RPL - Routing Protocol for low power and lossy Networks

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Overview

- Introduction
- Routing Requirements
- RPL instance and DODAG
- RPL Ranks
- Route construction
- Objective Function and Control messages

Introduction

- Low Power and Lossy Networks (LLN) are resource constrained
- Routers are usually limited in terms of processing power, battery and memory, and their interconnects are characterised by unstable links with high loss rates, low data rates and low packet delivery rates
- The traffic patterns could be P2P or P2MP or MP2P
- Lossy means the packet drop rate will be high.

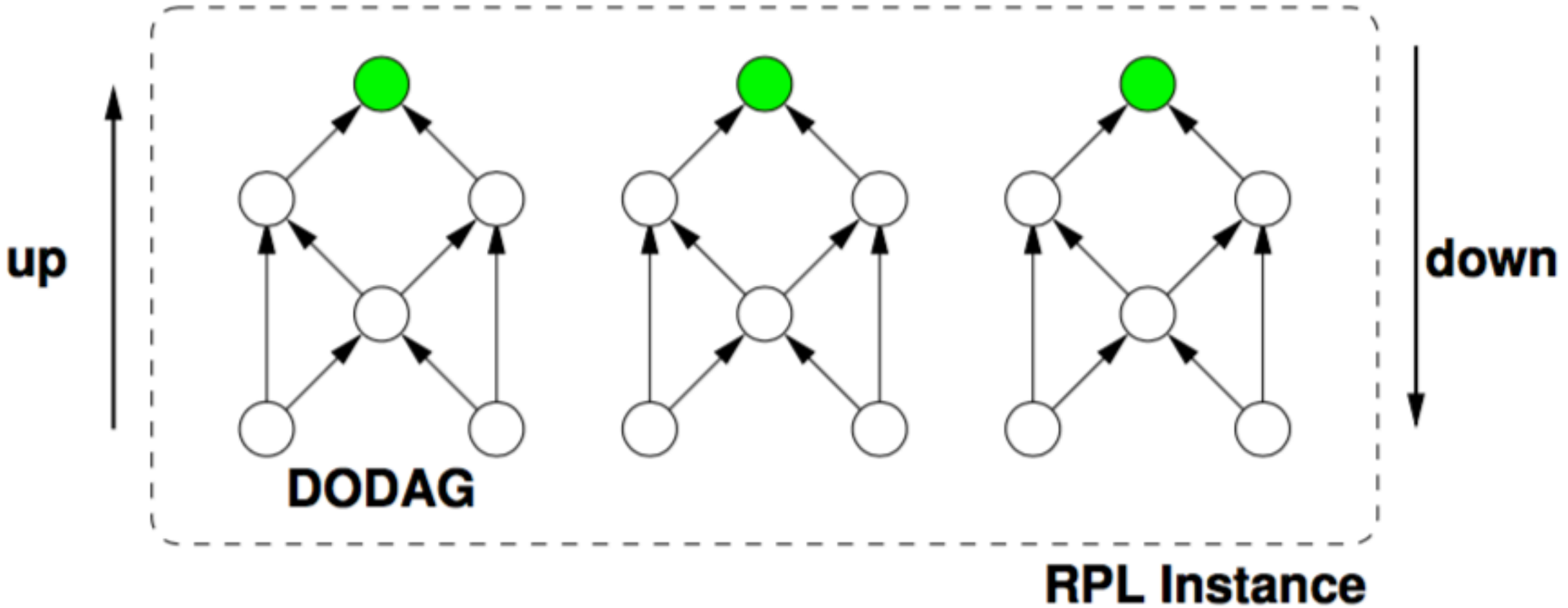
Introduction

- RPL is a distance vector routing protocol
- RPL mainly targets collection-based networks, where nodes periodically send measurements to a collection point.
- The protocol was designed to be highly adaptive to network conditions and to provide alternate routes, whenever default routes are inaccessible.
- RPL provides a mechanism to disseminate information over the dynamically formed network topology
- Contains thousands of nodes…

RPL topology

- DODAG (Destination Oriented Directed Acyclic Graphs)
    - A DODAG is a DAG rooted at a single destination. The DODAG root has no outgoing edges. A DODAG is uniquely identified by a combination of RPL Instance ID and DODAG ID.
- Rank
    - A nodes Rank defines the nodes individual position relative to other nodes with respect to a DODAG root. Rank strictly increases in the Down[1] direction and strictly decreases in the Up[2] direction.
- DODAG Root
    - The DODAG root is the DAG root of the DODAG. The DODAG root may act as a ***border router*** for the DODAG, and aggregate routes in the DODAG and may redistribute DODAG routes into other routing protocols

