DLEP

“What is it, and why should I care?”

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Introduction

- The MANET WG has been trying to solve a problem with routing in dynamic networks of radio bearers.
- The WG has a solution, the Dynamic Link Exchange Protocol (DLEP).
- We believe that the suggested solution to the problem has applicability beyond MANET.
- I’m here to try to convince you!

What is the problem?

"How do two routers form
and maintain an adjacency?"

What is the problem?

To form an adjacency:

- Configure each router with the usual Layer-3 information (protocol, address, etc.)
- Start sending “Hello” packets, with a configured retry interval
- Or some variation on that theme:
  - Configured multicast discovery
  - A secondary ‘neighbour discovery ‘protocol

What is the problem?

To maintain an adjacency:

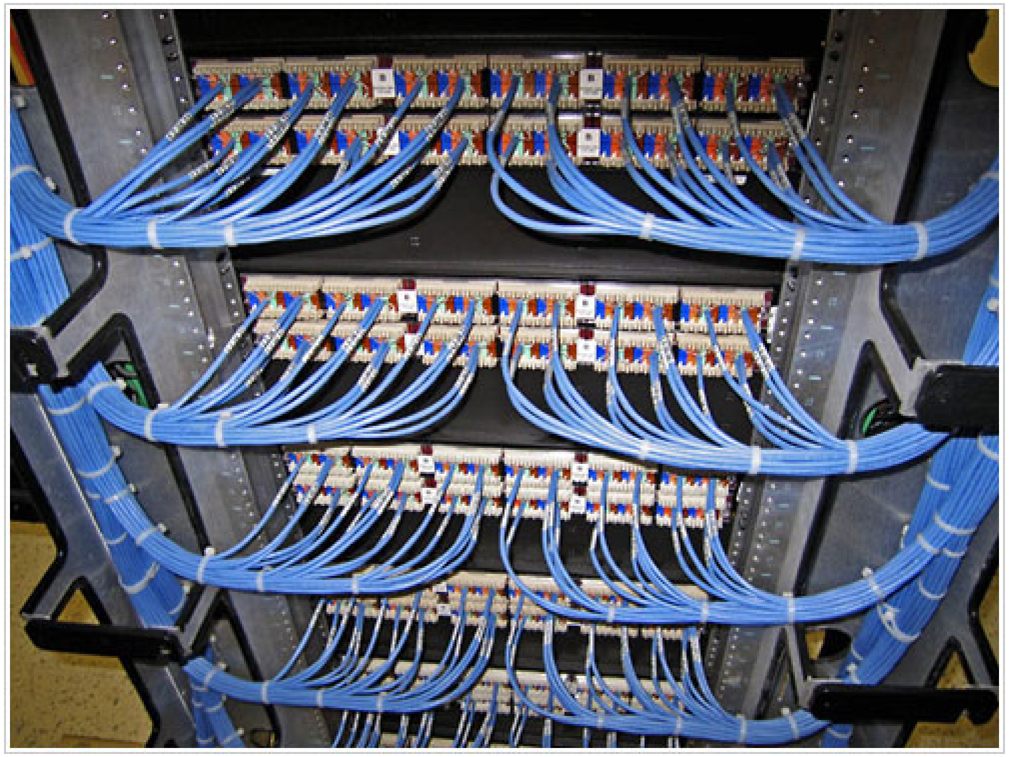
- Send a “Keep-Alive” every preconfigured time period.
- Wait until nothing is heard from the other end, and assume the link is down

What is the problem?

“But this works!”

What is the problem?

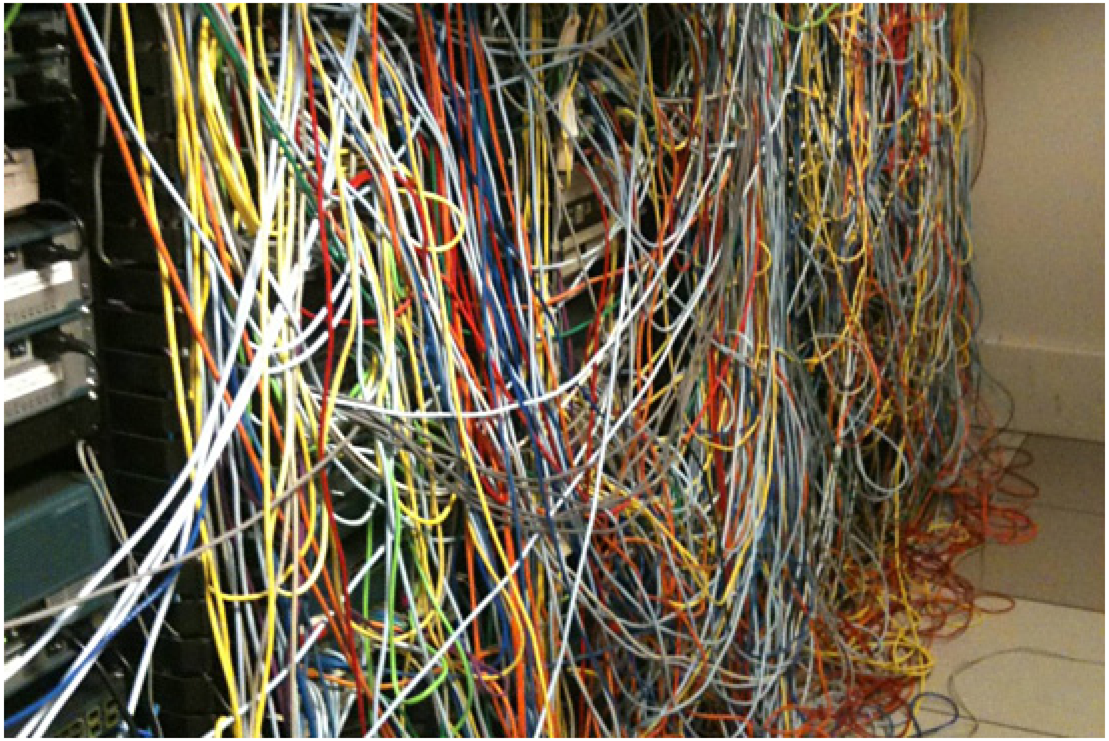
When your network looks like this:



Courtesy of Precision Fiber Optics.

