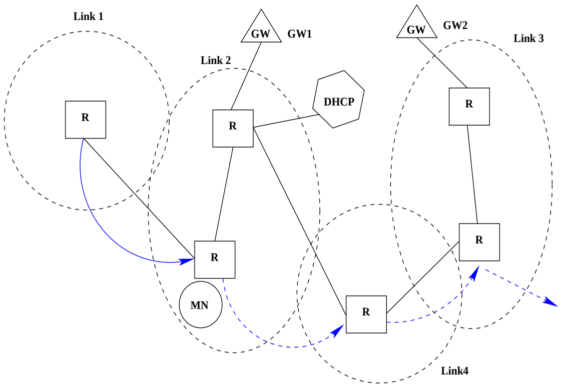
Messaging NSLP: Status and next steps

- First version of specification is ready
  - Works on paper...
  - ...and implementation has begun
- A couple of example applications are needed
- Tests and benchmarks
- Papers (including my MSc thesis...)
- Internet Draft?

Messaging NSLP

- Thank You for listening
- Questions or comments?

NSLP for End-host mobility



Outline of presentation

- Overview
- Design criteria
- Related work
- Protocol messages
- Example sequence
- Phases of development and future work
- Questions

Overview

- Initial version functionality
  - Provide “best effort” mobility for unmodified clients
  - Edge access routers act on behalf of their clients
  - Host and source host routes
  - Proactive information exchange between mesh routers
- Clients
  - Arrive in network: DHCP
  - Move: send data or DHCP
- Mesh routers running NSIS
  - Detect clients
  - Set routes, monitor routes
  - Proactive information propagation

Design criteria

- Any routing protocol between ARs
  - MANET, ad hoc, regular IGP
  - GW known or a route 'upstream' available
  - Routing handles topology changes between ARs
- Address management through DHCP
  - Centralized or distributed
- Multicast available (for multicast GIST)
- IPv4 or IPv6; all or part of the nodes

Related work

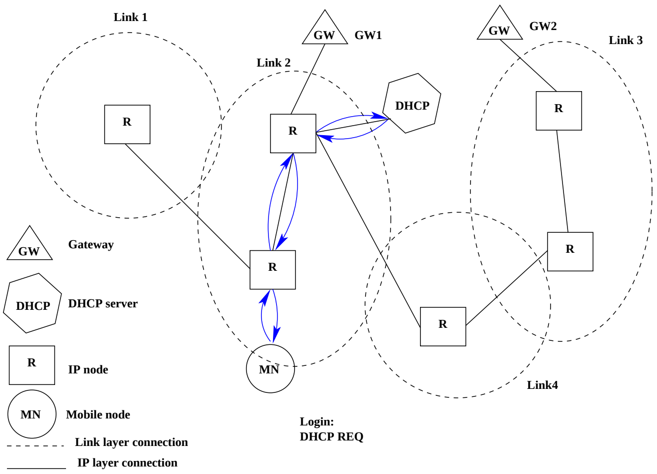
- MIP (Perkins RFC3344, Johnson et. al RFC3775)
- BCMP (Boukis et. al, IEEE globecom 2003)
- CellularIP Valko, ACM CCR 1999)
- HMIP (Soliman et. al RFC4140)
- NetLMM WG (ProxyMIP?)

Protocol messages

- Info
- Info refresh
- Set route
- Route reply
- Route refresh
- Example of header structure, *Set route:*

