



# Experimenting with Routing Policies using ProtoRINA over GENI

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## Motivation

- Lack of communication scopes makes the current Internet challenging to control and manage
- The rudimentary “best-effort” delivery service of the Internet makes it even harder to support modern new service models, e.g., Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS)

## What is RINA? [1][2][3]

- RINA: Recursive InterNetwork Architecture
- Based on the fundamental principle that *networking is Inter-Process Communication (IPC) and only IPC*
- Distributed IPC Facility (DIF): a collection of distributed IPC processes with shared states. They provide communication service to application processes over a certain scope (i.e., range of operation)
- Recursively, a DIF providing IPC service over a larger scope is formed based on lower level DIFs with smaller scopes
- Distributed Application Facility (DAF): a set of application processes cooperating to perform a certain function. The function can be a communication service, weather forecast, genomics, etc.
- A DIF is a specialization of a DAF whose function is only to provide IPC service
- RINA separates mechanisms and policies; IPC processes use the same mechanisms but may use different policies (routing, authentication, etc.) for different DIFs

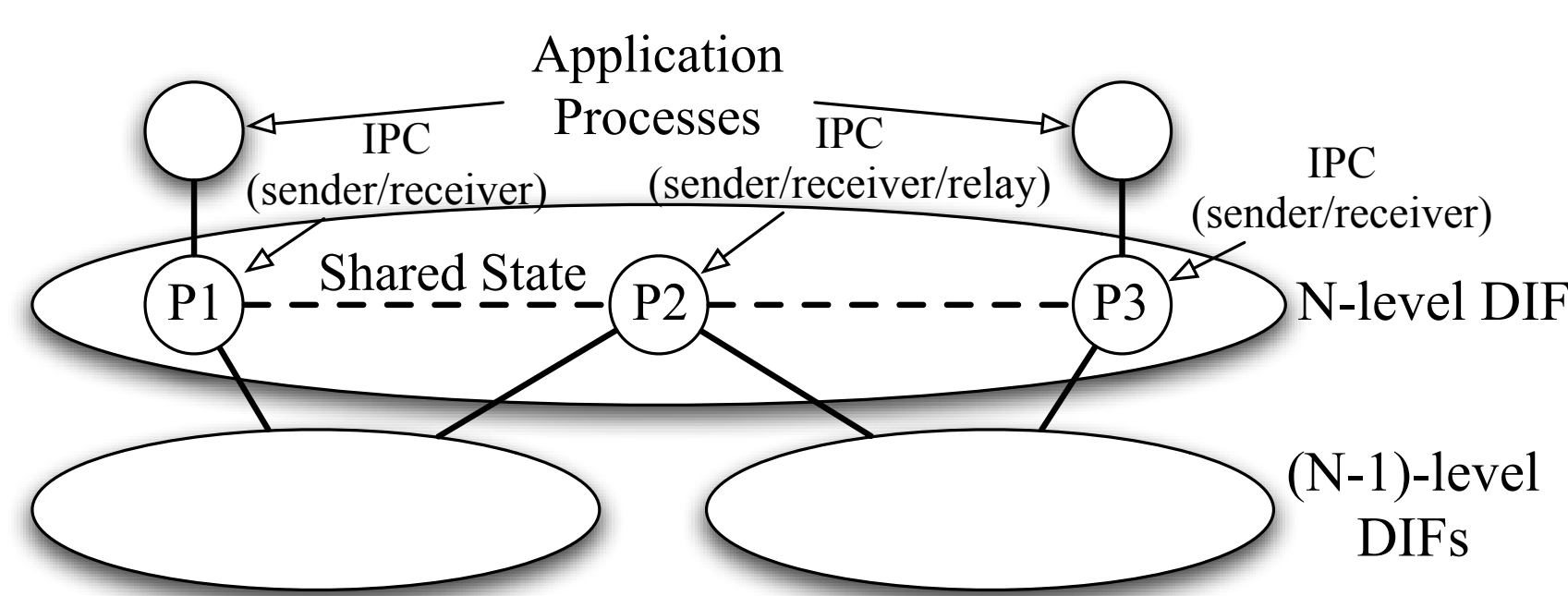


Fig 1 : RINA overview

## References

- John Day. “Patterns in Network Architecture: A Return to Fundamentals”. Prentice Hall, 2008.
- John Day, Ibrahim Matta and Karim Mattar. “Networking is IPC: A Guiding Principle to a Better Internet”. In ReArch 2008.
- Boston University RINA Lab. <http://csr.bu.edu/rina>.
- ProtoRINA. <http://csr.bu.edu/rina/protorina>.
- Yuefeng Wang, Ibrahim Matta and Nabeel Akhtar. “Experimenting with Routing Policies using ProtoRINA over GENI”. In GREE2014.

## RINA Prototype: ProtoRINA [4]

- ProtoRINA is Boston University’s user-space prototype of RINA
- Experimental tool for developing (non-IP based) user and management applications
- Teaching tool for networking and distributed systems classes

