draft-ietf-6lowpan-nd-07

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6LoWPAN: Constrained Nodes

- 8 MHz CPU, 10K RAM, 48 K Flash
- Battery operated, 2 AA, 2 years = 200 μW
- Sleepy nodes
  - don't always listen
  - like node-initiated communications

6LoWPAN: Constrained Networks

- IEEE 802.15.4
- 20..250 kbit/s (0.9 or 2.4 GHz), shared media, high error rates
- Packet size < 128 Bytes
- Non-transitive link ($A \rightarrow B \wedge B \rightarrow C \nRightarrow A \rightarrow C$)
- No real IP multicast
  - link-local = just radio range

6LoWPAN-ND

- 6LoWPAN is an NBMA
  - Non-transitivity ($A \rightarrow B \wedge B \rightarrow C \not\Rightarrow A \rightarrow C$)
  - Multicast is inefficient on a wireless mesh (if possible)
- RFC4861 was not aimed at this environment
  - see section 1
- The 6lowpan WG has specified and optimized ND mechanism for LoWPANs
  - Currently draft-ietf-6lowpan-nd-07

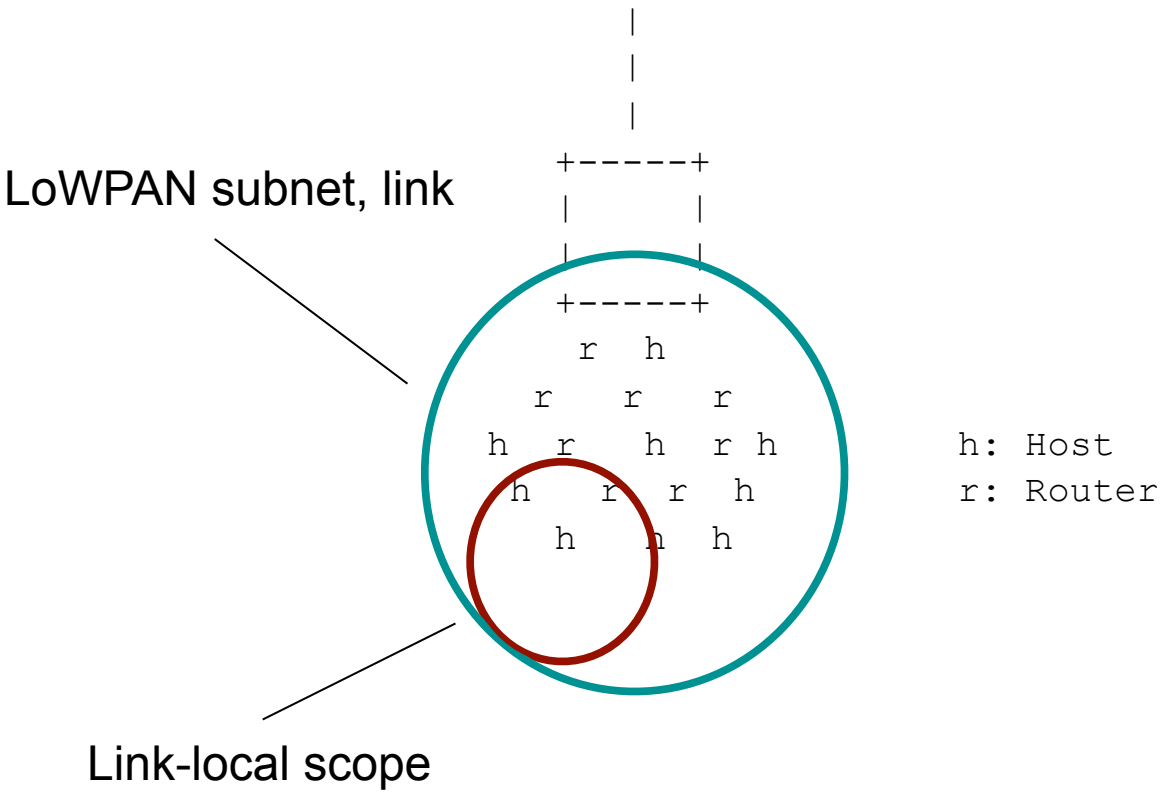
6LoWPAN ND Objectives

- Enables sufficient LoWPAN operation on its own
  - Other ND mechanisms may be used in addition
- Optimizes the **host-router** interface
- **Provide ND functions: DAD, AR and NUD**
  - Node Registration mechanism
- Multihop router and context information dissemination
- Compatible with link-layer mesh (MU) and IP routing (RO)
- Support for several LoWPAN topologies
- Fault tolerance and duplicate identifier detection

