ProtoRINA over ProtoGENI

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Motivation

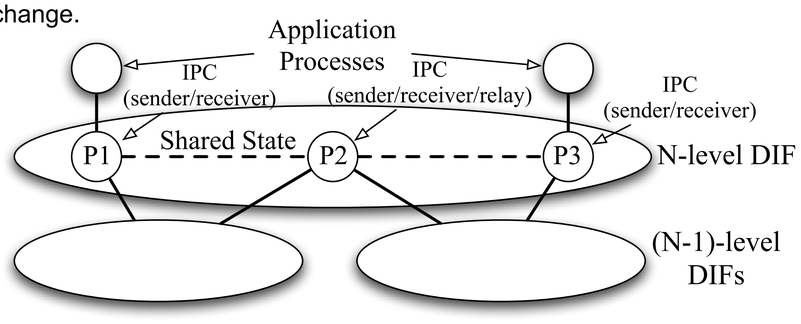
One of many fundamental problems with the current Internet architecture is the lack of scoping of control and management functions, which makes it challenging to deliver a communication service with required characteristics when the range of operation (e.g., capacity, delay, loss) is so wide. This deficiency, together with the desire to offer virtualized network services, have compounded existing network service management challenges.

What is RINA? [1][2]

Our Recursive InterNetwork Architecture (RINA) is based on the fundamental principle that networking is Inter-Process Communication (IPC).

RINA recurses the IPC service over different scopes, i.e., ranges of operation. A collection of distributed IPC processes with shared states is called a Distributed Inter-process communication Facility (DIF). A DIF layer provides data transport service over a certain scope. By DIF layer instantiation, we mean that a layer is built by customizing management and data transfer control policies, to deliver predictable services to applications.

Stacking DIF layers on top of each other allows networks to be built from smaller and more manageable layers of limited scope. The DIF layer instantiation is dynamic as layers can be discovered and created on the fly, and their mechanisms are able to respond and support policy adaptation as network states (e.g., quality of underlying services) change.



ProtoRINA [5]

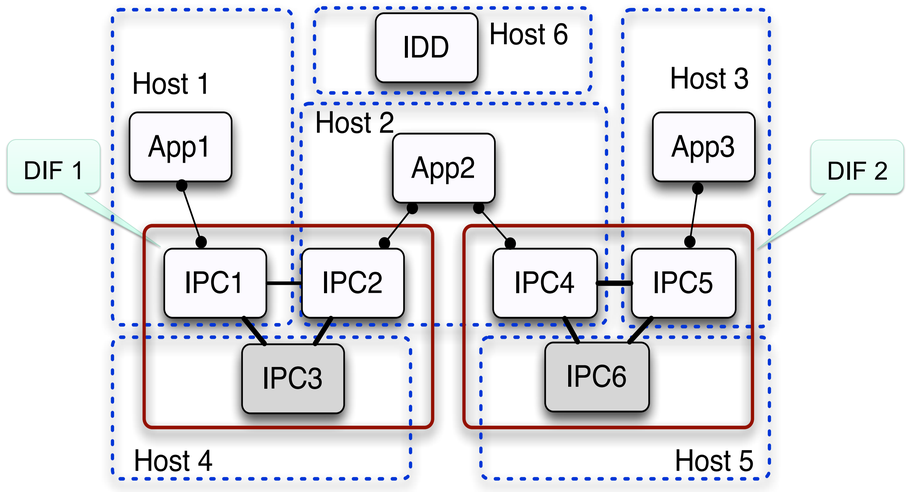
- Boston University prototype of the RINA architecture.
- ProtoRINA enables the development of new protocols and applications, and serves as a teaching tool for networking classes.
- Around 50,000 lines of code, tested on our campus network, and cross-debugged with two other prototypes.
- More components are continually being added.

RINA Dynamic Layer Instantiation [3]