What is the problem?

Hopefully, when your network looks like this:



What is the problem?

But very badly, when your network looks like this:

NB: This does not imply that the radio is bad, just the approach is sub-optimal

What is the problem?

Why so bad?

- Because radios are affected by the environment
  - Atmospherics
  - Interference
  - Position and orientation
- Radio equipment commonly moves
  - The quality of the link can change over time
  - If possible, use a cable!

A short digression

- IP networking has ‘won’
  - The market now demands all network equipment exposes an IP/Ethernet LAN interface
- The radio link layer does a lot of very clever stuff
  - The link layer is becoming increasingly more complex and capable
  - Vendor specific ‘special sauce’ enables competition and innovation

A short digression

Not just traditional point-to-point radios

- Satellite (SATCOM) systems
- Meshing radio systems
- Free-space optical/microwave systems

The Proposition

When dealing with links more complicated than wires, the link layer is already doing discovery and maintenance.

So why do it again at the routing layer?

Why not just talk to the link layer?

Radio to Router Protocols

- PPP over Ethernet (PPPoE) Extensions for Credit Flow and Link Metrics
  - RFC4938 (Informational) June 2007 (obsolete)
  - RFC5578 (Informational) Feb 2010
- Radio-Router Control Protocol (R2CP)
  - draft-dubois-r2cp-00 (Informational) March 2011
- Dynamic Link Exchange Protocol (DLEP)
  - RFC8175 (Proposed Standard) July 2017

DLEP condensed

A protocol to allow a router and radio to discuss what is happening at the link layer

- ‘Destinations’ (remote nodes) arriving or departing
  - Identified by reachable MAC address
  - Includes IP address information
  - Includes Multicast ‘Destinations’
- Information about the quality of the link to a ‘Destination’
  - Bandwidth
  - Latency
  - And others: Resources, RLQ

Back to the problem…

“So how does this help?”

Event-triggered Adjacency

By listening to events from the link layer, routing protocols can react to the arrival and departure of peers in a much more timely fashion than relying on timers and timeouts.

Metric-aware Adjacency

When the router has information about the quality of the links between peers, it can make smarter decisions: e.g., dynamic protocol timers and route costs.

An Example

I work for a company that makes aircraft.

We also make networks.

An Example

An aircraft can take as little as 45 seconds to overfly a ground position.

In this time:

- Both peers must notice each other
- The link layer must synchronize in some way
- The IP layer must resolve addresses, routes, etc.
- The application layer must sync and exchange data
  - ***This is the point of the whole exercise!***

An Example

- ARP/ND
  - One or more round-trips to resolve addresses
- Routing protocols
  - OSPF, commonly, Hello Timer is 10 seconds and Dead Interval is 40 seconds.
  - Other protocols have similar conservative defaults
- Upper layer protocols
  - Commonly designed for 100Mb/s Ethernet

An Example

Obviously, all of this can be tuned, but:

- Every deployment/mission is different
- No dynamism
- A (well-paid) human is inevitably always in the loop
- SDN seems to make it all worse
  - Based on always-on/fully-connected methodology
- The end-user just wants to do their day-job!

An Example

With DLEP:

- We can skip ARP/ND
  - DLEP can tell router destination IP information
- We can skip Hello Timer and Dead Interval
  - Bootstrap routing protocol session
- We might be able to skip a routing protocol
  - DLEP can tell router remote subnet information
    - But it’s intentionally limited.
- We can preload RTT estimates for TCP, etc.
  - Get the data moving efficiently, quickly

Meh...

“Yeah, that’s all very cool…
but I don’t do that radio stuff”

But...

I bet you are all using link layers more complicated than 10BaseT:

- L2VPN and friends
- Virtual networking
- 3G/LTE
- WiFi
- Domestic broadband

DLEP can help with all of these

What’s Next?

The DLEP extension mechanism allows re-use of the session to carry more information:

- Flows/Queue control
  - Both simple Pause/Resume and Credit Windowing
- Extended Layer-3 support
  - Infrastructure Access-point and L3 tunnel support
- More metrics
  - Hop count (and control)
  - Statistical information (min/max)

What’s Next?

- Reach out to the wider community
  - That’s you!
- YANG models
  - Yes, they are important
- Extensions
  - To support more use-cases, e.g. data-centre, DOCSIS, 5G

Open Questions

- How to work with SDN?
  - SDN is prescriptive
  - DLEP enables a reactive model
- How to work with BFD?
  - There is cross-over, but also opportunities
- How to work with the routing protocols?
  - Best practices for using with DLEP?
- What have the MANET WG missed or misunderstood?
- Is the MANET WG the right place for DLEP anymore?

Thank you!

Any questions?