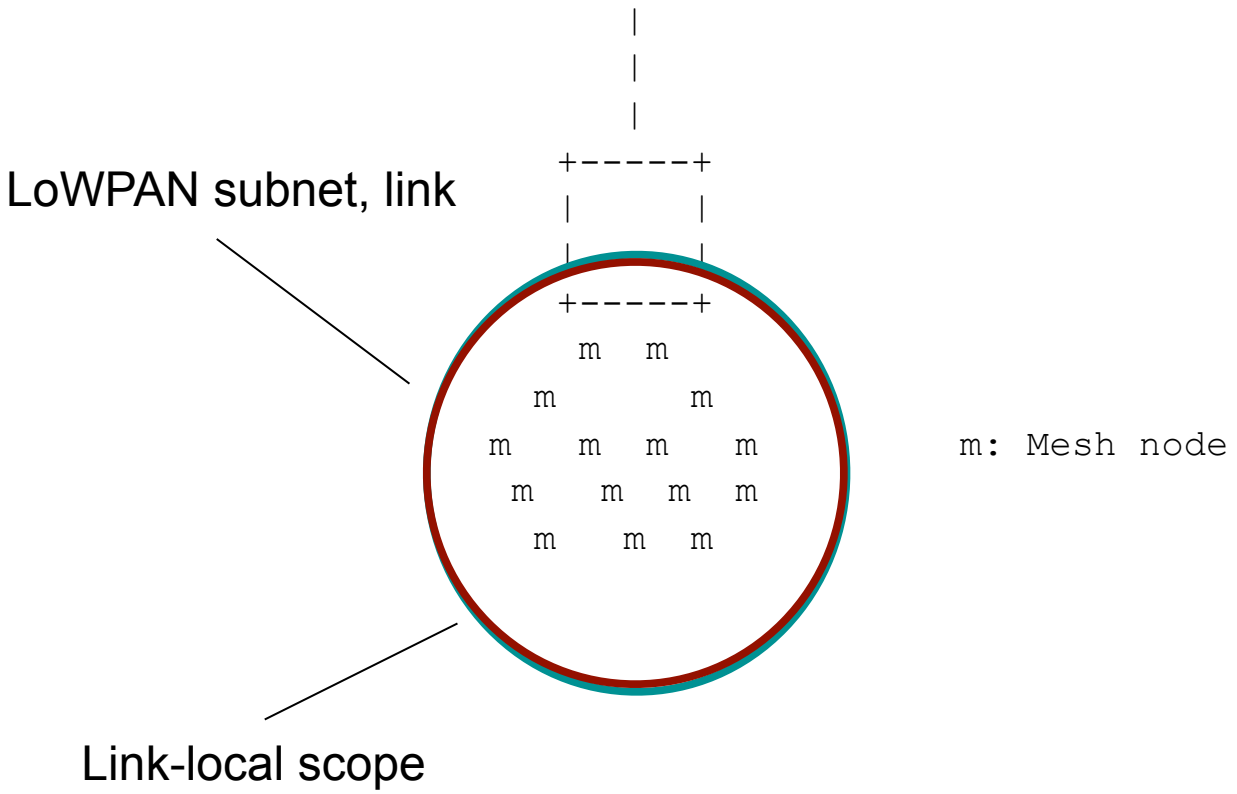
Link model

- A typical 6lowpan link:
  - e.g. an IEEE 802.15.4 wireless channel
  - Usually non-transitive ($A \rightarrow B \wedge B \rightarrow C \not\Rightarrow A \rightarrow C$)
  - Link-layer broadcast reaches only a subset of nodes
  - Looks like complex NBMA
- Link-local scope is one radio hop
- IP routing used to provide transitivity
- LoWPAN subnet may therefore have multiple hops
  - Not a multi-link subnet