RPL topology



RPL topology

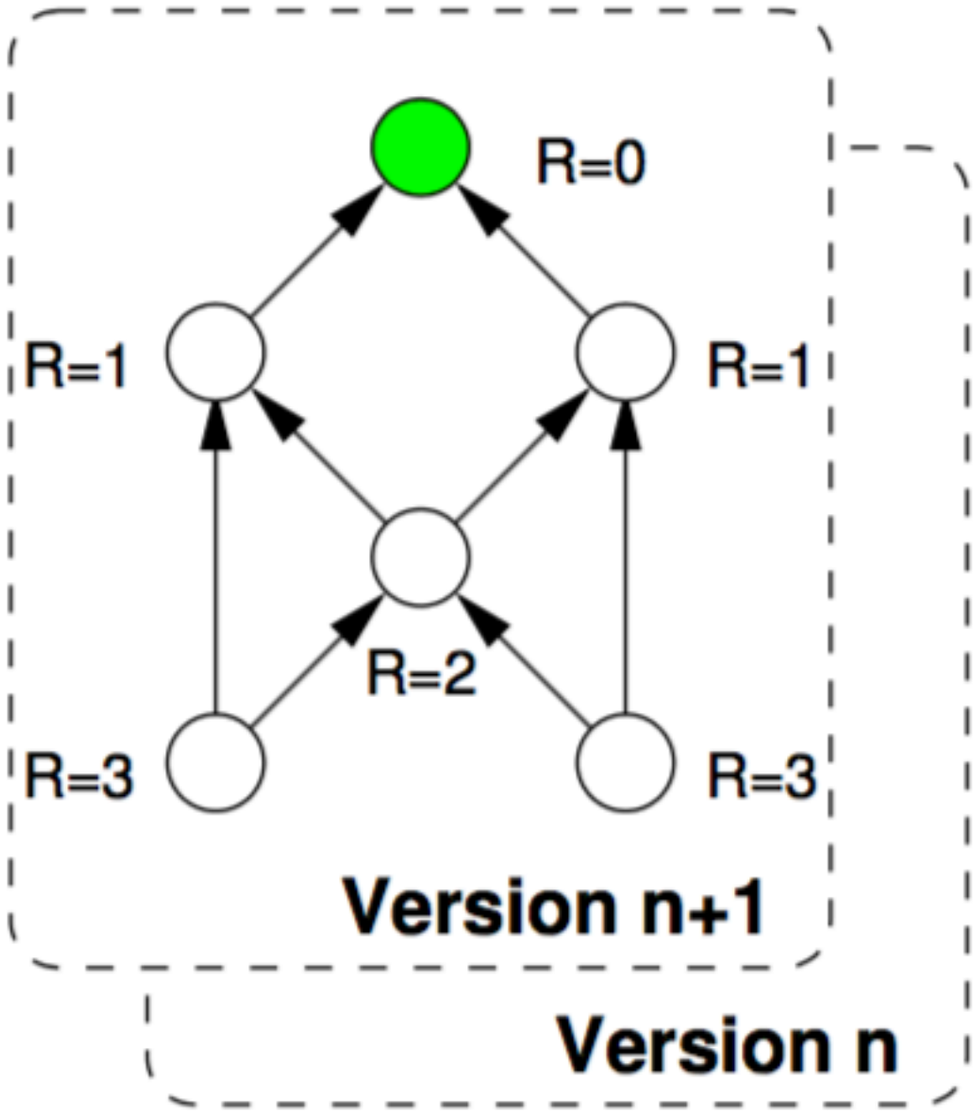
- Upward path is so common (mp2p)
- Downward path is optional mainly for p2p and p2mp

- An RPL Instance consists of multiple Destination Oriented Directed Acyclic Graphs (DODAGs). Traffic moves either up towards the DODAG root or down towards the DODAG leafs

RPL instance

- DODAGS are disjoint (no shared nodes)
- Link properties: (reliability, latency, . . .) \Node properties: (powered or not, . . .)
- RPL Instance has an optimization objective
- Multiple RPL Instances with different optimization objectives can coexist

RPL Rank



- A node's Rank defines the node's individual position relative to other nodes with respect to a DODAG root. The scope of Rank is a DODAG Version.

Forwarding and routing

- Up routes towards nodes of decreasing rank (parents), Down routes towards nodes of increasing rank

- Nodes inform parents of their presence and reachability to descendants.

- All routes go upwards and/or downwards along a DODAG

- When going up, always forward to lower rank when possible, may forward to sibling if no lower rank exists

- When going down, forward based on down routes

RPL control Messages

- ***DIO*** - DODAG Information Object
- ***DIS*** - DODAG information solicitation
- ***DAO*** - Destination advertisement object (propagate destination information upwards)
- ***DAO-ACK*** - DAO Acknowledgement (unicast packet by a DAO recipient)
- **CC** - Consistency Check (Checking for consistency in the messages)