Evaluation of a Multi-Instances RPL Network
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Routing in Low-Power and Lossy Networks (RPL)
RPL is the IETF candidate standard for IPv6 routing in low-power wireless sensor networks. It uses a Direction-Oriented Directed Acyclic Graph (DODAG) to construct routes from every node to the root.

- Nodes use an Objective Function to select their next hop to the root.
- The Objective function uses a set of metrics and constraints.
- DODAGs are advertised by the root using DODAG Information Object messages.

A RPL instance defines a set of DODAG using the same objective function, satisfying the same application goal. Thus, using a single instance only allows one type of traffic.

Benefits of using Multiple RPL Instances
By using multiple RPL instances, a node can participate in multiple applications with different route requirements and constraints over a same physical topology, enabling traffic differentiation.

- Routes using only main-powered nodes
- Encrypted-only links while minimizing hopcount
- Highly-constrained nodes that only work in minimal RPL configuration (Non-storing mode)

Multiple RPL instances in a same physical topology also allows new mechanisms for load-balancing and redundancy if all instances share the same root.

Goal of the paper
- Validate the implementation of multi-instances RPL for Contiki OS which also introduces new features.
- Evaluate impact of using multiple RPL instances on PDR, Energy consumption, route stability for a given physical topology.

- Compare performance of each RPL instance in a single instance context versus multi-instances context.
- Evaluate impact of DIO size overhead introduced by new features.

Early Results
Multiple instances with upward traffic only
In light traffic condition, the network performance did not significantly suffer except from node energy consumption.

Multiple instances with downward traffic
In high traffic condition, transmission of DAOs from nodes to root combined with downward data traffic seems to affect the PDR.

Overhead of control messages
- Carrying more information in the DIOs did not affect the performance significantly.

Testbed
Evaluation is performed in IoT-LAB, a very large scale open testbed.

- 30 Cortex-M3 based Nodes
- Spread over 3 floors
- Experiments of 30 minutes repeated 5 times

In our scenarios, we used different parameters:
- Traffic : data message every 2/15/30 seconds to the root, for each instance
- Number of metrics/constraints advertised : from 0 to 3
- Number of RPL instances : from 1 to 3

In a different scenario, we also enable Downward traffic to evaluate impact of advertising routes to every node.

Futur Works
- Multiple RPL instances over TSCH
- Contiki-NG support
- Evaluate redundancy & load-balancing mechanisms using multiple RPL instances

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