



Broadband Research in New Zealand

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The University of Waikato

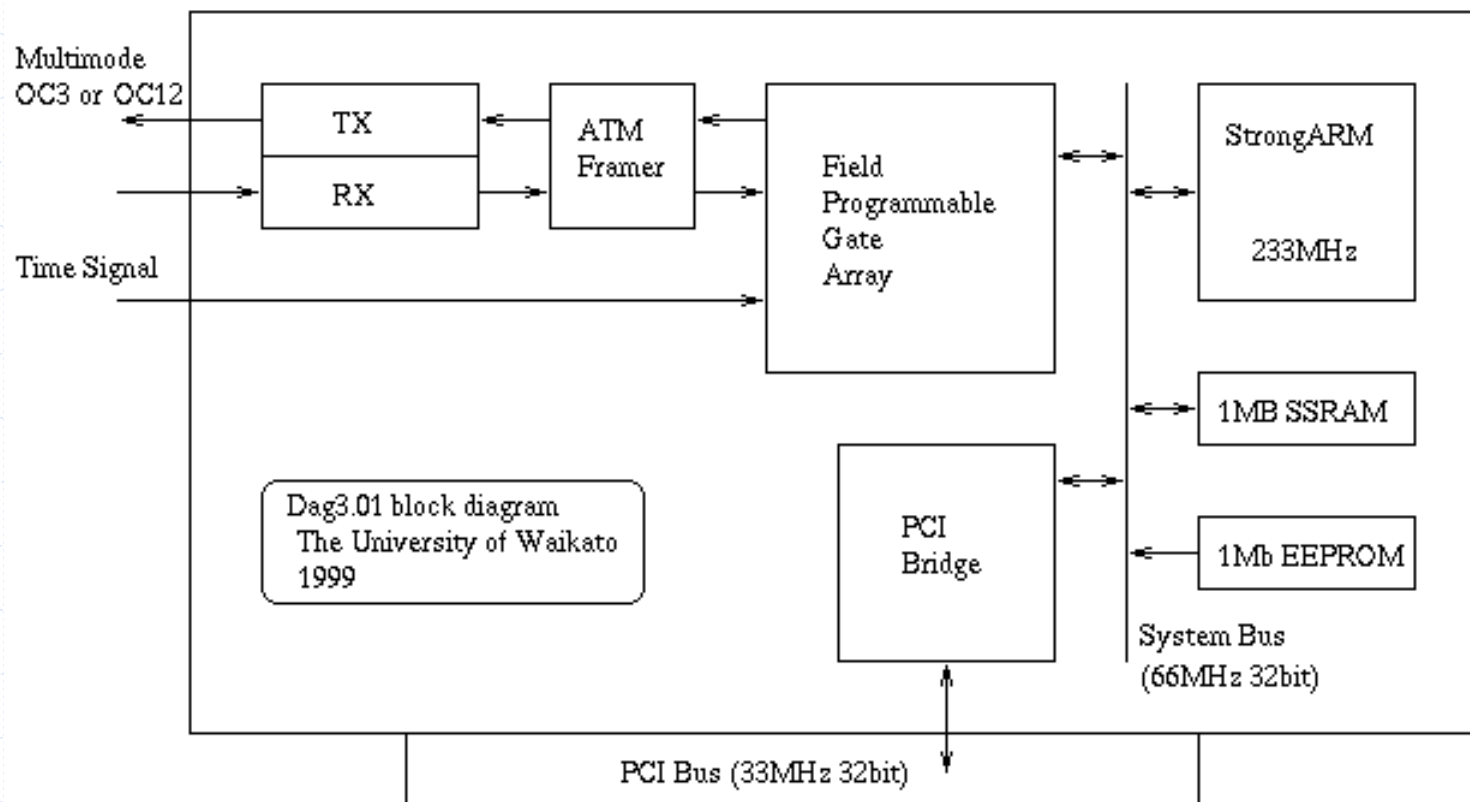
Passive Measurement

Overview

- High precision packet capture and timestamping
 - Network Measurement
 - Network and National Security
 - Test and debug
- Known as DAG cards
- Speeds from Ethernet to OC192 (10Gbps WAN)
- Spun off a startup
 - Endace (www.endace.com)

