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Report on P2P-RPL Interoperability Testing

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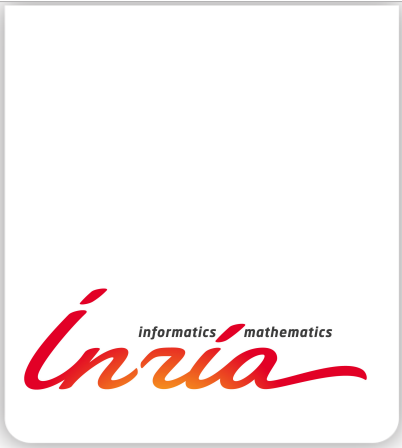

Report on P2P-RPL Interoperability Testing

Matthias Philipp *, Emmanuel Baccelli *, Anders Brandt †,
Hristo Valev †, Jakob Buron †

Project-Team HiPERCOM

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Abstract: In order to bulletproof the P2P-RPL specification currently in the works, interoperability testing of two independent implementations have been carried out. This document reports the tests that were performed and the bugs that were detected in the specification and their fixing. The updated P2P-RPL specification taking into account this bulletproofing was then published.

Key-words: protocol, routing, test, interoperability, sensor, network

* INRIA
† Sigma Designs

RESEARCH CENTRE
SACLAY – ÎLE-DE-FRANCE

Parc Orsay Université
4 rue Jacques Monod
91893 Orsay Cedex

Rapport de tests d'interopérabilité de P2P-RPL

Résumé : Ce document rapporte les résultats de tests d'interopérabilité du protocole de routage P2P-RPL pour réseaux de capteurs.

Mots-clés : protocole, routage, interopérabilité, test, capteurs, réseau

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1 Introduction

In order to bulletproof the P2P-RPL specification [1] currently in the works, interoperability testing of two independent implementations have been carried out. This document reports the tests that were performed and the bugs that were detected in the specification and their fixing. The updated P2P-RPL specification taking into account this bulletproofing was then published in [4].

2 Interop Participants and Location

The interoperability tests took place in Ecole Polytechnique, Paris, France. Two implementations of the P2P-RPL specification [1] were tested: one implementation from INRIA, and one from Sigma Designs. These two implementations were built independently, on the Contiki code base [2]: the INRIA implementation was built on Contiki 2.5, whereas the Sigma Designs implementation was built on Contiki 2.4.

The tests were carried out over several days by M. Philipp and E. Baccelli for INRIA, with the remote assitance of H. Valev, J. Buron and A. Brandt for Sigma Designs.

3 Setup, Configurations and Tests

Tests were performed via simulations on a perfect link-layer emulated by Sigma Designs' switch application on Windows XP. The network over which the tests were performed comprised of 9 nodes forming the topology shown in Fig. 1. Nodes with even IDs ran the INRIA implementation and nodes with odd IDs ran the Sigma Designs implementation.

The following configuration was used: DIOs did not carry any option, route constraint or metric container. Single routes were discovered, without DRO-ACK, using the OF0 objective function.

Routing with P2P-RPL was performed successfully across the whole network (with arbitrary source and destination) once programming errors and specification bugs described in the following section were fixed. The resulting updated specification was published in [4].

4 Detected Bugs and Fixes

This section lists the bugs that were detected while testing, and their fixes.

- **Different default configurations**. Sigma Designs nodes and INRIA nodes were found to use different default configurations if no configuration option was included in DIOs. A default configuration option has thus been defined in the updated specification (Section 6.1.), which is in effect when no configuration option is included in DIOs.
- **Inconsistent route comparison criteria**. The specification did not specify how route comparison should be done (i.e. decide which route is better). The updated specification (Section 9.2.) thus defines this procedure with the objective function, which should follow the same rules as the best parent selection.

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- **Empty slots in RDO address vector**. The specification allowed for empty slots in the RDO address vector, which was used by neither implementation and further found to be useless since DIO emission is based on the Trickle timer and the packets have to be created from scratch anyways. This feature was thus removed in the updated specification (Section 7.).

- **Non-compliant use of TTL** . The Sigma Designs implementation was found to overload the header field reserved for the empty slots feature, in order to have a TTL field used to limit the propagation of DIOs. For this purpose, the updated specification (Section 7.) defines now a MaxRank field .

- **Trickle bug**. Tests further revealed a flaw in the Trickle operation recommended in the specification. The loss of a single DIO could result in some nodes never joining the DAG. This is fixed in the updated specification (Section 9.2.), which considers DIOs from DAG parents as neither consistent nor inconsistent.

