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Automatic configuration of IPv6 addresses for MANET with multiple gateways (AMG)

draft-ruffino-manet-autoconf-multigw-03

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AMG overview

- General-purpose, stateless solution for AUTOCONF
    - Designed for MANETs with multiple gateways announcing multiple prefixes
- Overview:
    - Nodes use ULAs as MLAs
    - Proactive gateway discovery: GWs periodically flood prefix advertisements to all MANET nodes
    - ✓ MANET nodes build a set of global addresses (GA) and apply a ranking algorithm to it, using gateways metric, to choose which address to use for traffic
    - ✓ Nodes advertise the built GAs back in the MANET

Design goals

- Applicable to many connectivity scenarios
  - In particular, to dynamic ones, where gateways can abruptly disappear
  - And where global address can frequently change
- Performance and robustness
  - Exploitation of all available gateways
- No special mechanisms required in the Internet
  - And, no unnecessary load on the gateways
- Lightweight address uniqueness check
- Re-use of all existing protocols/mechanisms developed in MANET WG
  - Focus on AUTOCONF protocol functionalities

Design choices

- Use of ULA as MANET-local addresses
  - draft-jelger-autoconf-mla-00 proposes 56+64 bits ULA random address: high probability of uniqueness
- DAD is not specified
  - AMG could be integrated with a Address Conflict Detection mechanism (passive preferred)
- Different gateways advertise different prefixes, hence nodes can configure multiple addresses
  - No coordination needed among gateways
  - RFC 3633 can be use to automatically delegate prefixes to GWs
  - *Issue*: nodes' choice of source address affects the downstream data path within the MANET
    - *Best Prefix Selection algorithm introduced*

Design choices (cont.)

- To minimize latency after an address change occurs, *Global Addresses Advertising introduced*

- Use of an external flooding engine (e.g. SMF) to announce prefixes within the MANET
- Use of RP messages to advertise nodes' addresses
  - Because RP is responsible to install routes on the nodes
- Use of Generalized Packet/Message Format
  - Optimized for MANET and extendible

Phase I : MANET-local address configuration

- At bootstrap, nodes and gateways
  - build one ULA
  - configure it on one of their interfaces participating to MANET routing.
- Other MANET interfaces can be configured with ULA as well, but nodes must choose one of their MANET-local addresses as main address and activate the SMF process.
- MANET-local address should be used as originator address in routing protocol messages.

Phase II: Prefix Advertisement

- Gateways periodically advertise prefixes in Prefix Advertisement (PA) messages using SMF
  - PAs include validity time for prefixes

- PAs conform to the generalized message format, as specified in draft-ietf-manet-packetbb-00

