Survey of IP address autoconfiguration mechanisms for MANETs

draft-bernardos-manet-autoconf-survey-00

Carlos J. Bernardos <cjbc@it.uc3m.es>
María Calderón <maria@it.uc3m.es>

Dept. Telematic Eng. – Universidad Carlos III de Madrid
2005-08-01
63rd IETF – Paris
IP autoconfiguration in MANET

● There are several proposals

♦ I-Ds and research papers
♦ Different scopes / targets / applicability scenarios
  ○ IPv4 / IPv6 / IP family address independent
  ○ Ad-hoc routing protocol dependent / independent
  ○ Support for partitioning and merging
  ○ Duplicate Address Detection in MANETs
  ○ Centralised / Distributed
  ○ For Connected (hybrid) / Disconnected MANETs
  ○ Integrated or not with Internet-Gateway discovery

♦ Many of the proposals try to solve just one piece of the general problem
Conflict-detection allocation

1. Node x picks (e.g., chooses) an IPv6 address (addrX)

2. Node x requests for approval

3. Node x waits for an answer
draft-perkins-manet-autoconf-01

- **Scope**
  - Local IPv4/IPv6 address autoconfiguration
  - Ad-hoc routing protocol independent

- **Basic mechanism**
  - A node chooses an address randomly and performs Duplicate Address Detection (DAD) within the MANET
  - DAD within the MANET
    - Based on sending Address Request (AREQ) messages and waiting for Address Reply (AREP) messages (indicating that the address is already in use)
    - The node selects a temporary IP address (different to the requested one) as source of the AREQ messages
      - This is used to create reverse routes at intermediate nodes
  - Same mechanism for IPv4/IPv6
    - Modified Neighbour Solicitation and Advertisement for IPv6
    - New messages defined for IPv4
Scope
- IPv6 address auto-configuration for MANETs
- Ad-hoc routing protocol independent

Basic mechanism
- A hierarchy is established by special nodes (called leader nodes) that configure a group of nodes by issuing modified Router Advertisements within their scope, including a subnet ID (IPv6 prefix)
- DAD is performed within the scope (limited area) of the node
- The subnet ID has to be unique in the MANET to guarantee IPv6 address uniqueness
  - Duplicate Subnet ID Detection among leader nodes
draft-wakikawa-manet-globalv6-04

● Scope
  ♦ Global IPv6 address auto-configuration for hybrid MANETs
  ♦ Ad-hoc routing protocol independent

● Basic mechanism
  ♦ There exists at least one Internet-Gateway (I-G) that sends proactively or reactively (in response to I-G solicitations) I-G advertisements that contain prefix information
    ○ Extended Router Solicitation/Advertisement messages or control messages for each MANET routing protocol can be used for this signalling
  ♦ A node configures a global IPv6 address from the advertised prefix and the EUI-64 of the interface
    ○ No DAD for this address: it is assumed that the node has performed DAD for the link-local address
draft-jeong-adhoc-ip-addr-autoconf-04

● Scope
  ♦ Local IPv4/IPv6 address autoconfiguration for disconnected MANETs
  ♦ Ad-hoc routing protocol independent
  ♦ Considers partitioning/merging

● Basic mechanism
  ♦ Address autoconfiguration comprised of three steps
    ○ Selection of a random address
    ○ Verification of the address uniqueness (Strong DAD)
    ○ Assignment of the address to the interface
  ♦ Besides Strong DAD during initialisation, intermediate routers also check for
    address duplication during ad-hoc routing (Weak DAD)
    ○ Virtual address concept: IP address + key (unique)
    ○ Node receiving an Address Error (AERR) message should autoconfigure a
      new IP address
  ♦ New ICMPv4 and ICMPv6 messages defined for signalling (AREQ, AREP and
    AERR)
    ○ draft-jong-manet-aodv-addr-autoconf-01 defines the message format for AODV
Scope

- Global IPv6 address autoconfiguration for hybrid MANETs
- Specified for OLSR, but can be generalised to other routing protocols

