Introduction to current RINA R&D activities

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2014
Agenda

- Introduction
- BU activities
- TRIA activities
- Funded EC Research
  - IRATI
  - IRINA
  - PRISTINE
Flow of RINA R&D activities

Core RINA specs

- Research on RINA reference model
- New Insights & Invariances

Policy specs

- Design and development of simulators
- Study different use cases and deployment options

Simulators

- Use case analysis

Prototypes & Tools

- Experimentation and validation
- Data and conclusions

Prototyping & Tool Development

- TCP/UDP/IP
- VLANs
- WiFi
- MPLS
- LTE
- Coexisting with different technologies

Prototypes & Tools

- Test apps
- Prot. analyz

Simulators

- SDKs
- New Insights & Invariances

Use case analysis

- Core RINA specs

Policy specs

- New Insights & Invariances

Data and conclusions

- Data and conclusions

Simulators

- Use case analysis

Prototypes & Tools

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• **BU activities**
• TRIA activities
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  – IRATI
  – IRINA
  – PRISTINE
BU Activities

- Revising the Reference Model Documents adding detail on:
  - Name Space Management
  - DIF Allocation
  - Flow Allocator use of Name Space Management
- Tightening up EFCP specification
  - Which has uncovered new insights on the nature of the protocol
- Continued development and demonstration of the Java implementation
- Work on DTCP implementation, gamma version in Java
- Looking at Policy development tool
- Investigating RINA implications for economic models
- Investigating relation between RINA and Operating Systems.
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The IPC Process is an entity that provides IPC services for applications running on the same system

– It is an application, and uses RINA application operations to do everything it does
– It may or may not be an “OS Process”
– There is no set model for how to implement it, and there can be very different implementations – based on OS, scale, and many other concerns
– In some implementations, it will become part of the OS, just as IP networking is now
– In some implementations, it will operate as “middleware”, atop the OS and its normal networking layer

All IPC Processes do similar things – WHAT they do is described in the Reference Architecture, but there are many feasible Implementation Architectures for HOW those functions get done. TRIA built one, there are 2 others
TRIA’s Overall Goals and Approach

• Provide a framework to test and debug the new protocols
  – Use a single-threaded state machine model to simplify locking and increase repeatability
  – Operate entirely at user (application) level for easier debugging

• Anticipate the desire to move some portions (which ones were as yet unknown) into the OS kernel eventually
  – Coded in C
  – Memory/buffering/time-management operations similar to those available inside the UNIX/Linux OS

• Anticipate future porting to multiple targets
  – Use standard POSIX/UNIX capabilities common on all or most platforms, avoid extensions that impair portability
  – Test on MacOS (Mach-based UNIX) and Linux
  – Test on large and small systems (x86/x86_64 and ARM-based)
Major Parts of the Implementation

- **Infrastructure**
  - Main program, select (event) loop, state machine framework, file management, non-blocking I/O, delimiting, pseudo-files (internal IPC, Shim DIF), memory and message pools, timers, startup/shutdown, configuration parsing, logging and debug utilities, GPB and JSON utilities

- **CDAP**
  - Table-driven CDAP msg. parse/build/copy/allocate/free, connection state machine

- **RIB**
  - Node allocation, lookup, RIB Daemon operations on nodes
  - Object Manager mechanism for operations on objects

- **IPC Process**
  - Per-DIF management (RIB Daemon, enrollment, startup), FA, FAI, DTP/DTCP, Network Management client interface, Shim DIF, routing, IPC Process-specific Object Managers

- **RINA native API Library**

- **Tests**, including *RINABAND* and *RTEMP*
High-Level Block Diagram

UNIX/Linux Processes

UNIX/Linux Process

-authentication database

RIB

Routing Computation

Logger

IPCMGR Process

NetMgr Agent/Directory Server

Per-DIF Manager

Flow Al. Instances

EFCP Instances

RMT

Flow Allocator

Flow (N-1)DIF Flows

SHIM DIF

Device Driver file

I/O Device

(N-1) FAI socket

RINA DIF

NetMgr App.