Passive Measurement

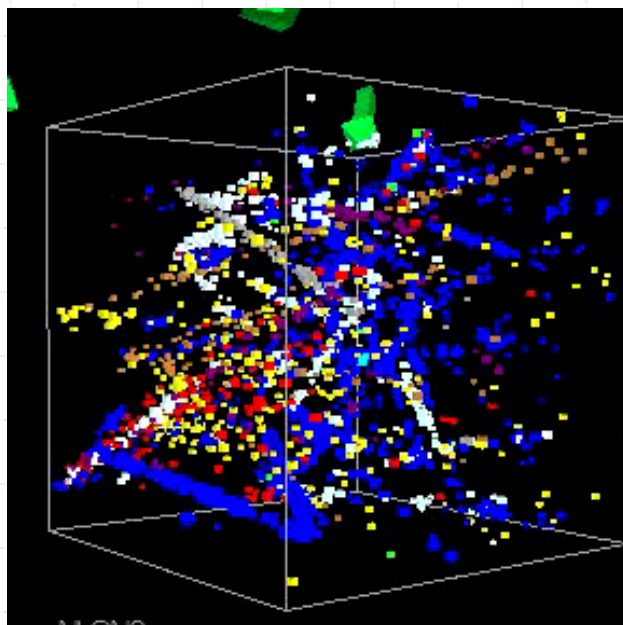
Dag 3 block diagram



Passive: Dag 4.2

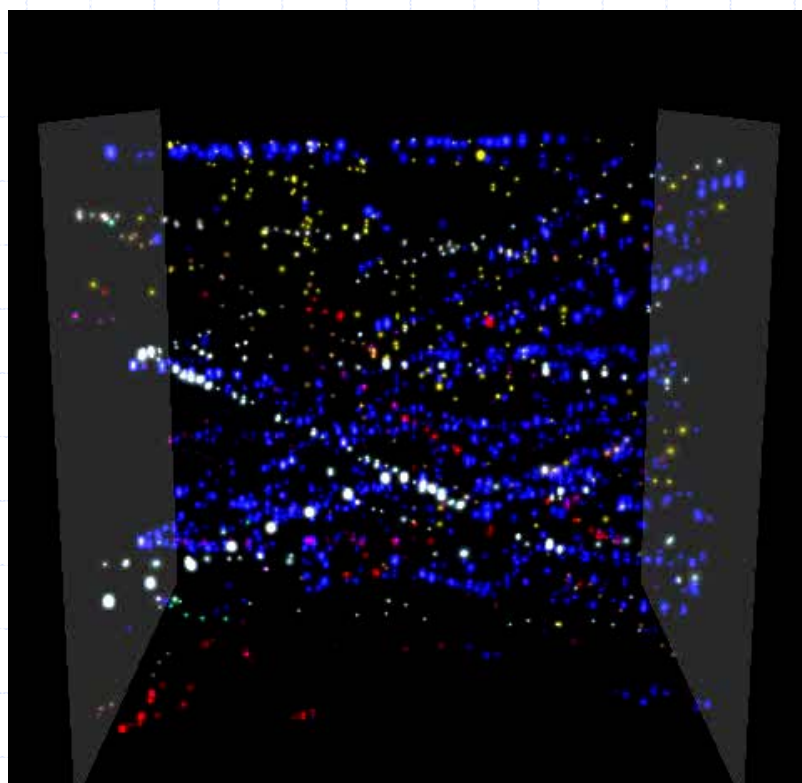


Passive Particles Visualisation



■ http	■ telnet/ssh	■ other tcp
■ https	■ windows	■ other udp
■ dns	■ irc	■ icmp
■ ftp	■ ntp	■ other
■ nntp	■ smtp/pop3/imap	

Passive: Slammer Visualisation

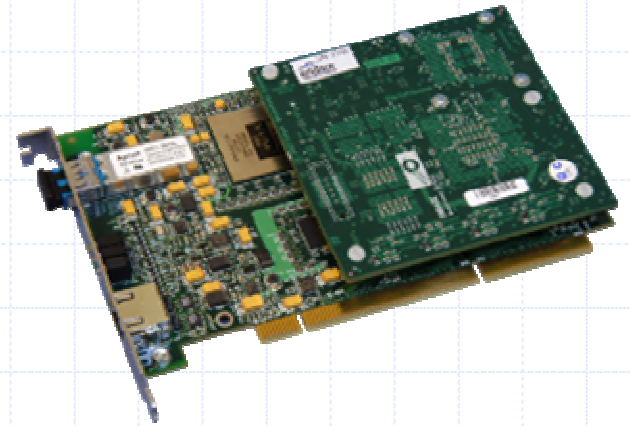


- | | | |
|---------|------------------|-------------|
| ■ http | ■ telnet/ssh | ■ other tcp |
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| ■ dns | ■ irc | ■ icmp |
| ■ ftp | ■ ntp | ■ other |
| □ nntp | ■ smtp/pop3/imap | |

