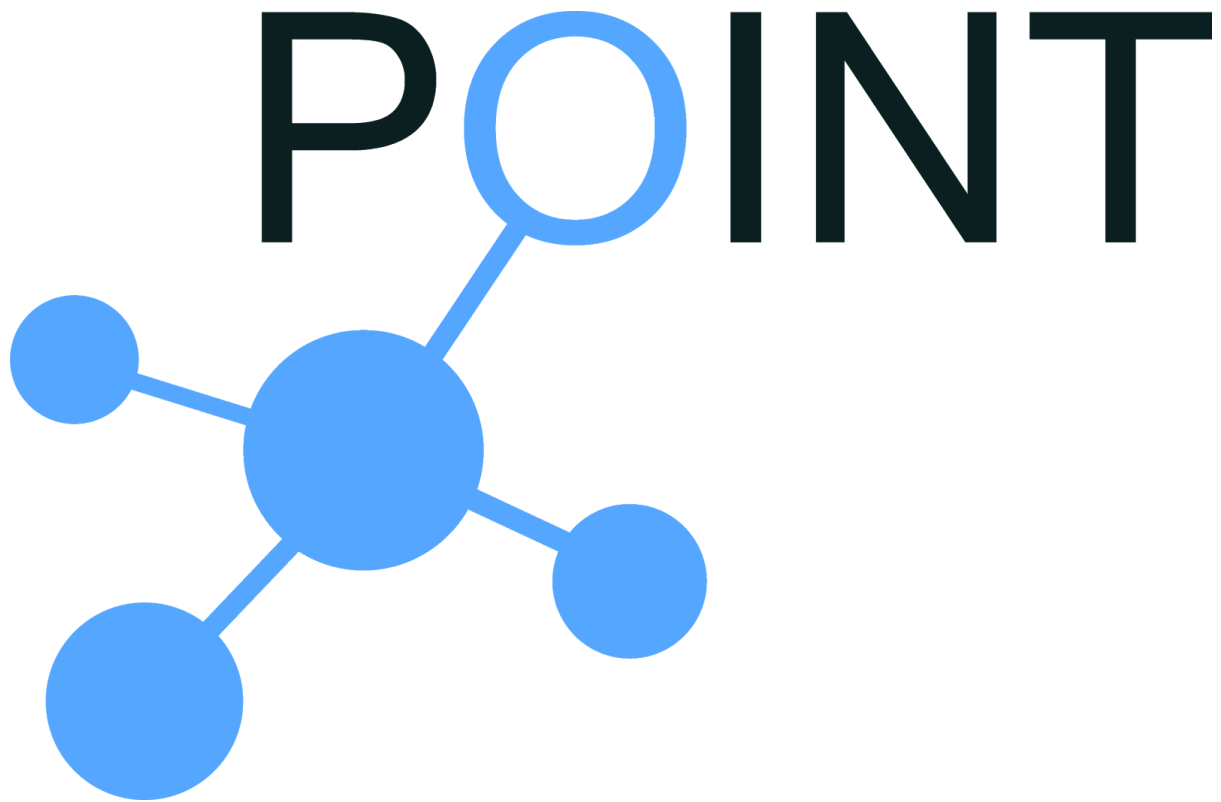


H2020 iP Over IcN- the betTer IP (POINT)

Design Description

Link State Monitor



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1. Overview

The Link State Monitor (LSM) is a lightweight ICN application, designed to facilitate periodic update of link state as a mechanism for detecting link and node changes. The application operates by periodically publishing Link State Updates (LSUs) under a predefined information identifier. The LSU is published with the 'BROADCAST_IF' dissemination strategy, which means it will be received by all neighbouring nodes but will not traverse beyond that.

At the same time the application maintains state of all neighbours from which it received a LSU. If a new neighbour joins the network or if the state of an existing neighbour expires before receiving a new LSU, for e.g. due to link failure, the LSM publishes a Link State Notification (LSN) to the Topology Manager under the predefined LSN information item. The LSN is published directly to the TM with the dissemination strategy 'IMPLICIT_RENDEZVOUS' using the RVTM FID. The latter is obtained from Blackadder using the MAPI. Figure 1 shows a high level view of the LSM operation.

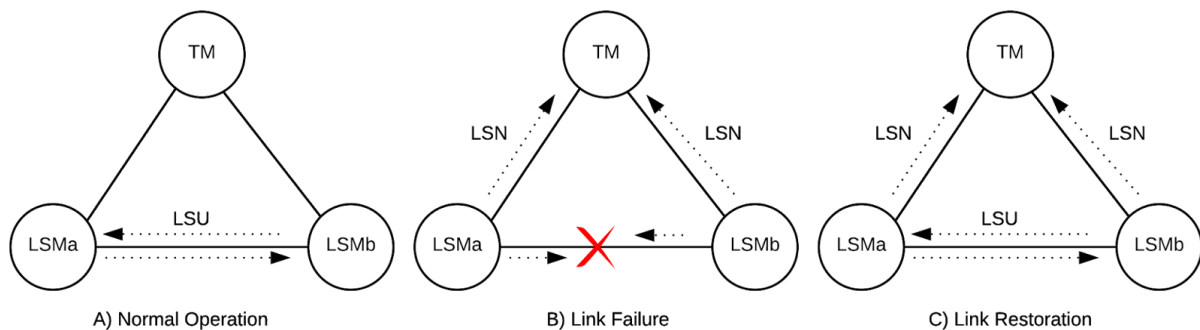


Figure 1: High level overview of the Link State Monitor operation

2. Predefined Information Items

Two information items are predefined for the LSM use:

- LSUID: `lsuSID/nodeID`, for the periodic LSU broadcasts
- LSNID: `lsnSID/nodeID`, for publishing notifications to the TM

3. State

- `<string, time_t> Neighbours`: a map of neighbour `nodeID` and time of last received LSU.

