IETF IPV6 Routing Protocol for RPL Roll

IETF- Internet Engineering Task Force

RPL- Routing Protocol for LLNs

LLNs- Low power and Lossy Networks

ROLL- Routing Over Low power and Lossy networks

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Low power and lossy networks (LLNs)A class of networks in which both the routers and their interconnect are constrained. LLN routers typically operate with constraints on processing power, memory, and energy (battery power)their interconnects are characterized by high loss rates, low data rates, and instability. LLNs comprise a few dozen routers up to thousands of routers. Supported traffic flows include point-to-point (between devices inside the LLN),point-to-multipoint (from a central control point to a subset of devices inside the LLN)multipoint-to-point (from devices inside the LLN toward a central control point).The IPv6 Routing Protocol for LLNs (RPL) is proposed by the IETF to support multipoint-to-point traffic from devices inside the LLN toward a central control point, as well as point to-multipoint traffic from the central control point to the devices inside the LLN.

LLNs consist largely of constrained nodes with limited processing power, memory, and sometimes energy when they are battery operated or energy scavenging. These routers are interconnected by lossy unstable links, resulting in relatively high packet loss rates and typically supporting only low data rates. Another characteristic of such networks is that the traffic patterns are not simply point-to-point, but in many cases point-to-multipoint or multipoint-to-point. Furthermore, such networks may potentially comprise up to thousands of nodes. To address these issues, the IETF ROLL Working Group has defined application-specific routing requirements for an LLN routing protocol; it has also specified the RPL.

Existing routing protocols include OSPF/IS-IS (open shortest path first/ intermediate system to intermediate system),OLSRv2 (optimized link state routing protocol version 2),TBRPF (topology-based reverse path forwarding),RIP (routing information protocol),AODV (ad hoc on-demand distance vector),DYMO (dynamic MANET on-demand),DSR (dynamic source routing).Some of the metrics for IoT applications include the following: Routing state memory space—limited memory resources of low power nodes; Loss response—what happens in response to link failures; Control cost—constraints on control traffic; Link and node cost—link and node properties are considered when choosing routes. The existing protocols all fail one or more of these goals for IoT applications.

In order to be use of LLN application domains, RPL separates packet processing and forwarding from the routing optimization objective. Examples of such objectives include minimizing energy, minimizing latency, or satisfying constraints. Consistent with the layered architecture of IP, RPL does not rely on any particular features of a specific link layer technology. RPL is able to operate over a variety of different link layers.

RPL operations, require bidirectional links. LLN scenarios, communication links may exhibit asymmetric properties. the reachability of a router needs to be verified before the router can be used as a parent. RPL expects an external mechanism to be triggered during the parent selection phase in order to verify link properties and neighbour reachability. Neighbour unreachability detection (NUD) is a mechanism, but alternates are possible, including bidirectional forwarding detection and hints from lower layers via layer 2 triggers. In general, a detection mechanism that is reactive to traffic is favored in order to minimize the cost of monitoring links that are not being used.

RPL also expects an external mechanism to access and transport some control information, referred to as the "RPL Packet Information," in data packets. The RPL packet information enables the association of a data packet with an RPL instance and the validation of RPL routing states. Example : IPv6 Hop-by-Hop RPL The mechanism is required for all packets except when strict source routing is used which, by nature, prevents endless loops and alleviates the need for the RPL packet information.

RPL provides a mechanism to disseminate information over the dynamically formed network topology to operate autonomously. In some applications, RPL assembles topologies of routers that own independent prefixes. A prefix that is owned by a router is advertised as "on-link." RPL have the capability to bind a subnet together with a common prefix and to route within that subnet. RPL in particular, disseminate IPv6 neighbour discovery (ND) information prefix information option (PIO) and the route information option (RIO).

Some basic definitions in RPL are as follows :Directed acyclic graph (DAG) is a directed graph with no cycles. Destination-oriented DAG (DODAG) is a DAG rooted at a single destination. RPL defines optimization objective when forming paths toward roots based on one or more metrics. Metrics may include both link properties (reliability, latency) and node properties (e.g., powered on not).

RPL defines a new ICMPv6 (Internet control message protocol version 6) message with three possible types: DAG information object (DIO)—carries information that allows a node to discover an RPL instance, learn its configuration parameters, and select DODAG parents; DAG information solicitation (DIS)—solicit a DODAG information object from an RPL node; Destination advertisement object (DAO)—used to propagate destination information upward along the DODAG.

A node rank defines a node's relative position within a DODAG with respect to the DODAG root. DODAG construction proceeds as follows: Nodes periodically send link-local multicast DIO messages; Stability or detection of routing inconsistencies influence the rate of DIO messages; Nodes listen for DIOs and use their information to join a new DODAG, or to maintain an existing DODAG; Nodes may use a DIS message to solicit a DIO; Based on information in the DIOs, the node chooses parents that minimize path cost to the DODAG root. RPL is optimized for many-to-one and one-to-many traffic patterns