Endace

Strengths

- Capture and Analysis
- Flexible (FPGA based)
- High speed and performance
- Accuracy



Endace

Capabilities

- Non-invasive network monitoring
 - Modem DSL and cable monitoring (at ISP)
 - 3G data monitoring
 - High speed business connections
 - Core internet links
 - LAN Technologies
- Monitoring and acceleration (in) hardware
- Core technology for IDS/IPS/UTM applications for broadband internet protection (failsafe etc.)

Endace

Research Directions

- Developing acceleration to deal with more sophisticated attacks, detection strategy on increasingly faster and more heavily loaded networks.
- Enabling freely available software to reliably monitor and detect network attacks, issues, problems etc.
- More into hardware, more accessible to larger audiences (small/medium enterprises, developing accessible to less sophisticated customers).



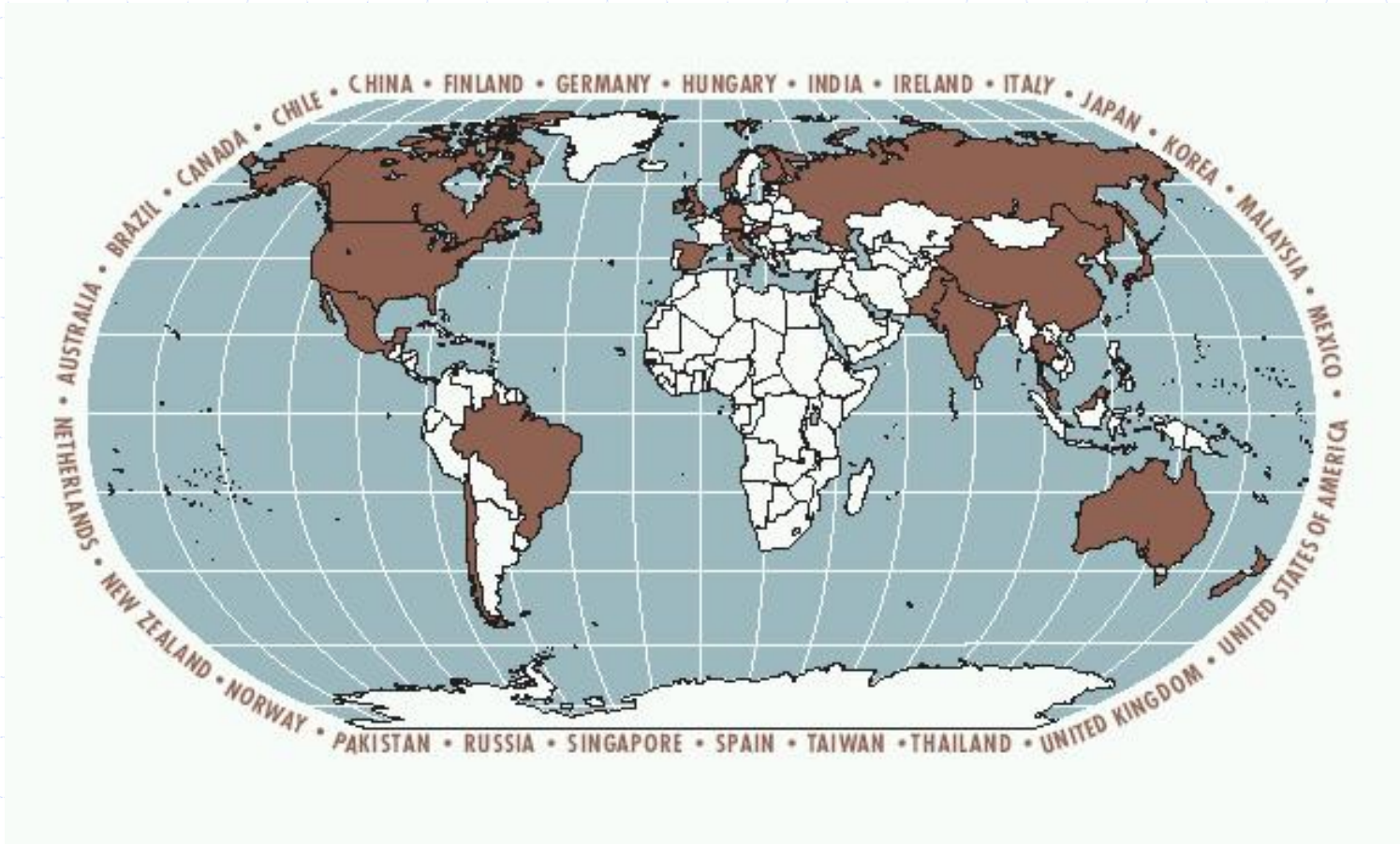
AMP

Introduction

- NLANR's active measurement project
- Approx 160 monitors, mostly in the USA.
- International deployments
 - a single AMP monitor in about twenty other countries
 - some national AMPs (Australia, Taiwan, Russia soon)
- Measure
 - RTT
 - Loss
 - Topology
 - Throughput and capacity
 - Applications (e.g. http, smtp)
- NSF funded

AMP

International Sites



AMP Demo

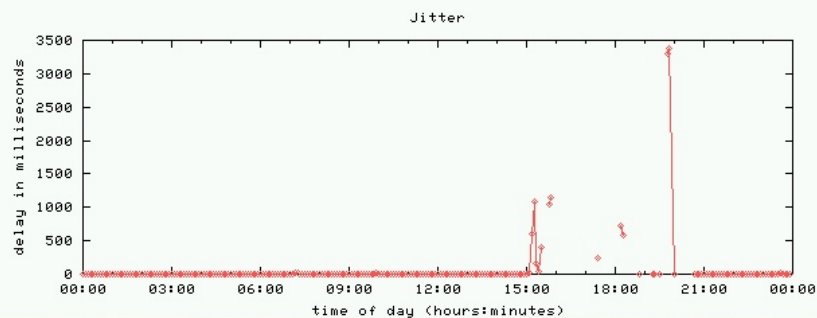
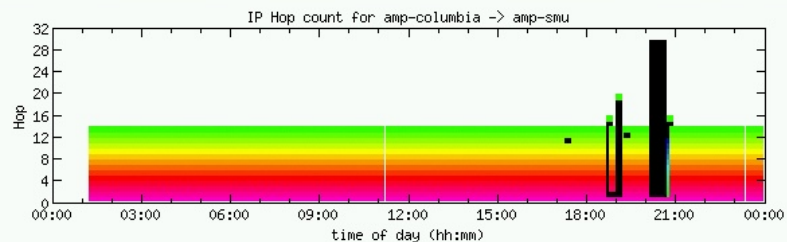
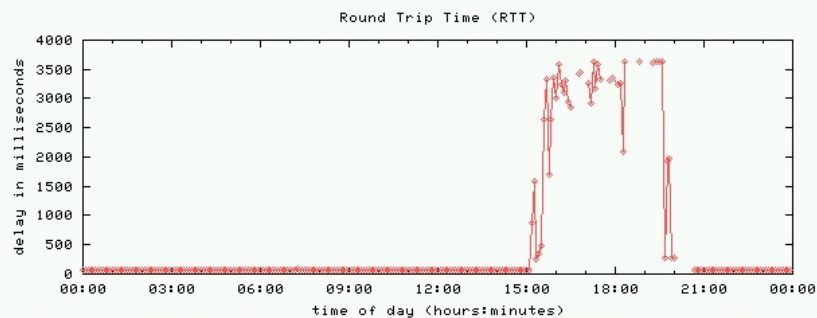
RTT And Loss Measurements

