

A Brief Talk on Mesh Routing

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http://www.personaltelco.net/~caleb/pubs/mesh_routing.*

WTF?

- Ben Jenks and I decided that we didn't know nearly enough about mesh routing – hence, this talk.
- High level overview of the purpose and challenges of wireless mesh routing and a bit of an introduction to a few of the (huge number of) candidates.
- Big topic, so let's try to skim the surface...

Review: the OSI 7-layer burrito

- Layer 1: Physical (i.e. 802.11x PHY)
- Layer 2: Data-Link (i.e. 802.11x MAC)
- Layer 3: Network (i.e. IP)
- Layer 4: Transport (i.e. TCP)
- Layer 5: Session (i.e. TCP sockets)
- Layer 6: Presentation (i.e. SSL)
- Layer 7: Application (i.e. HTTP)

Why Wireless is Hard

- Asymmetric and just-plain-crummy Links
- Mobile and Failing Nodes
- Redundant Routes

Several Approaches

- Reactive (On-Demand) (i.e. AODV, DSR)
- Proactive (i.e. OLSR)
- Hybrid (i.e. HSLS, 802.11s)
- Other (i.e. BATMAN, 802.11 WDS)
- And then, how many radios?
- Common: nodes communicate (usually via UDP) to exchange route information.

AODV

- Ad-hoc On-Demand Distance Vector (RFC 3561 – Experimental) - Reactive
- Don't compute routes ahead of time. When one is needed, flood network with broadcast route discoveries.
- Accept “fresh” routes on “recommendation”
- Expire routes. Expire discoveries (TTL and ID)
- Ultimately, pick discovered route with least number of hops.

DRS

- Dynamic Source Routing (RFC 4728 – Experimental) - Reactive
- Like AODV, but uses “source routing”, meaning it doesn't trust partial routes.
- Outgoing packets are given a prescriptive set of hops all the way from source to destination.
- Routing tables can be huge. Overhead is small for mostly static networks.

OLSR

- Optimized Link-State Routing (RFC 3626)
- Proactive – builds routing table before it is needed.
- Some nodes are nominated as MPRs (Multi-point relays) and are in charge of passing on control traffic – this limits “flooding” as seen in AODV et al.
- MPRs are chosen by their neighbors so that a set of MPRs reaches all possible 2-hops

OLSR (continued)

- Uses more memory than other approaches and hence requires more powerful routers (WRT-class routers are good enough).
- Communicates using UDP/698
- Uses HELLO messages to discover the “neighborhood topology” and establish MPR signaling
- Uses TC messages (sent by MPRs) to advertise topology information.

OLSR (continued)

- Routing table at each node is composed of: (destination, next-hop, hop-count, interface)
- On transmit, routing table is used to choose shortest path in the directed graph (which has a polynomial time greedy solution).

HSLs

- Hazy Sighted Link-State Routing
- Being developed by CUWiN
- Combines Proactive, Reactive, and Suboptimal (incomplete information) strategies.
- Accepts having some out-of-date and incomplete information to reduce overhead (in this sense, it is an “engineered” approach)

HSLs (continued)

- Sends link-state updates only to near nodes (within r hops) and only when connections fail or they are required by the schedule (every t seconds)
- r and t have been derived mathematically and hence, are theoretically optimal parameters.

802.11s

- Based on HWMP (Hybrid Wireless Mesh Protocol), but allows for alternative routing protocols.
- One such alternative is RA-OLSR (Radio Aware OLSR)
- HWMP is a combination of AODV and tree-routing.
- One Laptop per Child will use 802.11s.
- It is currently in Draft.

BATMAN

- Better Approach to Mobile Ad-hoc Routing
- Wants to replace OLSR, but is still very young
- Fails the “modest name” test
- Nodes periodically send OGM (Originator Messages) and other nodes relay them
- If you see an OGM from some node, there must be a route from you to that node.
- Claims to be neither proactive, nor reactive
- Documentation/Spec. is seemingly non-existent

802.11x WDS

- Layer 2 – Not really a “routing protocol”
- Allows 802.11 repeaters using additional “intermediate” address fields in the 802.11x frame.
- Also, plain-old 802.11 Ad-hoc. Both are purely broadcast, and are agnostic to the higher-layer protocols. But, are arguably layer-puncturing.

Miscellaneous Comments

- Mobile Ad-hoc Networking \neq Mesh Networking
 - Centralized configuration distribution can work in a static mesh. The gateway is a logical point of centralization.
- In practice, static routing with a preferred route and a fail-over route is common. MetroFi (on Skypilot) and the RICE TFA network both use this, for instance.

References

- General

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