InterMesh: connecting heterogeneous mesh networks…

J. Khoury *, J. Crichigno *, L. de Cicco ‡, B. Pradhan *, H. Jerez †, C. T. Abdallah *, G. Heileman *, W. Shu *

* Department of Electrical and Computer Eng., Uni. Of New Mexico, Albuquerque, NM 87131, USA

† Corporation for National Research Initiatives, Reston, VA, USA

‡ Politecnico di Bari, Italy

Introduction

There is an indispensable need for inter-networking of WPAN-, WLAN-, WMAN- and cellular-based wireless mesh networks. Currently, the Internet protocol (IP) is employed to provide this functionality at the network Layer. However, given the limitations of IP in supporting future network architectures, the InterMesh architecture is introduced as a novel architecture with the goal of inter-networking heterogeneous mesh networks to provide a seamless service to individual network entities. The following key design concepts distinguish InterMesh:

• Intrinsic support for unstructured networks;
• persistent identification/naming and certification of network entities;
• a novel approach to dynamic and extensible network management and service provisioning using mobile agents; and
• seamless mobility.

Design: Components and Functionality

A simplistic sketch of the system model is shown in **Fig. 1**. There are 3 essential components: 1) **Entity,** 2) **Area of Influence** (AoI), and 3) **Neutralization environment**.

- **Entity**: simplest element that can be mobile; is persistently identified; example is process, thread, service; InterMesh is *entity-oriented* approach to networking
- **AoI**: is a local communication community that defines its own protocols and architecture implementation.
- **Neutralization Environment**: GHOST/SHELL virtualization.

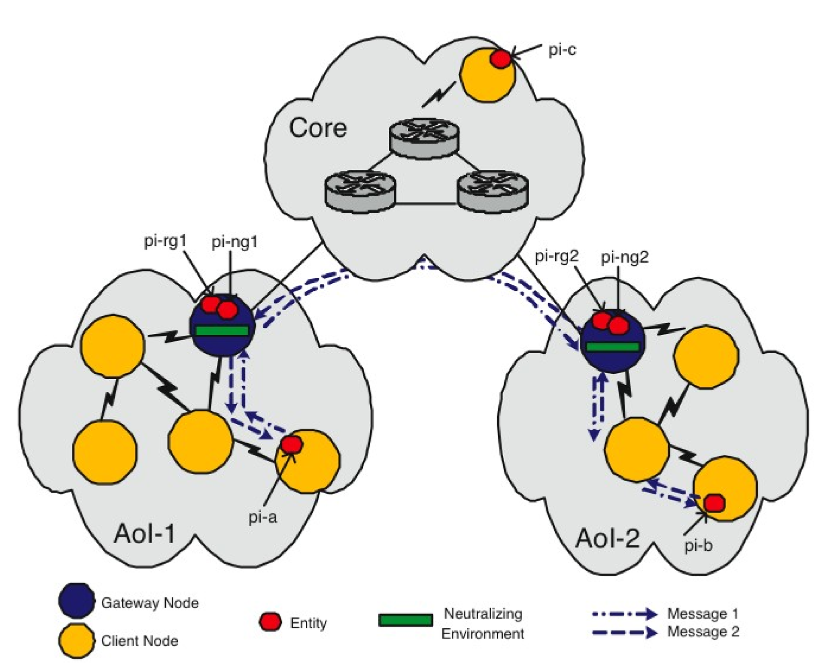

Figure 1. InterMesh reference model, AoIs - Entities - Virtualization

Functionality

- Naming:
  - User Instance (UI) and User Entity Instance (UEI),
  - persistent identifiers, with distributed administration,
  - secure by design.
- Dynamic and extensible services: Using the GHOST/SHELL model, network services can be introduced into the network on-the-fly preventing ossification and embracing extensibility. We identify 2 essential services within AoI: *Identification* and *Routing*.
- Protocol Stack: depicted in **Fig. 2,**