amp-smu from amp-columbia

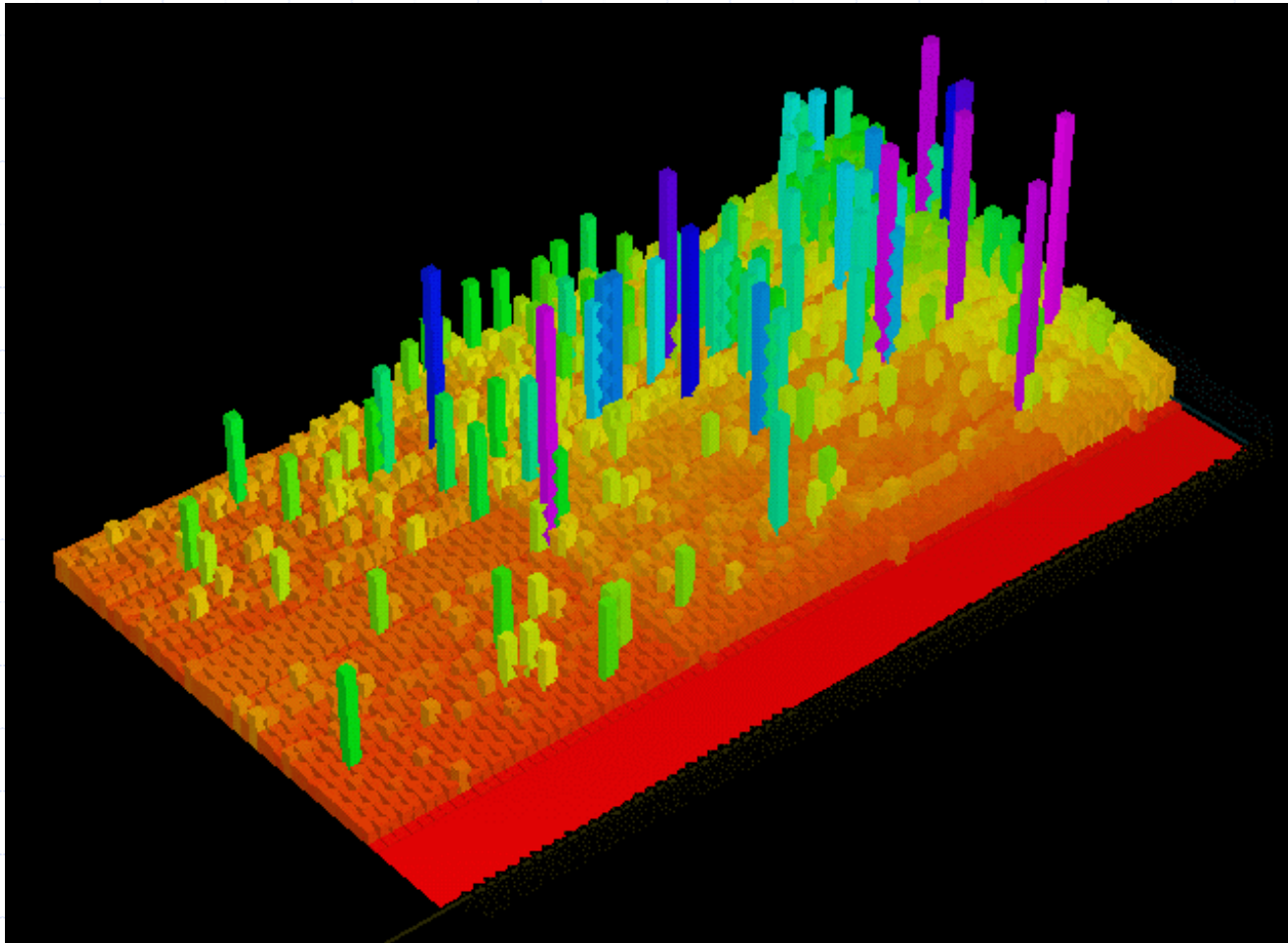
[\[NLNR\]](#) [\[AMP\]](#) [\[monitors\]](#) [\[weekly graphs\]](#) [\[reverse\]](#) [\[derivatives\]](#) [\[routes\]](#) [\[src info\]](#) [\[dst info\]](#) [\[2003.9.12\]](#) [\[2003.9.14\]](#)