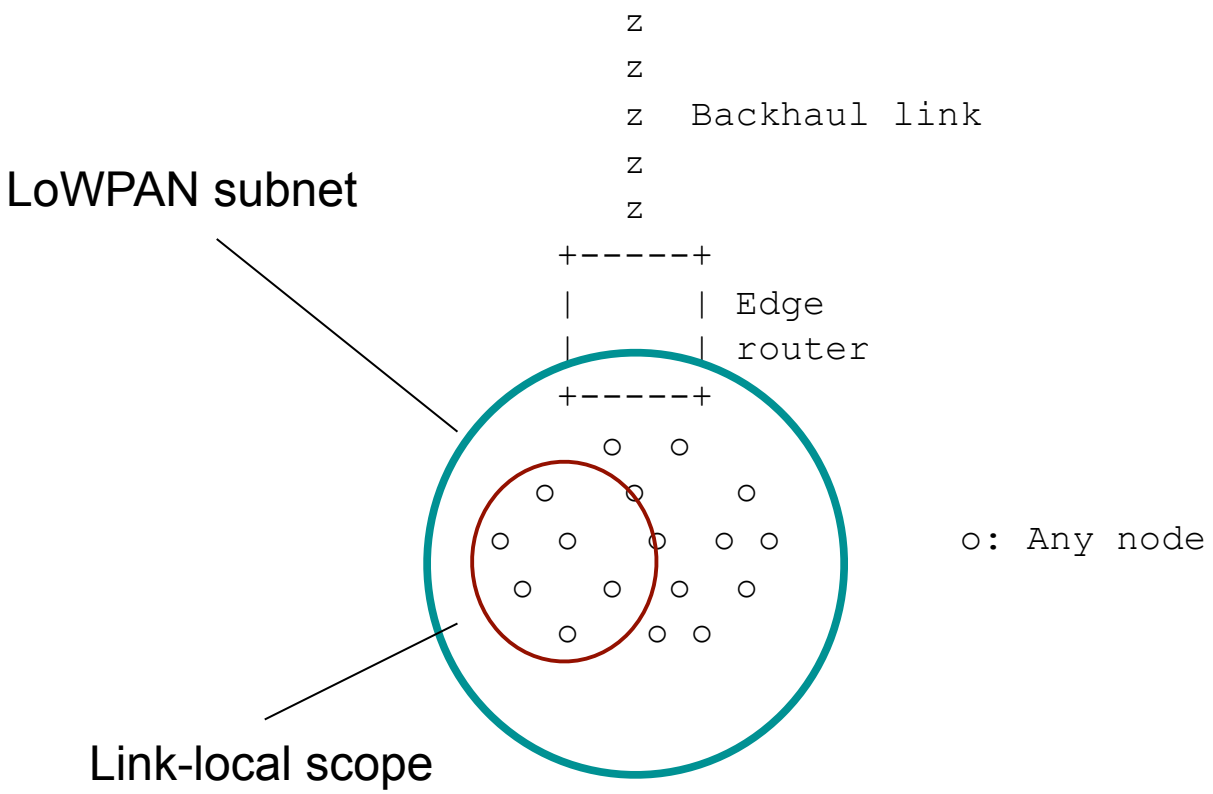
Link model – Route Over



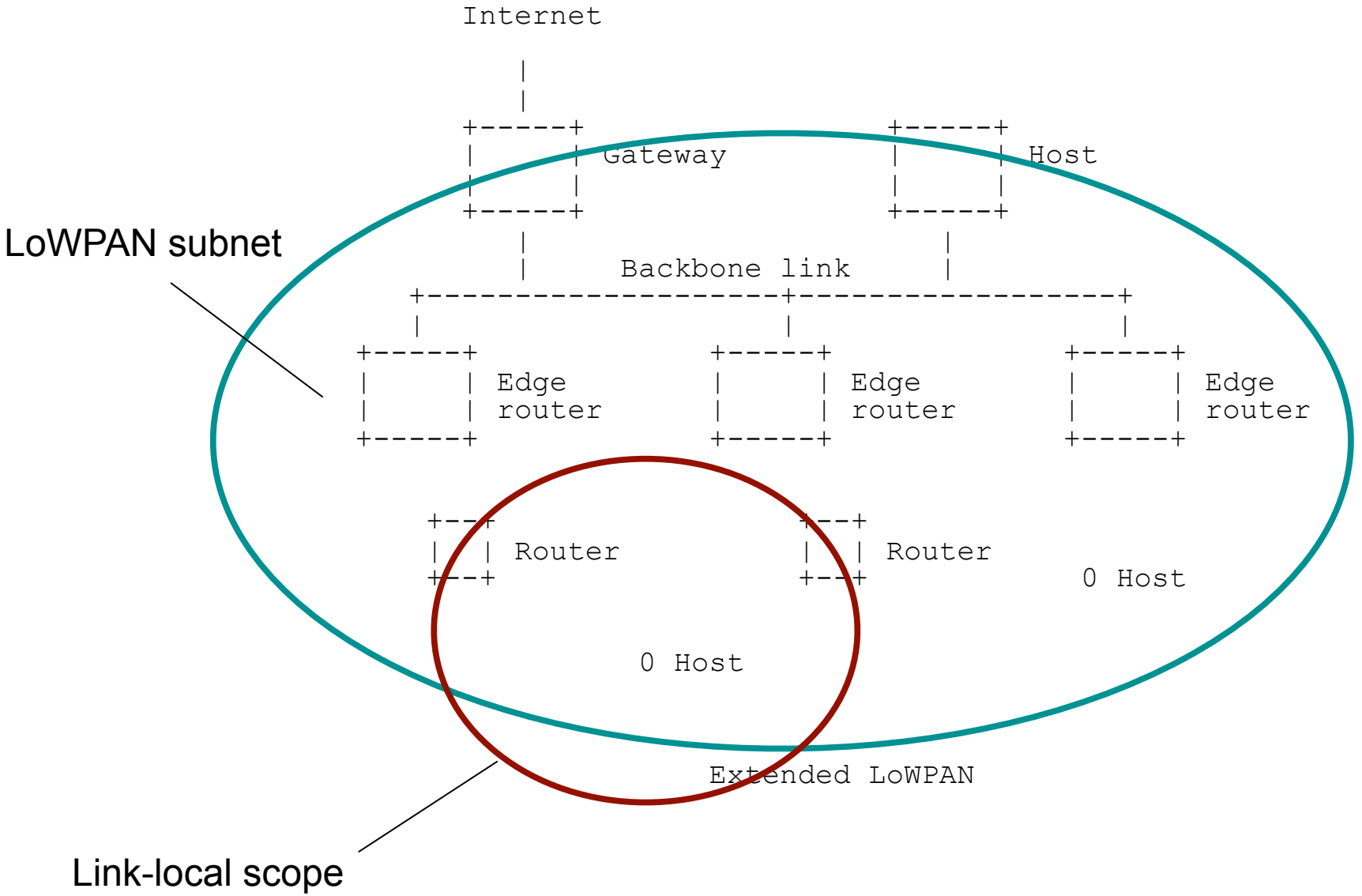
Link model – Mesh Under



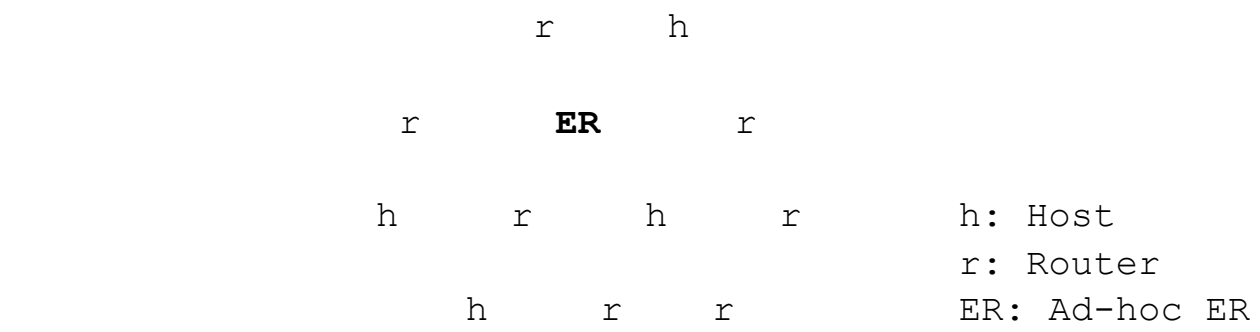
Link model – Single LoWPAN



Architecture – Extended LoWPAN

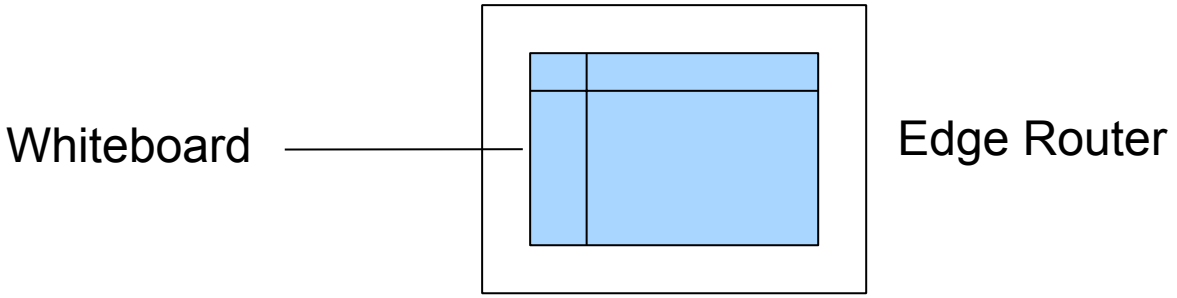


