Simplified Multicast Forwarding (SMF) Update

Brian Adamson
Aug 4, 2005
63rd IETF - Paris, France

SMF Goal Review

- Provide a basic multicast packet forwarding function
- Simple baseline (all nodes receive)
- Target native IP multi-hop forwarding
  - Both IPv4 and IPv6 design
- Support dynamic, optimized relay set algorithms (e.g., MPRs, CDS variant)
  - Experience with MPR-variants. Other CDS algorithms of interest being considered
- Internet connectivity and interoperability
- Avoid encumbered protocol mechanisms in baseline
- Support potential mix of "neighborhood aware" and "unaware" SMF nodes?
- *"draft-ietf-manet-smf-00" was submitted.*

SMF Components Summary

- Basic Forwarding Process
  - *The current draft focuses on this area and describes some implications for S-MPR and E-CDS relay set selection algorithms*
- Relay Set Selection Algorithms
  - *Different algorithms are available with different characteristics*
  - *Detailed algorithm descriptions should be documented* (separate document(s)?)
- Neighborhood Discovery Protocol
  - *A baseline protocol should be probably be defined, but*
  - *Routing protocols may perform this function for their own purpose anyway, and*
  - *Some layer 2 schemes may have this information.*

Forwarding Process

- Duplicate packet detection required
- Baseline "Classical Flooding" requires no addition control or topology knowledge
- Different control information and forwarding heuristics required depending upon relay set algorithm
  - S-MPR forwarding requires selector list, symmetric neighbor list, packets w/ previous hop identification (I.e. MAC addr)
  - E-CDS forwarding needs only "forward/don't forward" indication.

Duplicate Packet Detection

- Sequence-based Identifier
  - IPv4 (ID field or extension header or encapsulation) (Note ID may require re-sequencing)
  - IPv6 (header extension or encapsulation required)
  - IPSec (can leverage sequence field or encapsulate)
- Sequencing space
  - Per-source vs. Per Source::Destination (plus IPSec per-security parameter index (SPI))
- Hash-based
  - No need for sequence id, but
  - Pathology of false-alarm issue
  - Complexity issue

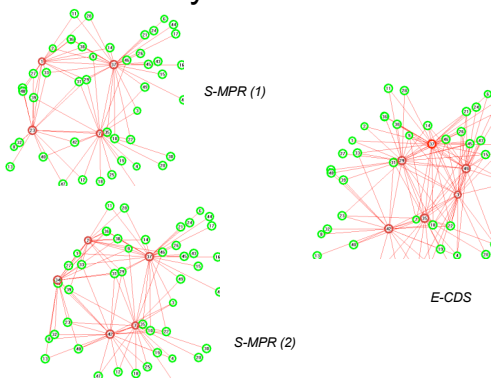
Neighborhood Discovery Protocol

- To pick more efficient relay sets than that of "classical flooding" some neighborhood topology information is required.
- This information may come "for free" if:
  - Routing protocol is already present that collects appropriate information
  - Link layer provides the needed information
- But some baseline neighborhood discovery mechanism is probably needed for SMF as a "stand-alone" capability
- Different relay set algorithms may require slightly different information
- If standard message formats/semantics are established for different MANET routing protocols, it is possible that a baseline SMF neighborhood discovery protocol could leverage the same.

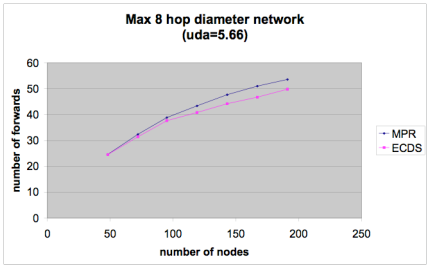
Relay Set Selection Algorithms

- S-MPR
  - Pros: More distributed of relays (*but may be a con since there are competing metrics: congestion, channel access, hidden terminals,etc*)
  - Cons: More complex state required to support forwarding (I.e., previous hop information selector information, symmetric neighbor list, and forwarded status per interface), forwarding must follow tree explicitly (no opportunistic forwarding)
- E-CDS
  - Pros: Only binary (yes/no) forwarding status required, "opportunistic" early forwarding can be leveraged, may more gracefully support mix of "aware" and "unaware" nodes.
  - Cons: More centralized relay set (*but could be a pro - see above*)
- Other …
  - (e.g. draft-perkins-manet-smurf-00)
- Several use 2-hop symmetric neighborhood information
  - Can either be extended to support asymmetric links?
  - Extensions to leverage link quality information for relay set selection?

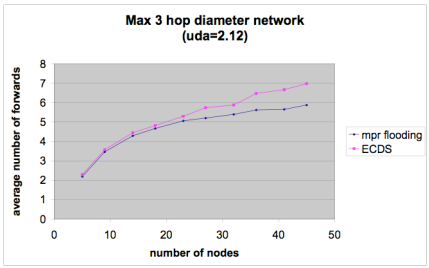
Relay Set Selection



S-MPR and E-CDS Performance



S-MPR and E-CDS Performance (cont'd)



S-MPR and E-CDS Performance (cont'd)

- More analysis should be conducted:
  - Dynamics, mobility (graceful handoff provisions?)
  - One- or few-to-many vs. many-to-many information flows
  - MAC layer impact
  - mixed mode (topology "aware" and "unaware" nodes)
- Preliminary NRL experiments and simulations indicate comparable performance between the two approaches, but nothing is conclusive yet.
- Similar analysis was done in MANET-OSPF design team (similar algorithms used in control plane)
  - Additional performance criteria (e.g., partial topology)

Outstanding Issues

- IPv6 option header type/definition
  - "Hop-by-hop" or "Destination" option?
  - IPv4 extension header definition also?
  - Note that option/extension headers provide clear indication that the packet has been appropriately sequenced for SMF purposes!
  - This can mitigate issues related to possible MANET area multicast ingress/egress when gateways are present.
- Baseline neighborhood discovery protocol definition (separate document?)
- Normative references for relay set algorithm descriptions needed.