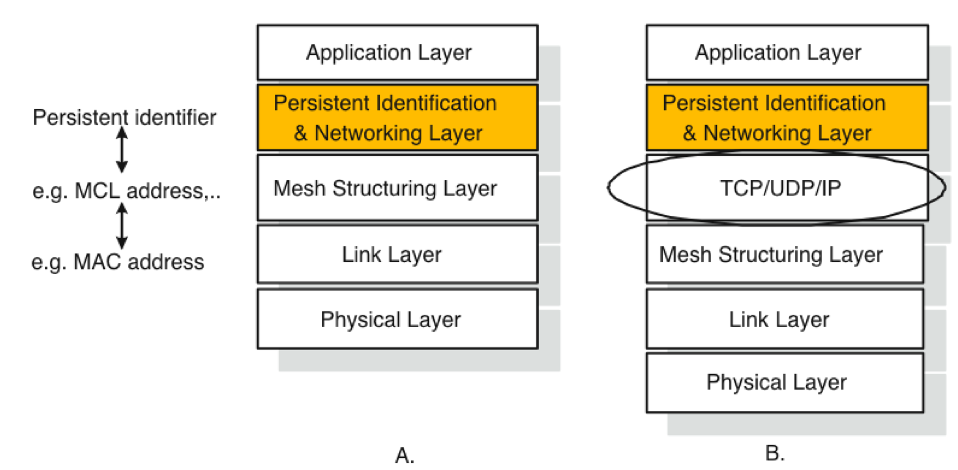

Figure 2. Logical stack layering, A) native mode, B) overlay mode

Implementation

We have implemented the intermesh stack (PINL) as a componentized set of modules depicted in **Fig. 3**. Some modules are implemented in C and others in JAVA. Entities are oblivious of the underlying Mesh Structuring Layer (MSL). We implemented the stack on top of 2 MSLs:

- Microsoft Mesh Connectivity Layer (MCL) [Draves] (runs on Windows XP), and
- Ad hoc Wireless Distribution Service (AWDS) [AWDS] (runs on Linux both on PC and ARM based devices).

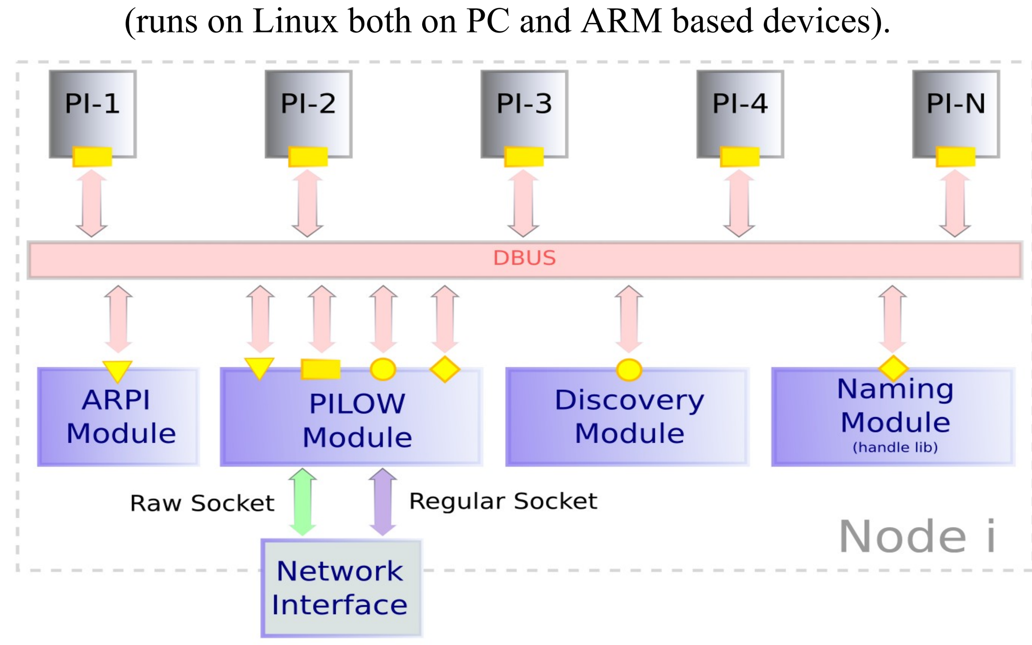

Figure 3. Current modularized stack implementation.