Ad-hoc LoWPANs



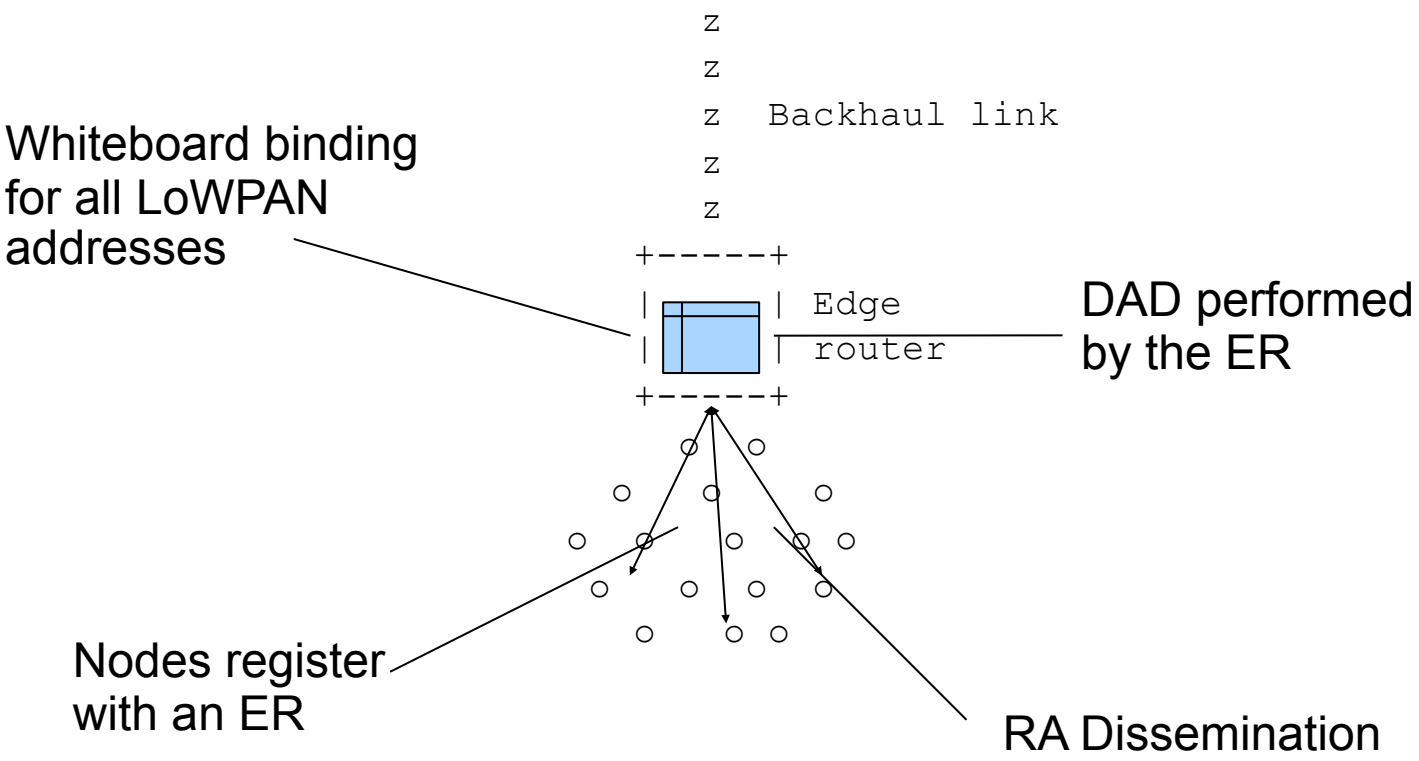
- Ad-hoc use of 6LoWPAN-ND defined
  - Almost identical to simple LoWPAN operation
  - 100% transparent to LoWPAN nodes
  - ER generates ULA [RFC4193] and disseminates it
  - Whiteboard state can be optimized