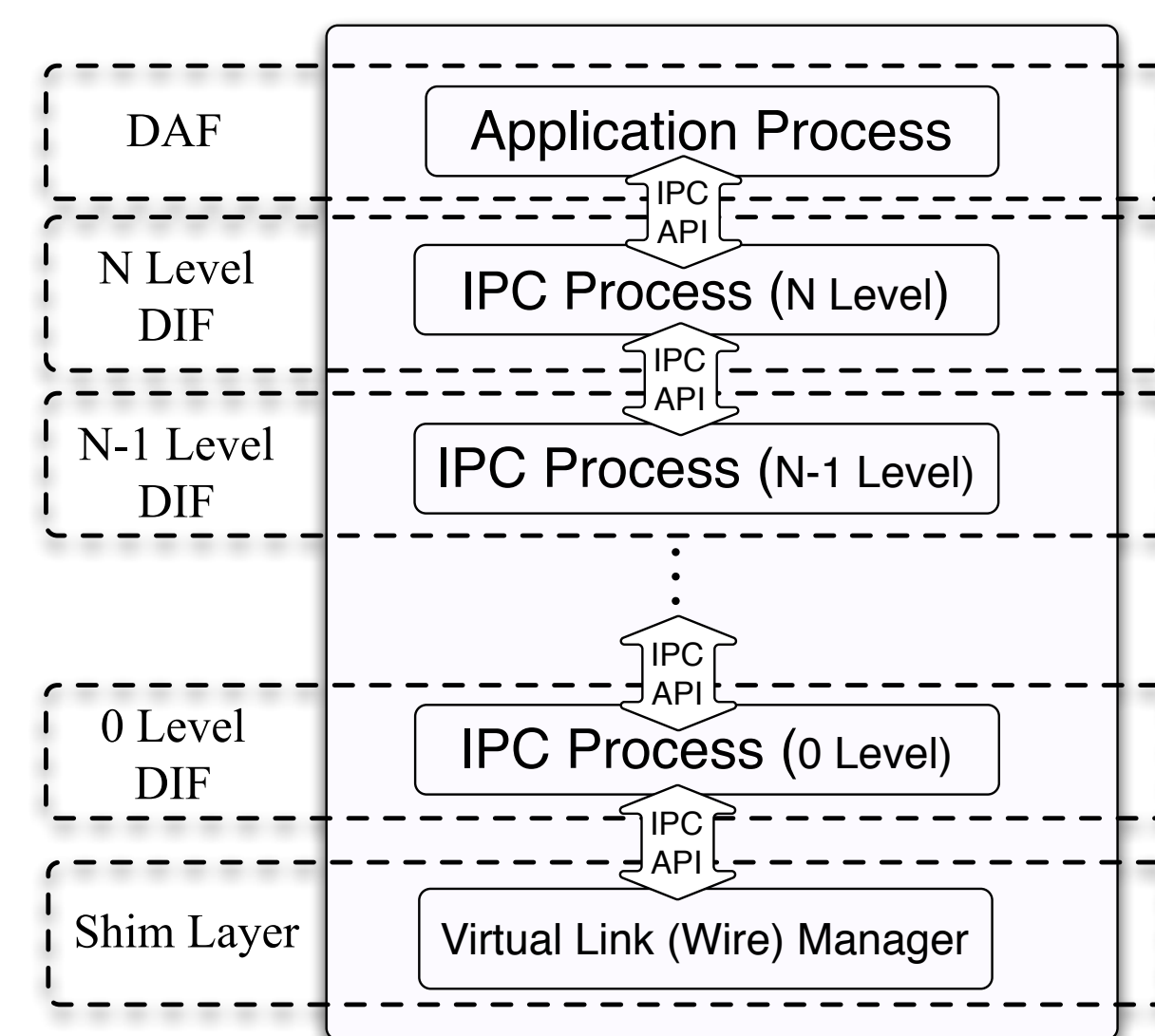


Fig 2 : RINA node

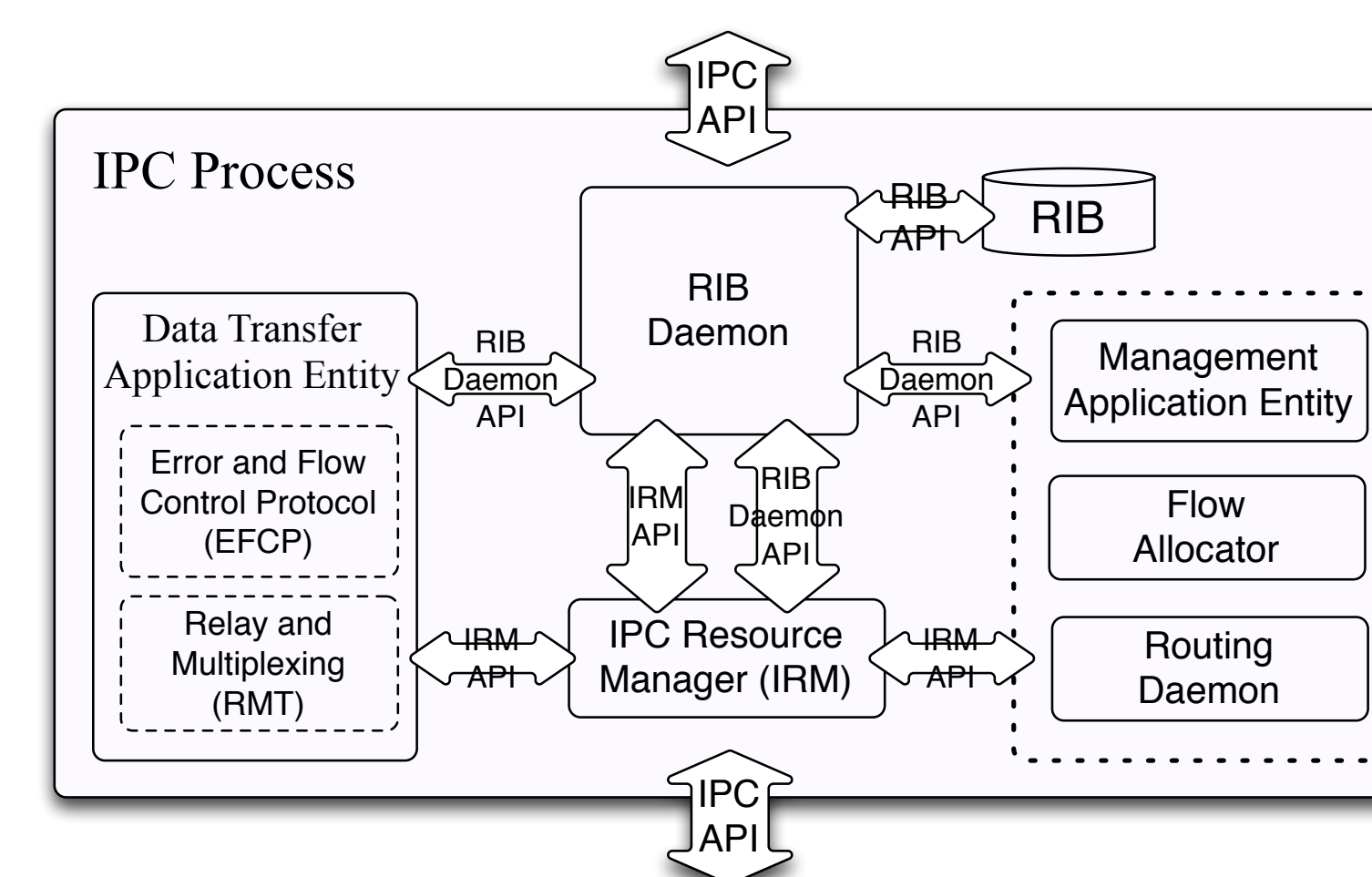


Fig 3 : IPC components and RINA APIs

- Tested on our local Boston University campus network and on the GENI testbed, with some preliminary cross-debugging with other RINA prototypes (TRIA and IRATI)
- Version 1.0 released on October 2013; around 55,000 lines of Java code following the RINA specifications of January 2013
- Disclaimer: The current version is not a complete implementation of RINA and we continue to modify and add elements