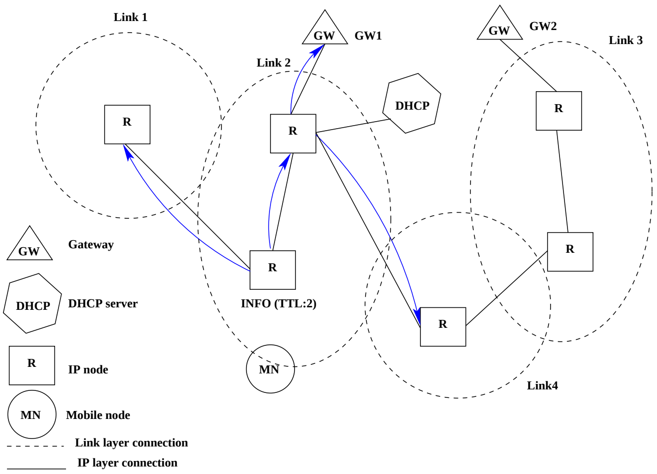
```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|    Type       |       Reserved        |       Length          |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                          SEQNO                                |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|IP-ver |M|E|G|S|                  Reserved                     |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
//                         MN-IP                               //
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
//                         EAR-IP                              //
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
://                         MGW-IP                             //:
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Example sequence: Login



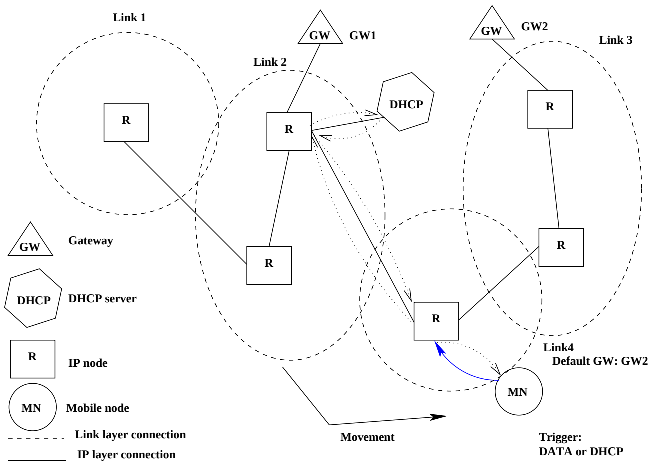
Login:
DHCP REQ

Example sequence: Info

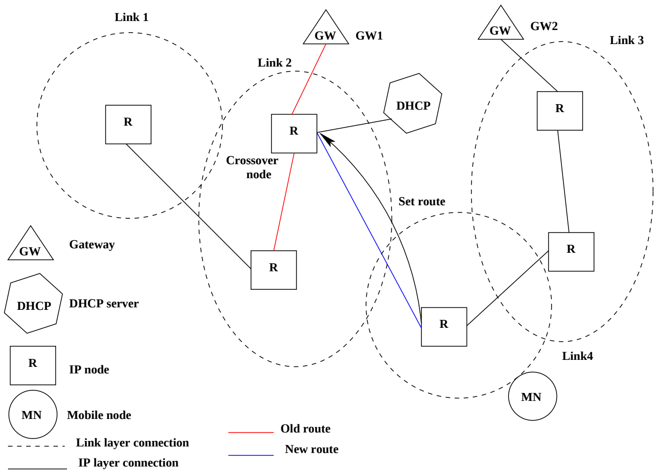


INFO (TTL:2)

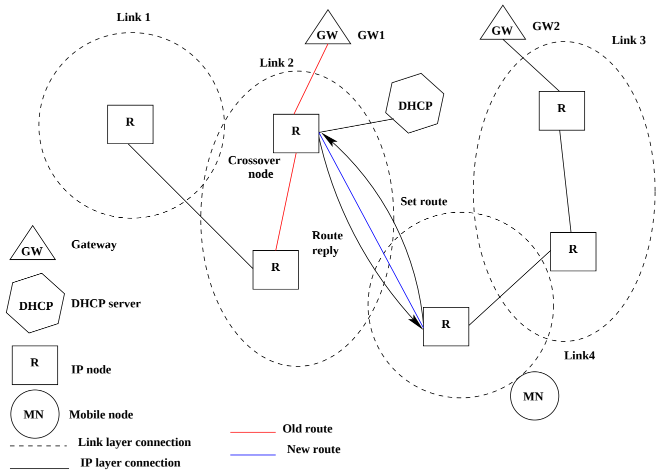
Example sequence: Handover



Example sequence: Set route



Example sequence: Route reply



Example sequence

- Terminating at the crossover node optimizes:
  - Delay in setting route
  - Space on routers, only routers that need them have host routes set
- CRN compares *Set route* to Mobile Node Info and detects different peer

Phases of development and future work 1/2

- Three phases: basic, basic plus and extended

- Basic
  - Like described above, only a baseline
  - Handovers not very smooth
  - No route optimization
  - Lacks persistence if information has not propagated

- Basic plus
  - Forcefully change IP of client to e.g. optimize routes
  - Reactive exchange of client information

Phases of development and future work 2/2

- Extended
  - The client participates in the signaling, NSLP on host
  - Co-operative handovers, planned change of IP
  - Session authentication
  - CARD + CTP functionality
  - Utilize other metrics for handover, available bandwidth and battery etc.

- Currently working on
  - Implementation
  - My MSc thesis on the basic phase
  - More detailed presentations for future workshops

Questions

- Thank You for listening
- Any questions or comments?