Whiteboard model

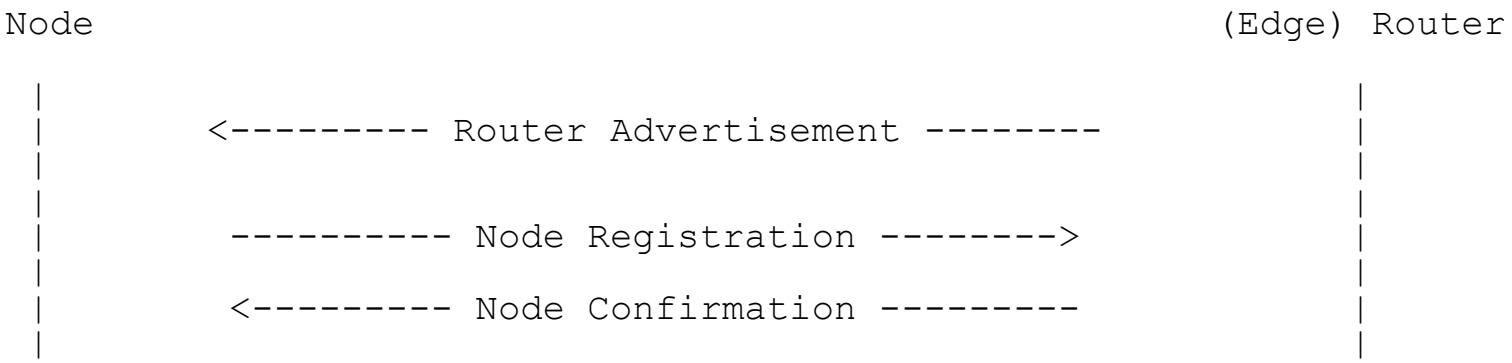


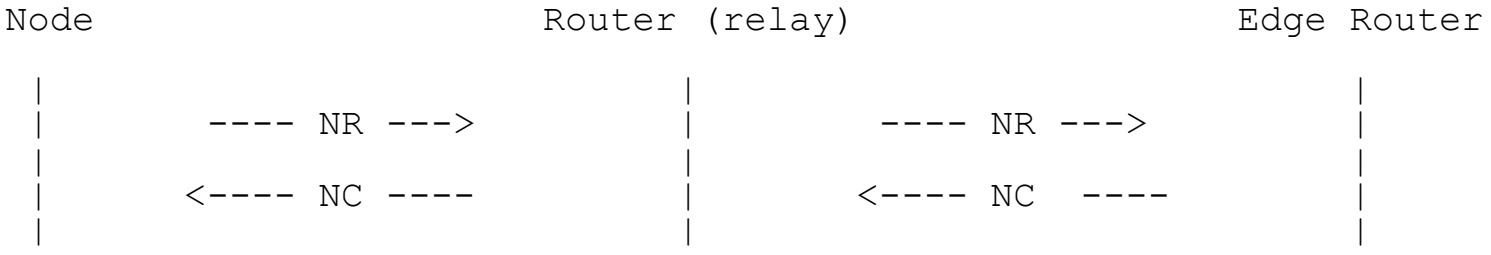
- A whiteboard binding entry has the following fields:
  - `Owner Interface Identifier`
  - `IPv6 Address`
  - `TID, Nonce, Lifetime`
- Bindings are soft
  - Must be refreshed
  - Can be moved between ERs