## VMs reserved from GENI

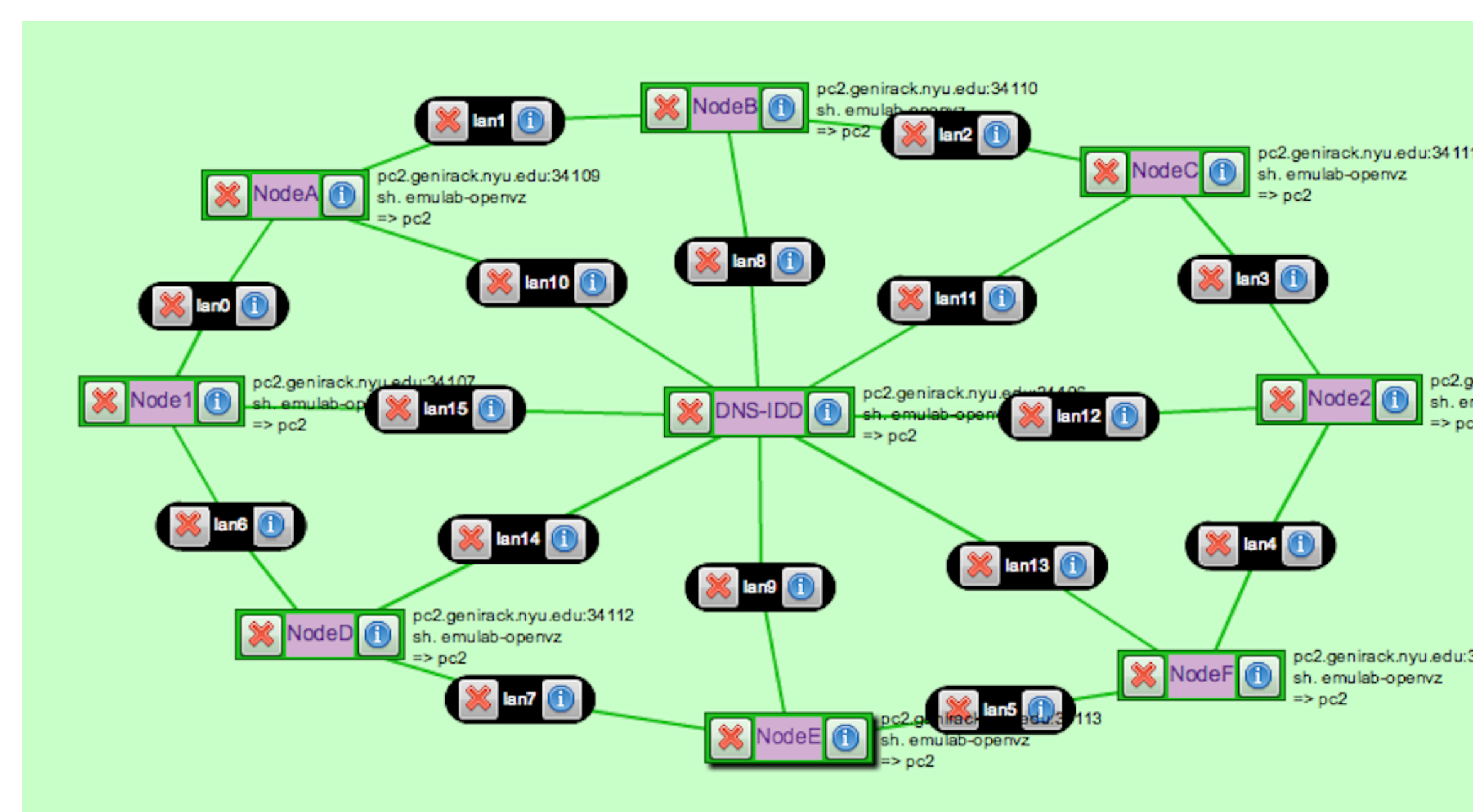


Fig 4 : RINA node on each VM from NYU aggregate

## Experimenting with Routing Policies [5]

- RINA’s support for the scoping of routing control and management, and instantiation of different routing policies, can be leveraged to yield faster convergence and lower routing overhead