Results

The **preliminary** performance results of the network stack are measured by utilizing 2 applications each of which involves 2 entities communicating over PINL. The first application is a simple RTT probing app. and is depicted in **Fig. 4**. The second is a VoIP application that was ported to use PI instead of IP. The results of the latter are depicted in **Fig. 5** and **Fig. 6**.

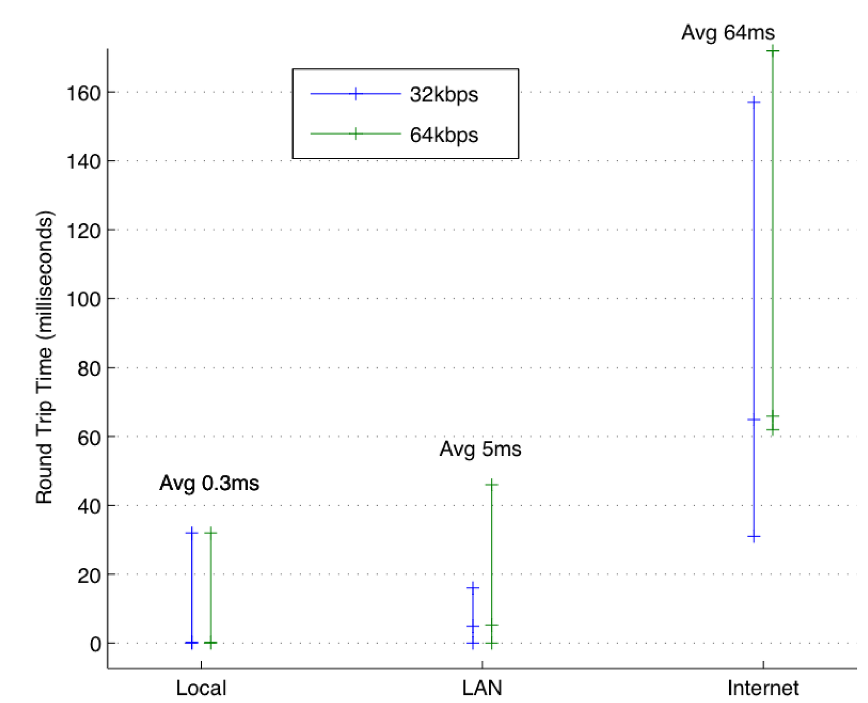

Figure 4. PINL layer preliminary RTT performance results. The MSL used for this graph is Microsoft's MCL. Two entities exchange traffic at the rates of 32 and 64 Kbps, noting the RTTs over local, LAN, and Internet settings.