- **Compliance with basic RPL**. Interoperability concerns between the specification and basic RPL specification [3] prompted the use of a new Mode of Operation P2P Mode of Operation to avoid that non-P2P nodes join the P2P DAG. The updated specification (Sections 6. and 13.) thus defines a new MoP.

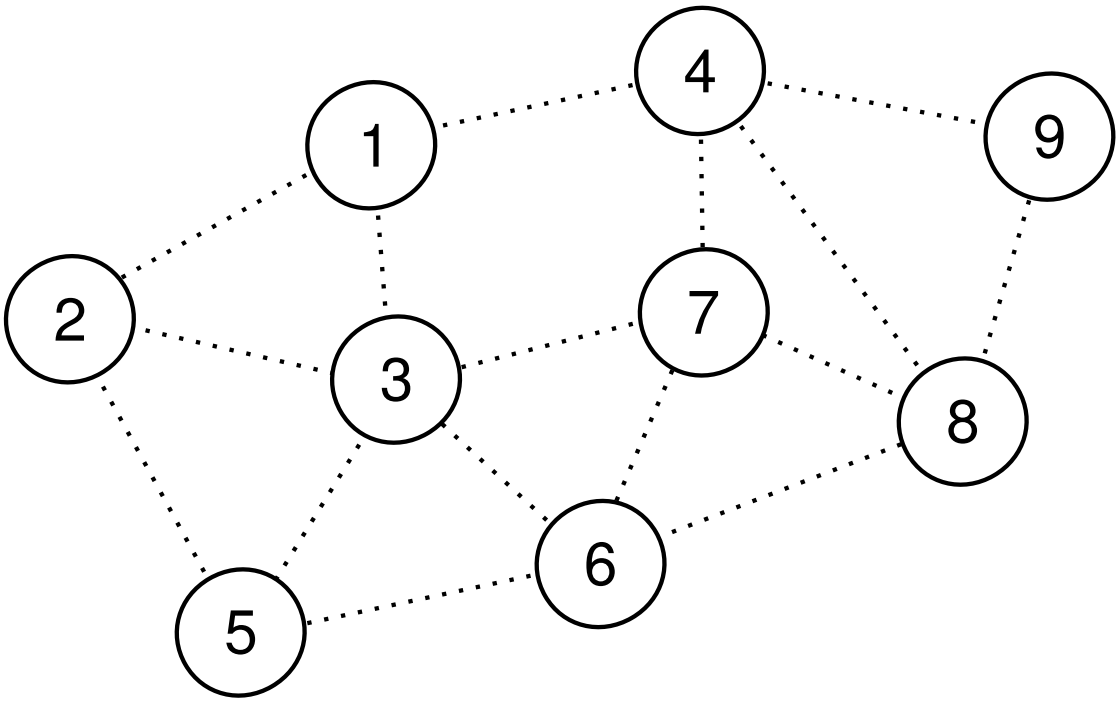

Figure 1: Topology of the network over which the tests were performed. Nodes with even IDs ran the INRIA implementation and nodes with odd IDs ran the Sigma Designs implementation.

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References

[1] M. Goyal, E. Baccelli, M. Philipp, J. Martocci, A. Brandt "Reactive Discovery of Point-to-Point Routes in Low Power and Lossy Networks," IETF Internet Draft draft-ietf-roll-p2p-rpl-05, 2011.

[2] The Contiki Operating System. www.contiki-os.org

[3] T. Winter, P. Thubert et al. "RPL: IPv6 Routing Protocol for Low power and Lossy Networks," IETF Internet Draft draft-ietf-roll-rpl-19, 2011.

[4] M. Goyal, E. Baccelli, M. Philipp, J. Martocci, A. Brandt "Reactive Discovery of Point-to-Point Routes in Low Power and Lossy Networks," IETF Internet Draft draft-ietf-roll-p2p-rpl-06, 2012.

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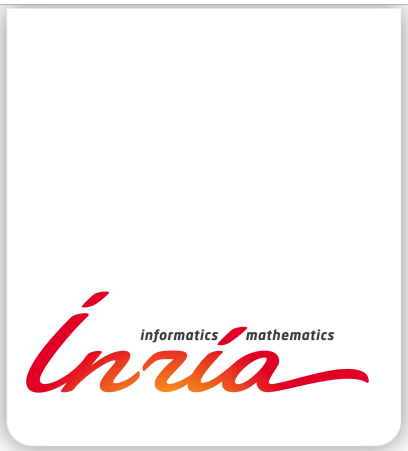

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