Sat Sep 13 2003

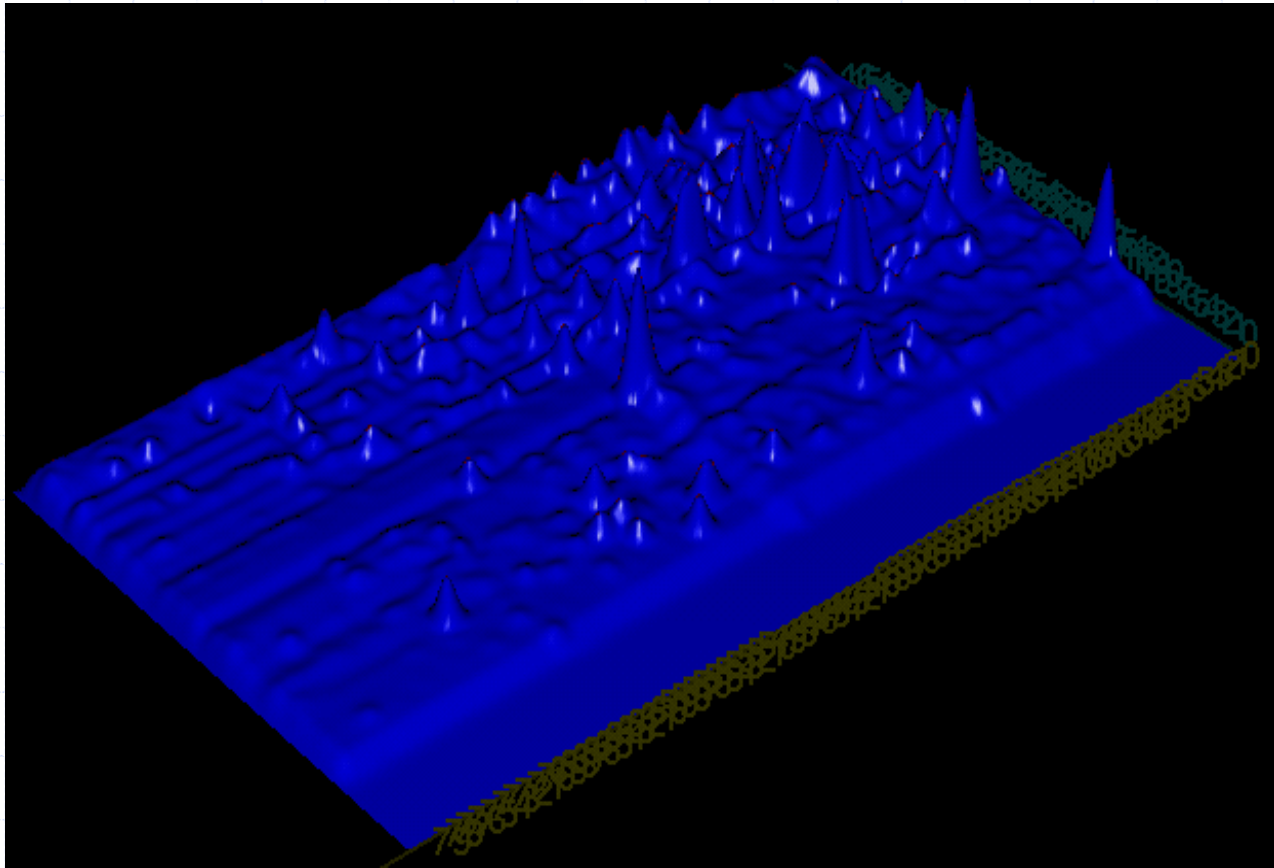
min: 59.00, mean: 217.82, max: 3662.00, stddev: 688.19 (ms)



AMP Demo



AMP Demo



IPv6 Global Topology (Scamper)

- Goals
 - create a portable open-source tool for large scale measurement and data collection
 - expose host features to measurement techniques that aren't widely used but can be very useful, such as the route socket and data link access
 - focus on ad-hoc / one-off data collection
- Currently: topology discovery and inference
- Future: BGP client

Scamper

Current Results

- Identifying IPv6 Network Problems in the Dual-Stack World
- IPv6 AS Core Topology
- Exposing Path MTU Discovery Failures