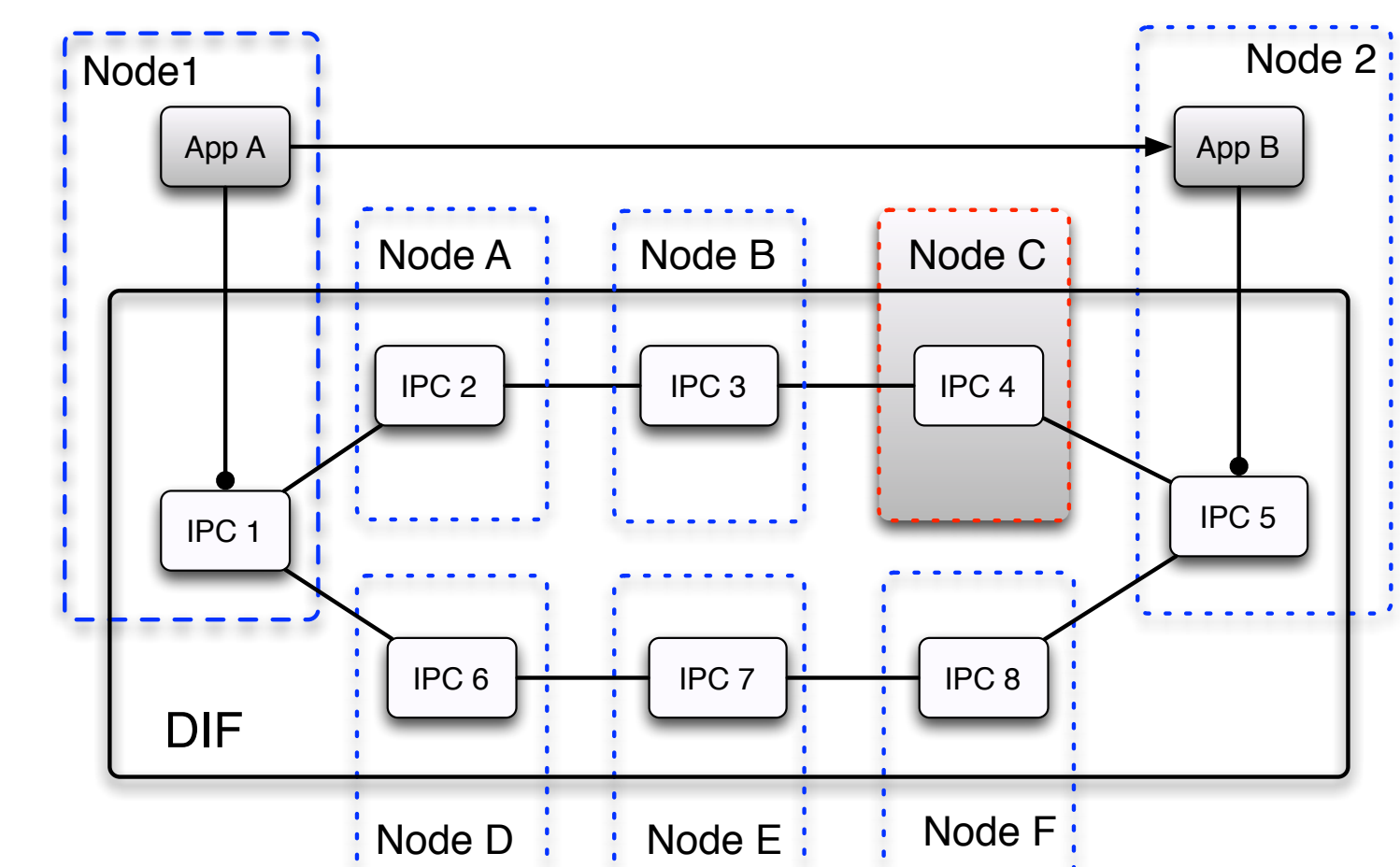


Fig 5: One-level DIF topology, where link-state info updated every 10 seconds.