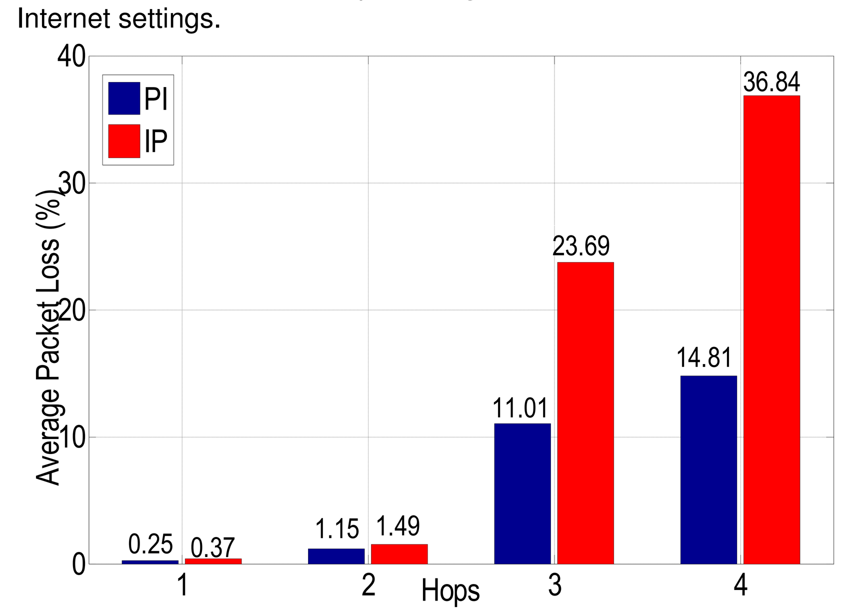

Figure 5. Average packet loss of VoIP/VoPI application versus number of hops within local mesh network. Results of PI are contrasted to those of IP.

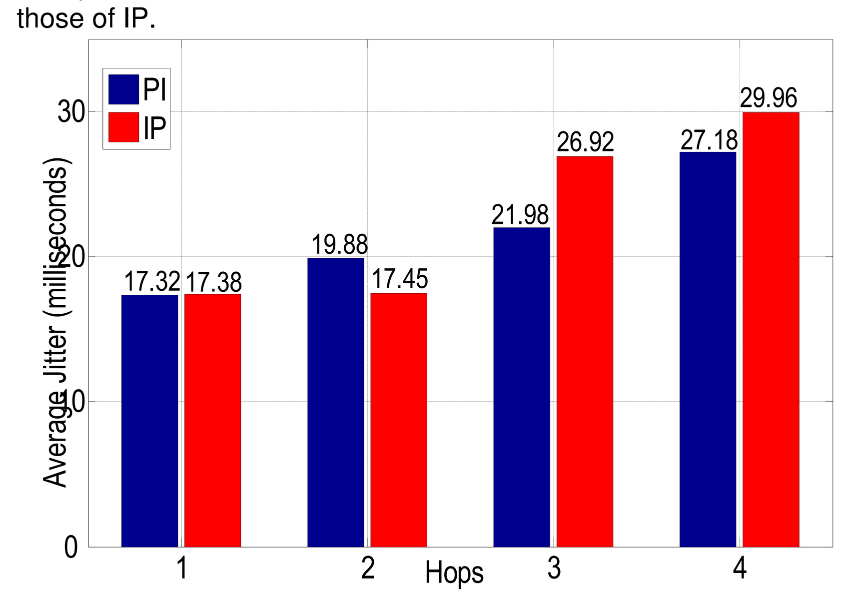

Figure 6. Average Jitter of VoIP/VoPI application versus number of hops within local mesh network. Results of PI are contrasted to those of IP.

Conclusions

To efficiently embrace the characteristics of emerging access networks, and to broaden the user's innovation space clean-slate architectural approaches are being pursued towards designing the future Internet. We have previously introduced a general architectural vision for a possible future Internet which we call the Transient Network Architecture from which InterMesh is instantiated. In this paper, we have presented the InterMesh platform that achieves convergence of heterogeneous mesh networks through a novel PINL layer providing a seamless service to individual network entities. We have identified the key concepts behind the InterMesh architecture and presented an interesting prototype implementation that can coexist with today's Internet. As part of our current work, we are extending InterMesh to include generic mobile ad-hoc networks (MANETs) and wireless sensor networks (WSNs). We are also investigating a completely distributed naming system formed of the naming GHOSTs that organize into a resilient P2P network.

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Literature cited

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For further information

Please contact *jkhoury@ece.unm.edu*. More information on this and related projects can be obtained at the project website http://hdl.handle.net/2118/tna.

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