RINA API

User Application

RINA API

IDD Application

RINA API

UNIX/Linux Processes

UNIX/Linux Process

The Pouzin Society

Pristine
ALTERNATIVE IMPLEMENTATIONS

Some Implementation Architectures with Interesting Properties
RINA in the OS Kernel

Pristine

• Make RINA a “native” networking API
  – New/Extended OS system calls provide full RINA capability
  – Move (at least) DTP/DTCP into the OS kernel for speed

“Network Device” Might be a Shim DIF or a RINA DIF
RINA Split Between H/W and S/W

- RINA RMT/DTP performed in hardware
  - Software still does DTCP and remainder of IPC Process fn's
  - Transiting PDUs need not be processed by software
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IRATI @ a Glance

Pristine

• What? Main goals
  – To **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 enable the **experimentation and evaluation of RINA in comparison to TCP/IP**.

Who? 5 partners

5 activities:

- **WP1**: Project management
- **WP2**: Arch., Use cases and Req.
- **WP3**: SW Design and Implementation
- **WP4**: Deployment into OFELIA
- **WP5**: Dissemination, Standardisation and Exploitation

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External Advisory Board

Juniper Networks, ATOS, Cisco Systems, Telecom Italia
IRATI contributions to RINA roadmap

• Reference model and core specifications
  – Detect inconsistencies and errors

• Research on policies for different areas
  – Routing (link-state), Shim DIF over Ethernet VLANs (802.1q)

• Use cases
  – Corporate VPNs and cloud networking

• Prototyping
  – Initial implementation for Linux OS (user-space and kernel)
  – Porting of RINA implementation to Juniper platforms

• Experimentation
  – First experimental analysis of RINA against TCP/IP in similar conditions (focusing in LAN environments)
PRISTINE @ a Glance

What? Main goals
- To **design and develop an SDK for the IRATI RINA prototype**, to unleash the programmability provided by RINA.
- To **use the SDK to design, implement and trial a set of policies to create optimized DIFs** for different **use cases**: distributed cloud, datacenter networking and network service provider.
- To **design and implement the first RINA multi-layer management system**.

Who? 15 partners
- WIT-TSSG, i2CAT, TID, Ericsson, NXW, Thales, Nexedi, Atos, BISDN, Juniper, Telecom SudParis, U Brno, UiO, CREATE-NET, i Minds

7 activities:
- **WP1**: Project management
- **WP2**: Use cases, req. analysis and programmable reference architecture
- **WP3**: Programmable performance-enhancing functions and protocols
- **WP4**: Innovative security and reliability enablers
- **WP5**: Multi-layer management plane
- **WP6**: System-level integration, validation, trials and assessment
- **WP7**: Dissemination, standardisation and exploitation

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External Advisory Board
- Cisco Systems, Telecom Italia, Deutsche Telekom, Colt Telecom, BU, Interoute
PRISTINE contributions to RINA roadmap

- **Reference model and core specifications**
  - Detect inconsistencies and errors
- **Research on policies for different areas**
  - Congestion control, distributed resource allocation, addressing, routing, authentication, access control, encryption, DIF management
- **Use cases**
  - Decentralized cloud, DC networking, network service provider
- **Prototyping**
  - Build on IRATI implementation for Linux OS. Develop SDK to allow easier customization, develop sophisticated policies with SDK. Prototype first DIF Management System
- **Experimentation**
  - More realistic experimentation, with more complex deployments, coexisting with several technologies at once (IPv4, IPv6, Ethernet), usage of business applications
IRINA @ a glance

What? Main goals

- To make a study of RINA against the current networking state of the art and the most relevant clean-slate architectures under research.
- To perform a use-case study of how RINA could be better used in the NREN scenario, and showcase a lab-trial of the use case.
- To involve the NREN and GEANT community in the different steps of the project, in order to get valuable feedback.

Who? 4 partners

5 activities:

- **WP1**: Technical coordination and interaction with GEANT3+
- **WP2**: Comparative analysis of network architectures
- **WP3**: Use case study and lab trials
- **WP4**: Dissemination and workshop organization

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IRINA contributions to RINA roadmap

- **Reference model and core specifications**
  - Compare with other architectures

- **Use cases**
  - Research network operators (NRENs and GEANT environment)

- **Prototyping**
  - Little adaptations to the IRATI prototype (Linux OS), to be able to trial the use case in the lab

- **Experimentation**
  - Focus on the requirements of NRENs