4. Configurations

There are a number of configurations that can be set externally by the user using the respective flags. Here I will list the configurations (and their flags):

- `lsu_lifetime(-d)` : expiration period of an LSU
- `Lsu_interval(-i)` : Interval between two consecutive LSU publications. This parameter tunes the frequency of LSU publications.
- `Bidirectional(-n)` : defines whether the network is bidirectional or not (i.e. uni-directional). This influences the way in which a LSN is treated by the TM. in a bidirectional network, a LSN of the combination (a, b) is enough to cause action on both directions of a link; whereas in a unidirectional network, it takes two LSNs of the combinations (a, b) and (b, a) to have an action on both directions.

5. Workflow

- The LSM opens two threads: `_event_listner` and `_lsu_worker`
 - `_event_listner`: processes LSU messages received from neighbouring nodes. If a LSU is received for the first time (i.e. no record in the 'neighbours' state), the LSM adds a new entry in the neighbours' state and publish a LSN to the TM of type 'ADD', stating the node identifier of the newly added neighbour. The TM treats the `nodeID` of the `LSNID` as the source node identifier, while the node identifier in the LSN payload as the destination.
 - Notably, if the LSU is received after an isolation state - i.e. the node used to be connected but lost all state to all of its neighbours - the LSM would also use MAPI to set the node connectivity state to `RECONNECTED`, in order to allow the node to resume publish/subscribe activities with the the LSM as well as other applications.
 - On the other hand, if the neighbour is already visible to the node (i.e. state exist), the LSM will only update the timestamp of the neighbour's record, without publishing a new LSN to the TM.
 - `_lsu_worker`: walk through the 'neighbours' state and identify any neighbours with expiring timestamps. If a neighbor state is expired (i.e. `now - timestamp > lsu_lifetime`), the LSM publishes a LSN of type `REMOVE` to the TM, but does not remove the node from its list yet - this is because the LSM cannot ensure that this LSN has reached the TM, in case the failed neighbour lies on the path towards the TM . If more time passes without receiving a LSU (configured to $1.5 \times lsu_lifetime$) or if an updated RVTMFID is received, the LSM will remove the node from the state and republish the LSN to the TM. Afterward, the LSM will check whether or not the state is now empty, to find out if the node is still connected to the ICN or not
 - If the state is empty, the LSM - using MAPI - sets the node connectivity status to `DISCONNECTED`. Having this setting the node knows that it has become isolated from the network and hence it will halt all publication/subscription activities, requested by other applications, until the node is connected again.

Figure 1 illustrates the message sequence achieved by a new LSM node connected to one of its neighbours.

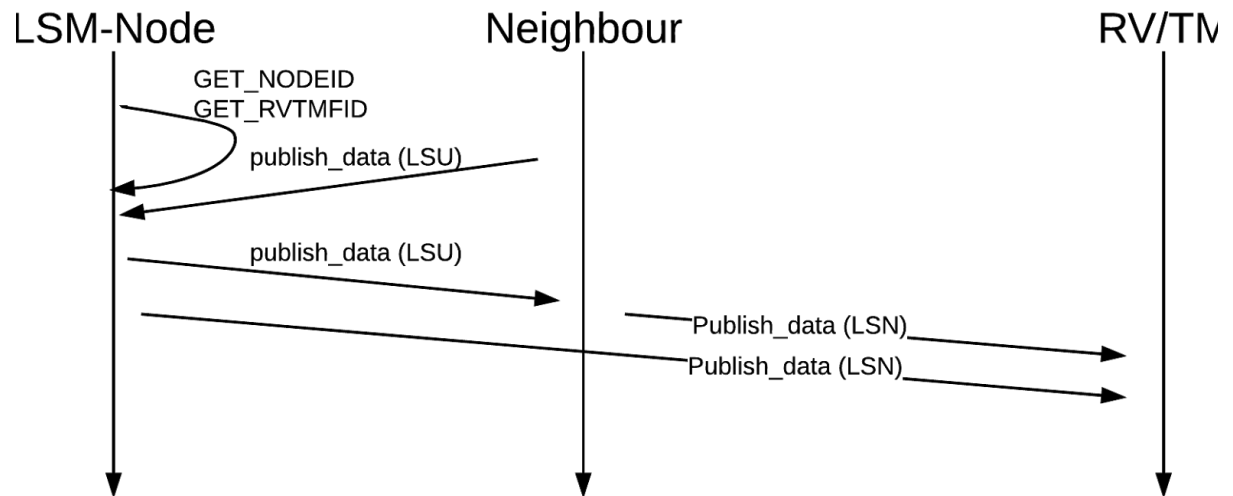


Figure 1: Sequence of messages exchanged between a node that newly activated the LSM, its neighbour and the TM.