IRATI - Investigating RINA as an Alternative to TCP/IP

Summary: Driven by the requirements of the emerging applications and networks, the Internet has become an architectural patchwork of growing complexity which strains to cope with the changes. Moore's law prevented us from recognising that the problem does not hide in the high demands of today's applications but lies in the flaws of the Internet's original design. The Internet needs to move beyond TCP/IP to prosper in the long term, TCP/IP has outlived its usefulness.

The Recursive InterNetwork Architecture (RINA) is a new Internetwork architecture whose fundamental principle is that networking is only inter-process communication (IPC). RINA reconstructs the overall structure of the Internet, forming a model that comprises a single repeating layer, the DIF (Distributed IPC Facility), which is the minimal set of components required to allow distributed IPC between application processes. RINA supports inherently and without the need of extra mechanisms mobility, multi-homing and Quality of Service, provides a secure and configurable environment, motivates for a more competitive marketplace and allows for a seamless adoption.

RINA is the best choice for the next generation networks due to its sound theory, simplicity and the features it enables. IRATI's goal is to achieve further exploration of this new architecture. IRATI will advance the state of the art of RINA towards an architecture reference model and specifications that are closer to enable implementations deployable in production scenarios. The design and implementation of a RINA prototype on top of Ethernet will permit the experimentation and evaluation of RINA in comparison to TCP/IP. IRATI will use the OFELIA testbed to carry on its experimental activities. Both projects will benefit from the collaboration. IRATI will gain access to a large-scale testbed with a controlled network while OFELIA will get a unique use-case to validate the facility: experimentation of a non-IP based Internet.

Objectives:

1) Enhancement of the RINA architecture reference model and specifications, focusing on DIFs over Ethernet. The enhancement of the RINA specifications carried out within IRATI will be driven by three main forces: i) the specification of a DIF over Ethernet as the underlying physical media; ii) the completion of the specifications that enable RINA to provide a level of service similar to the current Internet (low security, best-effort) and iii) the project use cases targeting ambitious scenarios that are challenging for current TCP/IP networks (targeting features like multi-homing, security or quality of service). The industrial partners in the consortium will be leading the elaboration of the use cases, with the input of the External Advisory Board.

2) RINA open source prototype over Ethernet for a UNIX-like OS.

This is the goal that can better contribute to IRATI's impact and the dissemination of RINA. Besides being the main experimentation vehicle of the project, the prototype will provide a solid baseline for further RINA work after the project. By the end of the project the IRATI partners plan to setup an open source community in order to attract external interest and involve other organizations in RINA R&D.

3) Experimental validation of RINA and comparison against TCP/IP. This objective is enabled due to the availability of the FIRE facilities, which provide the experimentation environment for a meaningful comparison between RINA and TCP/IP. IRATI will follow iterative cycles of research, design, implementation and experimentation, with the experimental results retrofitting the research of the next phase. Experiments will collect and analyze data to compare RINA and TCP/IP in various aspects like: application API, programmability, cost of supporting multi-homing, simplicity, vulnerability against attacks, hardware resource utilization (proportional to energy consumption). The industrial partners in the consortium will be leading the choice of benchmarking parameters, with the input of the External Advisory Board.

4) RINA prototype over Ethernet for JunOS. The RINA implementation within the JunOS operating system, using the JunOS SDK, will allow IRATI to increase the impact and realism of the experimentation. JunOS is a FreeBSD based OS, therefore there is no need to start a RINA implementation from scratch: the UNIX-like OS prototype will be adapted to JunOS. IRATI project members will learn to what degree the current router platform architectures can be reused for non-IP based technologies.

5) Interoperability with the Pouzin Society (PSOC) RINA prototype over UDP/IP. The achievement of interoperability between independent implementations is a good sign that a specification is well done and complete. Therefore, achieving interoperable RINA implementations is both a necessity and a validation of the RINA specifications; even more taking into account that PSOC and IRATI prototypes target different programming platforms (middleware vs. OS kernel) and work over different underlying technologies (UDP/IP vs. Ethernet).

6) Provide feedback to OFELIA in regards to the prototyping of a clean slate architecture. Apart from the feedback to the OFELIA facility in terms of bug reports and suggestions of improvements, IRATI will contribute an OpenFlow controller capable of dynamically setting up Ethernet topologies to the project. IRATI will be using this controller in order to setup different topologies for the various experiments conducted during the project. Moreover, experimentation with a non-IP based solution is an interesting use case for the OFELIA facility, since IRATI will be the first to conduct these type of experiments in the OFELIA testbed.