Basic features

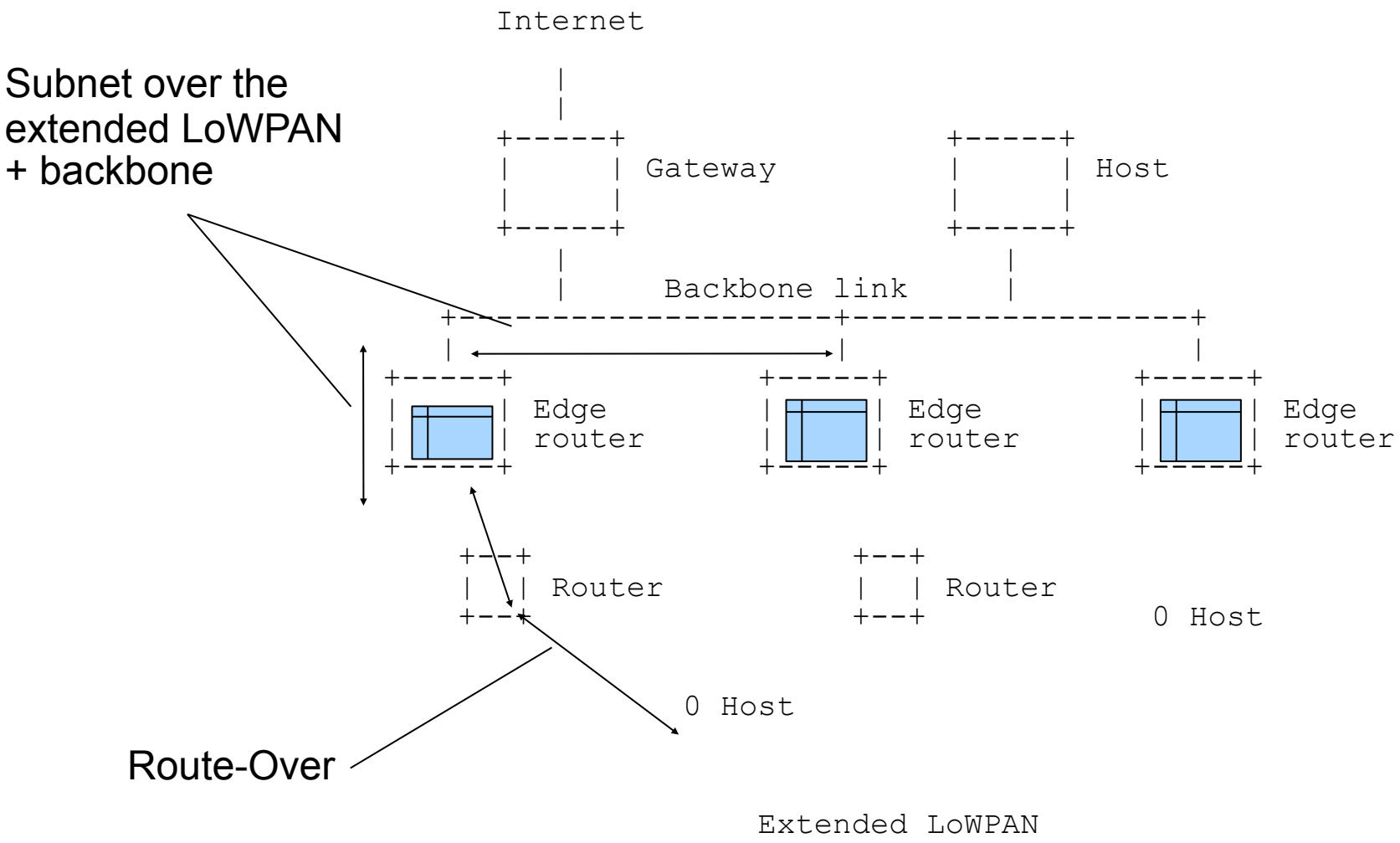


Message exchanges

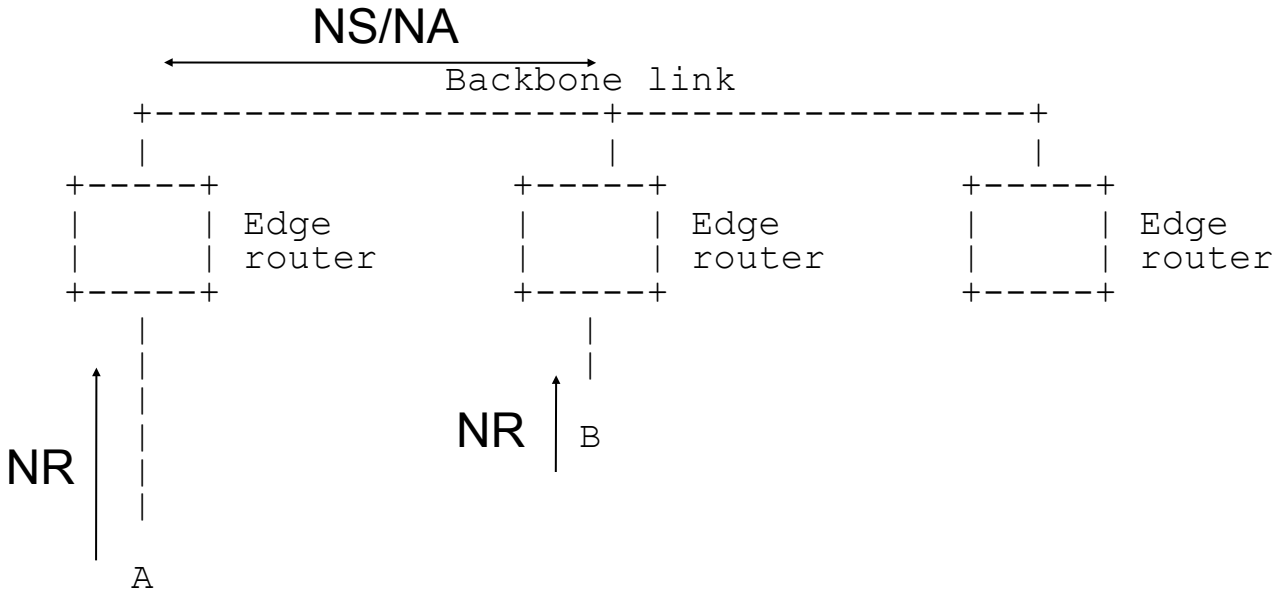




Extended LoWPAN (optional)



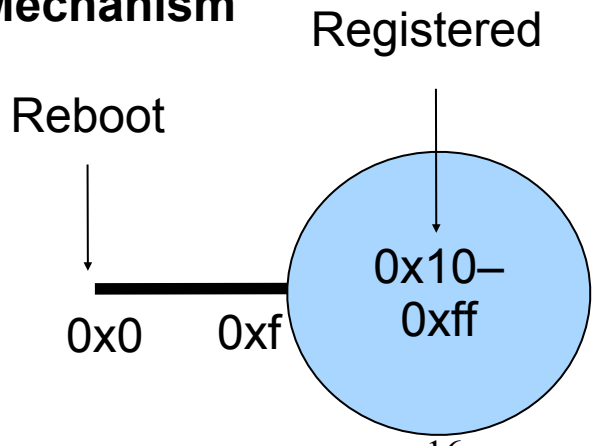
Duplicate identifier detection



NR message contents:

- Owner Interface Identifier (64-bit)
- Nonce (32-bit)
- Transaction ID (8-bit)
- Addresses to register

TID Lollypop Mechanism

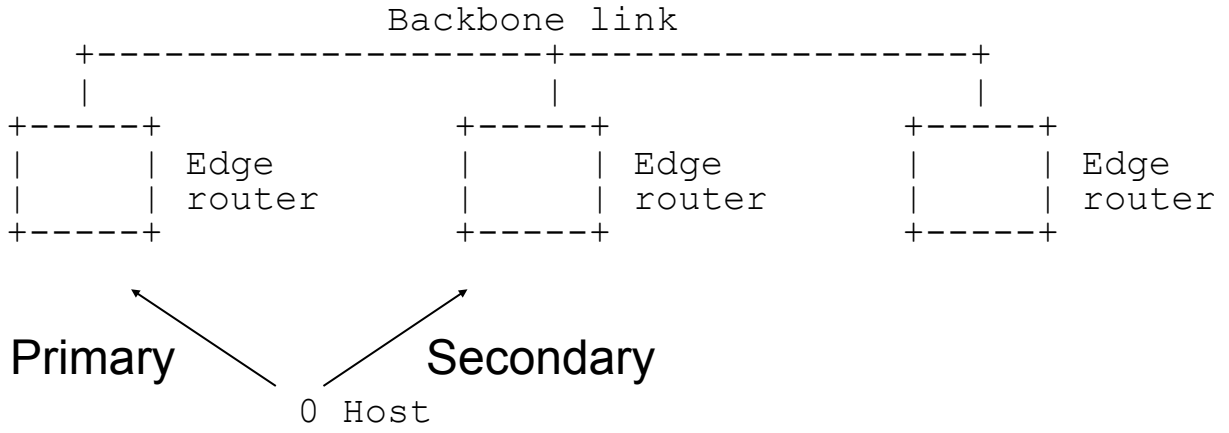


NR message processing

Type	OII	Nonce	TID	Address	Action
Initial Registration	Unique	*	*	Unique	Accept
New Address or Movement	Duplicate	Same	>	*	Accept
Duplicate message	Duplicate	Same	<=	*	Ignore
Duplicate message	Duplicate	Same	<=	*	Ignore
Node Reboot	Duplicate	Different	< 0x10	*	Accept
OII Collision	Duplicate	Different	> 0xf	*	Reject

* = Wildcard

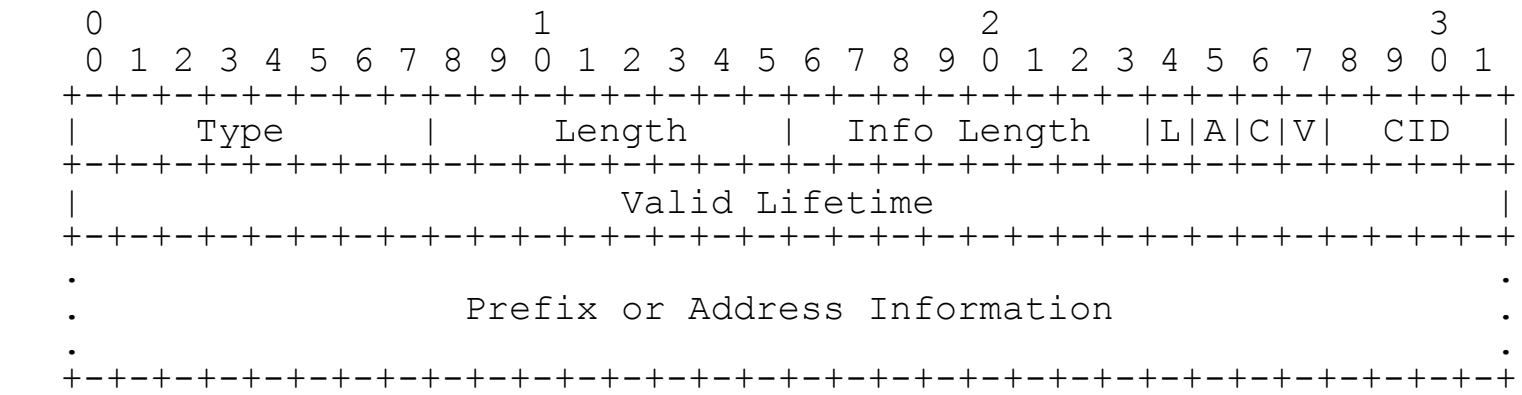
Fault tolerance



- Edge Router recovery
- Use of secondary registrations for fault tolerance
  - Prepare network state for movement to new primary
  - Automatic primary->secondary backup operation
  - Bicasting possible