Basic mechanism

- There exist several gateways available in the MANET. Each of these gateways has a global IPv6 prefix that is announced using a new OLSR message type: Prefix Advertisement (PA)
- At bootstrap, a node configures a (MANET-scoped) Primary Address (PADD) as main address in OLSR
  - The node receives PAs from the gateways in the MANET
- With the prefix information from PAs, a node is able to build a set of global IPv6 addresses: Secondary Addresses (SADDs)
  - The node chooses the “best” prefix and start using the address formed from this prefix: Designated Secondary Address (DSADD)
  - The node introduces all (or a subset) of the SADDs in OLSR MID messages, enabling these addresses to be routable within the MANET
- A generic DAD procedure should be performed to verify address uniqueness
draft-laouiti-manet-olsr-address-autoconf-01

● Scope
  ♦ DAD for MANETs
  ♦ Specified as an extension to OLSR
  ♦ Supports partitioning/merging

● Basic mechanism
  ♦ Each node in the MANET includes its IP addresses and a (randomly chosen) node identifier (assumed to be unique within the MANET) in a new OLSR control packet: Multiple Address Declaration (MAD)
  ♦ Address conflict: MAD message received with same IP address and different identifier
Scope

- Global IPv6 address autoconfiguration for hybrid MANETs
- Ad-hoc routing protocol independent

Basic mechanism

- The default gateway periodically sends modified Router Advertisements (RA)
  - Also in response to modified Router Solicitations
- With the prefix information contained in the RAs, each MANET node configures a unique IPv6 address
draft-mase-manet-autoconf-noaolsr-00

● Scope
  ♦ IPv6 address autoconfiguration for MANETs
  ♦ Modification of the OLSR specification

● Basic mechanism
  ♦ 3 parts
    ○ Address selection, based on the “busy address list”
    ○ Ongoing Duplicate Address Detection, using 10 simple rules, that can deal with the optimisation of OLSR
    ○ Gradual entry in OLSR network and routing table contamination avoidance, using three autoconfiguration states (HELLO, TOPOLOGY and NORMAL)
Conflict-free allocation

1. Node x (first node) picks the pool and configures its interfaces
2. Node y joins the network and requests some addresses
3. Node x gives half of its pool of addresses
4. Both Node x and y can give addresses to new arriving nodes requesting addresses

Pool of addresses (initial)

Pool of addresses of Node x

Pool of addresses of Node y
Scope

- Global IPv6 address autconfiguration for hybrid MANETs
- Specified for OLSR, but can be generalised to other routing protocols

Basic mechanism

- There exists at least one “configured” (e.g., an I-G) node in the MANET
- The configured nodes periodically beacons ADDR_BEACON messages
- A new node selects one configured node as its “configuring” node and sends an ADDR_CONFIG message to it, requesting a local address
- The configuring node assigns a local address to the new node and signals it through another ADDR_CONFIG message
  - Now, the new node can start participating locally with the routing protocol
- The configuring node acquires a global IP address (e.g., DHCP, autonomously) for the new node and signals it with an ADDR_CONFIG message
Scope
- Global IPv6 address autoconfiguration for hybrid MANETs
- Ad-hoc routing protocol independent

Basic mechanism
- Each gateway present in the MANET sends periodically GW_INFO messages, containing IPv6 global prefix information, to its one-hop neighbours
  - GW_INFO can be sent via control packets of an ad-hoc routing protocol or via UDP packets
- Each node in the MANET selects one prefix for the configuration of its address (using the EUI-64)
  - The node forwards an updated version of the GW_INFO message that contains the selected prefix to its one-hop neighbours
    - This way of propagation leads to “Prefix Continuity”
- DAD not performed since there is very low probability of address duplication
non I-D proposals

- There are also several interesting proposals published as papers in conferences, journals, etc.
  - Some of them introduce concepts and mechanisms that are afterwards reused by some of the existing I-D mechanisms
  - Interesting conflict-free allocation approaches
  - References to these papers can be found in the draft