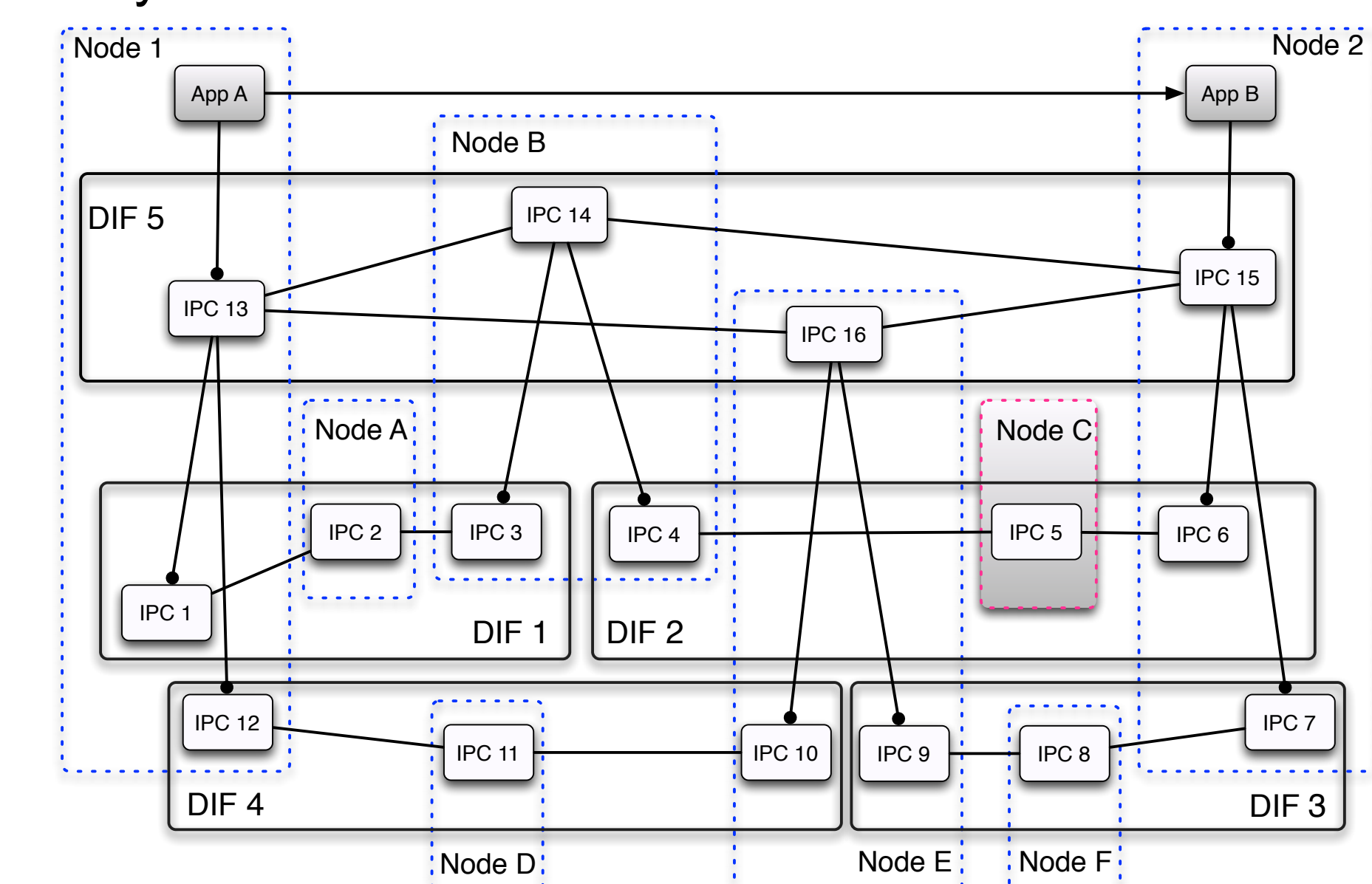


Fig 6: Two-level DIF topology, where level-0 DIF’s link-state info updated every 10 seconds, but level-1 DIF (DIF 5)’s link-state info updated every 5 seconds.