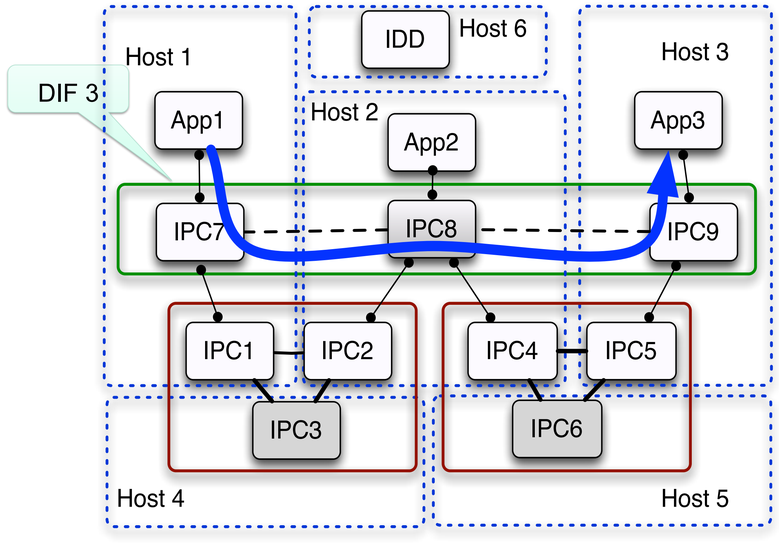
RINA enables private (e.g., virtual or content delivery) networks to be dynamically instantiated, by customizing network management policies (e.g., authentication, routing, addressing, and resource allocation) into a single layer, without the shortcomings of the TCP/IP architecture.

We demonstrate with our prototype how such dynamic instantiation of a DIF layer over lower-level service layers is a natural service that RINA can provide.

(1) App1 wants to communicate with App3, but existing DIFs cannot provide such communication service.



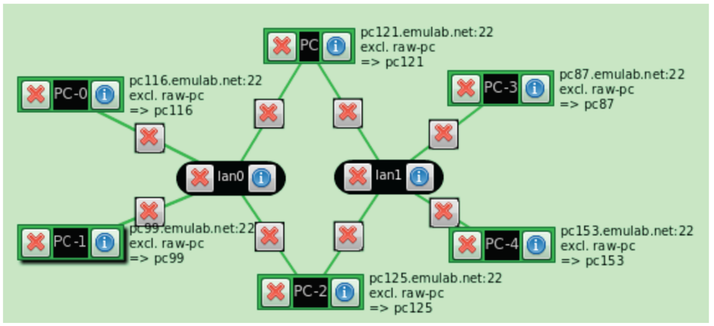
(2) DIF3 is dynamically instantiated to provide communication service between App1 and App3.



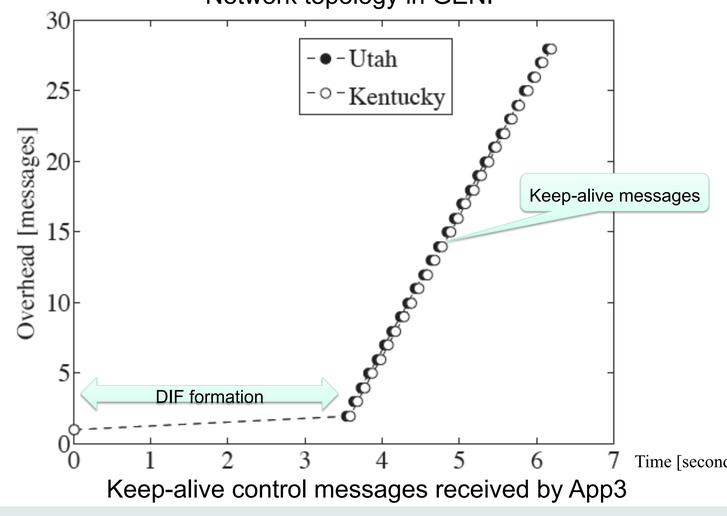
Demonstration over ProtoGENI [4]

The Global Environment for Network Innovations (GENI) is a wide-area virtual network testbed which allows experimentation of such architectures for possible deployment. GENI experimenters are in fact able to acquire isolated (layer-2) virtual “slices” of a physical network spanning resources across multiple federated aggregates.

Running ProtoRINA over a long-lived GENI slice enables users to test RINA and compare it with other competing architectures. We demonstrate dynamic instantiation of the DIF layer over the GENI testbed.



Network topology in GENI



Keep-alive control messages received by App3

References

[1] John Day. “Patterns in Network Architecture: A Return to Fundamentals”. Prentice Hall, 2008.

[2] John Day, Ibrahim Matta, and Karim Mattar. “Networking is IPC: A Guiding Principle to a Better Internet”. In ReArch 2008.

[3] Flavio Esposito, Yuefeng Wang, Ibrahim Matta, and John Day. “Dynamic Layer Instantiation as a Service”. Demo in NSDI 2013.

[4] Yuefeng Wang, Flavio Esposito, and Ibrahim Matta. “Demonstrating RINA using the GENI Testbed”. In GREE 2013.

[5] Boston University RINA website : http://csr.bu.edu/rina.