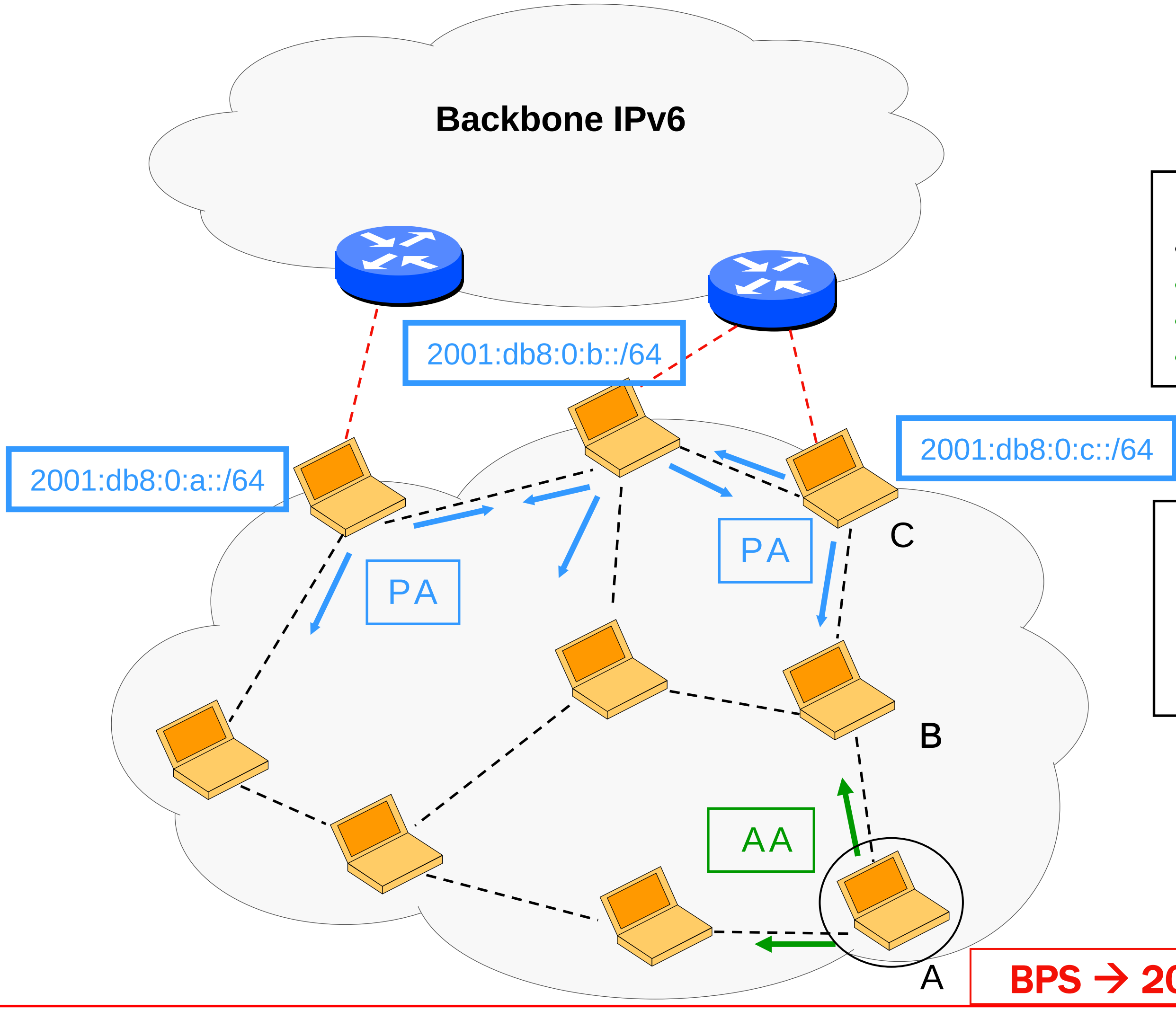
Phase III: Global Address Configuration

- Nodes receive prefixes, carried in PAs, and build global address
  - They can configure one or more global addresses on interfaces
- Nodes rank Global Addresses applying Best Prefix Selection (BPS) algorithm
  - Goal: to provide hints on the "best" address to use as SA
  - It can use metric associated with Gateways, if available, taken from the Routing Table
  - Two alternative algorithms:
    - Default Gateway method: nodes always choose prefix announced by the default gateway
    - Threshold method: nodes don't change their ranking, unless current best gateway metric decreases below a threshold

Phase IV: Global Addresses Advertising

- Nodes advertise built global addresses to other MANET nodes
  - All or a subset (to decrease overhead)
- Other MANET nodes bind each other node's MANET-local address with the global addresses owned by each node.
  - Routes to global addresses of a node are available to all other MANET nodes (in particular, to gateways)
- DYMO, OLSRv1 and OLSRv2 can already support advertisement of multiple addresses, belonging to a single node
  - OLSRv1 can use MIDs, OLSRv2 can use TCs, DYMO can use RMs (for further study)
  - No new transport mechanism defined

AMG



MANET Node A
- fc00::1 → Main Address
- 2001:db8:0:c::1 → Global address
- 2001:db8:0:b::1 → Global address
- 2001:db8:0:a::1 → Global address

Routing table C (par.)
- fc00::1 → Next hop B
- 2001:db8:0:c::1 → Next hop B
- 2001:db8:0:b::1 → Next hop B
- 2001:db8:0:a::1 → Next hop B

BPS → 2001:db8:0:c::1

Best Prefix Selection

- BPS should be executed at bootstrap AND when particular events trigger a topological change in the MANET.
  1. Failure of the gateway owning the chosen prefix;
  2. A partition, after which the node and the gateway, owning the chosen prefix, belong to two different MANETs;
  3. A merging occurs, after which a gateway previously not connected to the MANET may have a better metric value;
  4. The gateway, which announces the chosen prefix, stops announcing prefixes
     - e.g. after shutting down the interface connecting it to the external network;
  5. After a movement of one or more MANET devices, a gateway has a better metric than the gateway announcing the chosen prefix;
- Threshold algorithm accounts for dynamic scenarios

Global Addresses Advertising

- GA Advertising minimizes outages after address change
  - Since nodes has already disseminated their “new” global address (after they first received prefixes from other gateways), they can start using it as SA with negligible latency.

- If Mobile IPv6 is used
  - A MN send a BU when its global address changes
  - the gateway already has a valid route towards the new global GA
    - BA is immediately delivered, no route discovery needed

Pros and Cons

- ✓ Node can always use best path for "downlink traffic" and effectively exploit all available gateways
- ✓ Merging and partitioning cause no major problems
- ✓ Account for situations where gateways intermittently appear and disappear

- ✗ Optimized for proactive protocols
- ✗ Overhead of global address advertising (actually, optional)

Draft status

- Currently, version -03

- Future work
  - Interaction between Best Prefix Selection and IPv6 SA selection must be further studied
  - Overhead introduced by GA Advertising should be further analyzed
  - Detailed operations for OLSRv2
  - Investigation on interactions with DYMO

- Linux implementation (based on OLSRv1) and ns-2 code
  - Demo at Mobicom 2005

- For updated versions
  - http://vesuvio.ipv6.cselt.it/ruffino/