## Experimental Results

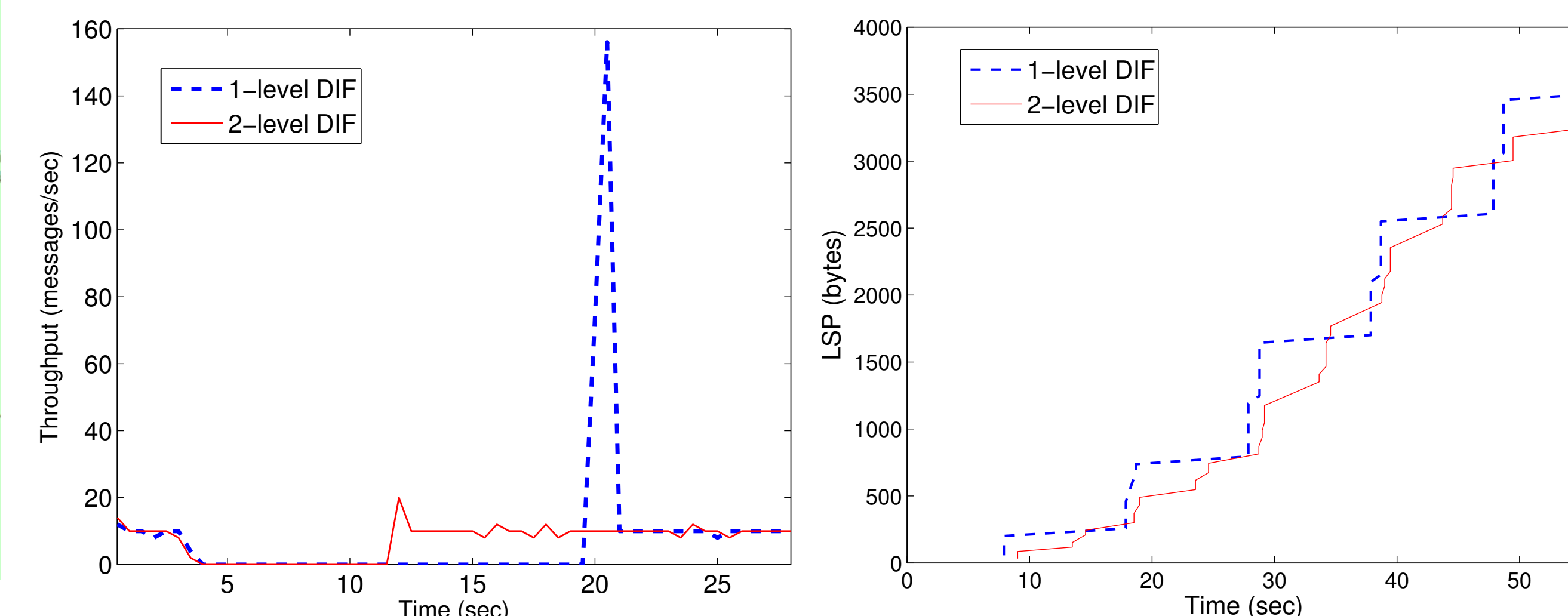


Fig 7: Instantaneous throughput from App A to App B. Node C fails after about 3 seconds.

Fig 8: Routing overhead at Node 2