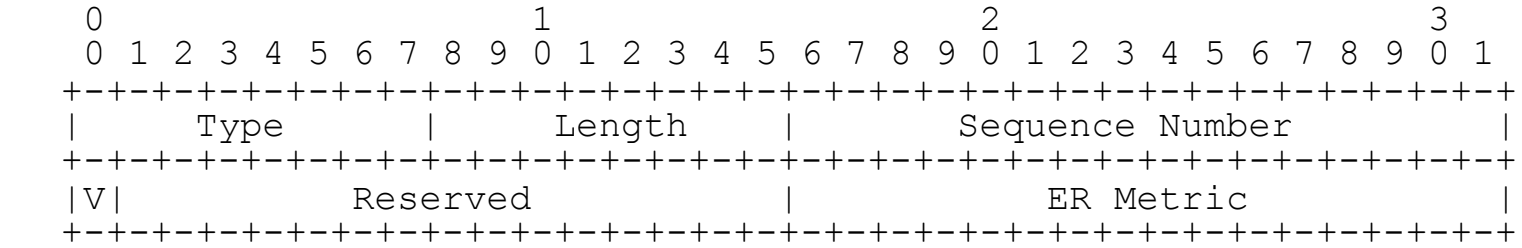
RA options

6LoWPAN Information Option (6IO)

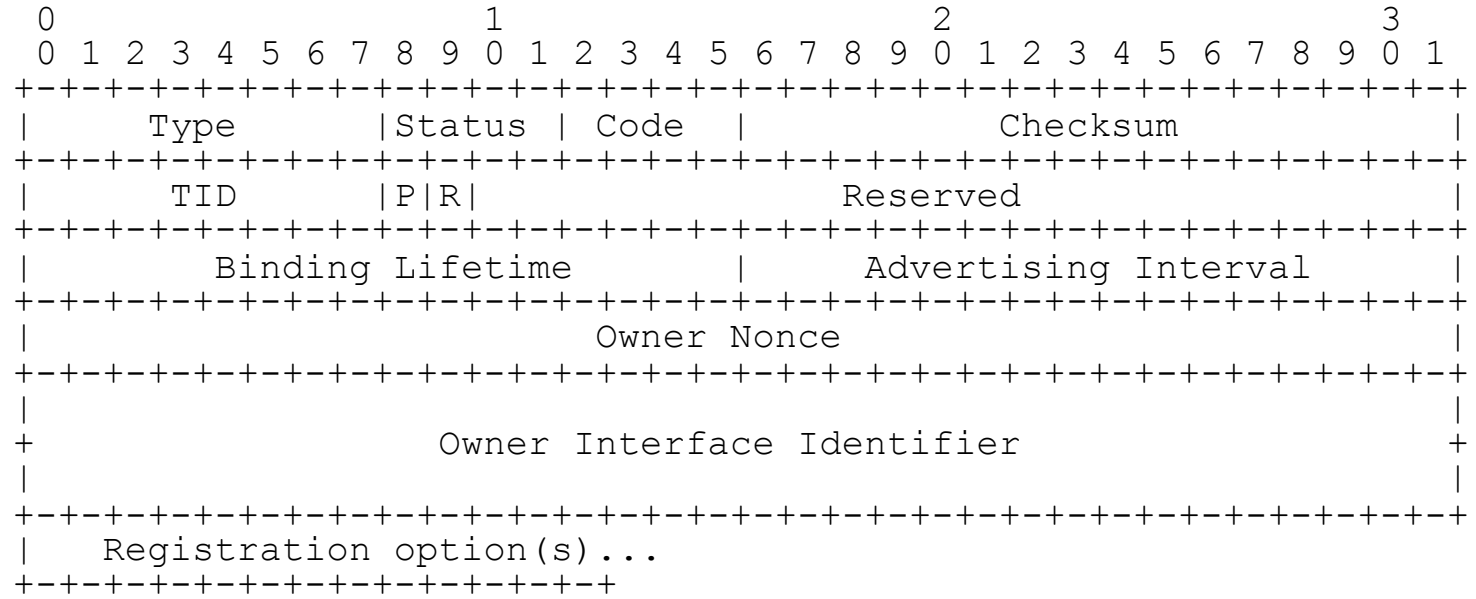


CID – Context Identifier for use in 6LoWPAN HC compression.

6LoWPAN Summary Option (6SO)



NR/NC message



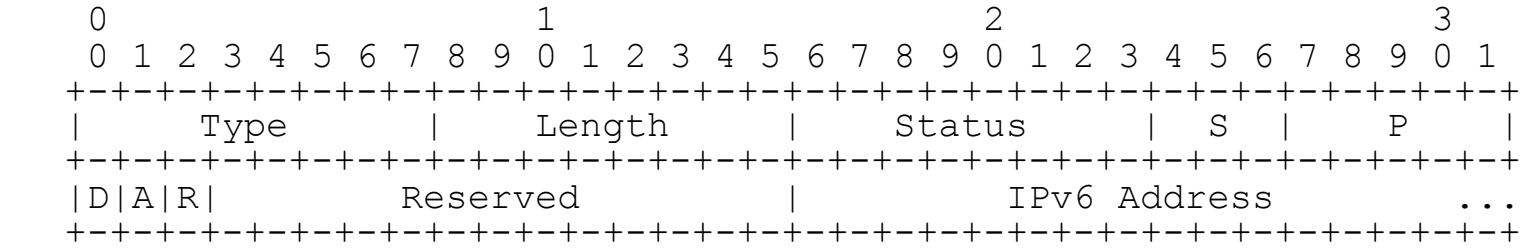
TID – Transaction ID for matching confirmations.

P – Primary flag for using an ER as primary. For use with secondary registrations.

R – Indicates if the registering node is a host or router.

NR/NC options

6LoWPAN Address Option (6AO)



P/S – Prefix and suffix compression fields.

D – Allow duplicates flag.

A – Address request flag.

R – Remove address flag.

Source link-layer address option [RFC4861, RFC4944]

Target link-layer address option [RFC4861, RFC4944]