Scamper

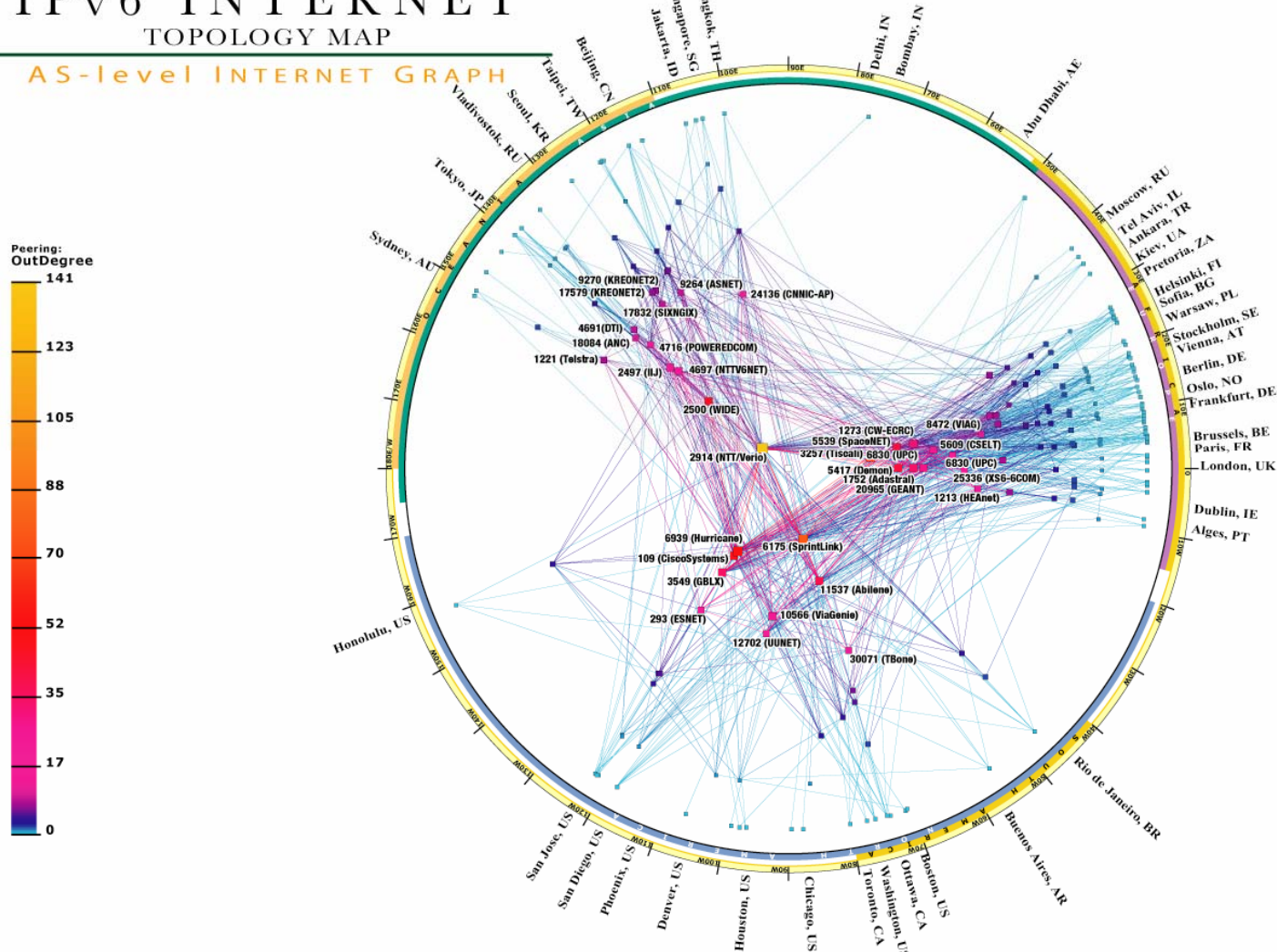
Dual Stack Error Discovery

- Algorithm:
 - measure delay to hosts with both IPv4 and IPv6 addresses
 - if there exists a significant delay difference, then measure the forward IP topology and use Path MTU Discovery to infer IPv6-in-IPv4 tunnels, which are widely blamed for poor path performance
- Results:
 - the majority of IPv6 paths have similar delay characteristics to their IPv4 path
 - but some are much worse delay

Scamper IPv6 AS Core

IPv6 INTERNET TOPOLOGY MAP AS-level INTERNET GRAPH

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Scamper

Path MTU Discovery Failures

- Methodology
 - scamper can infer the largest packet size that can be forwarded, and the failure location.
- The datasets we have (from IPv6 paths and jumbo-capable machines) indicate that MTU mismatches are a much larger (not widely known) problem than ICMP black-holes.

CRCnet

- Bringing broadband to rural communities
- Develop a new network architectures suitable to deploy future generation wireless networks in rural and remote areas
 - Based around a tree/mesh architecture

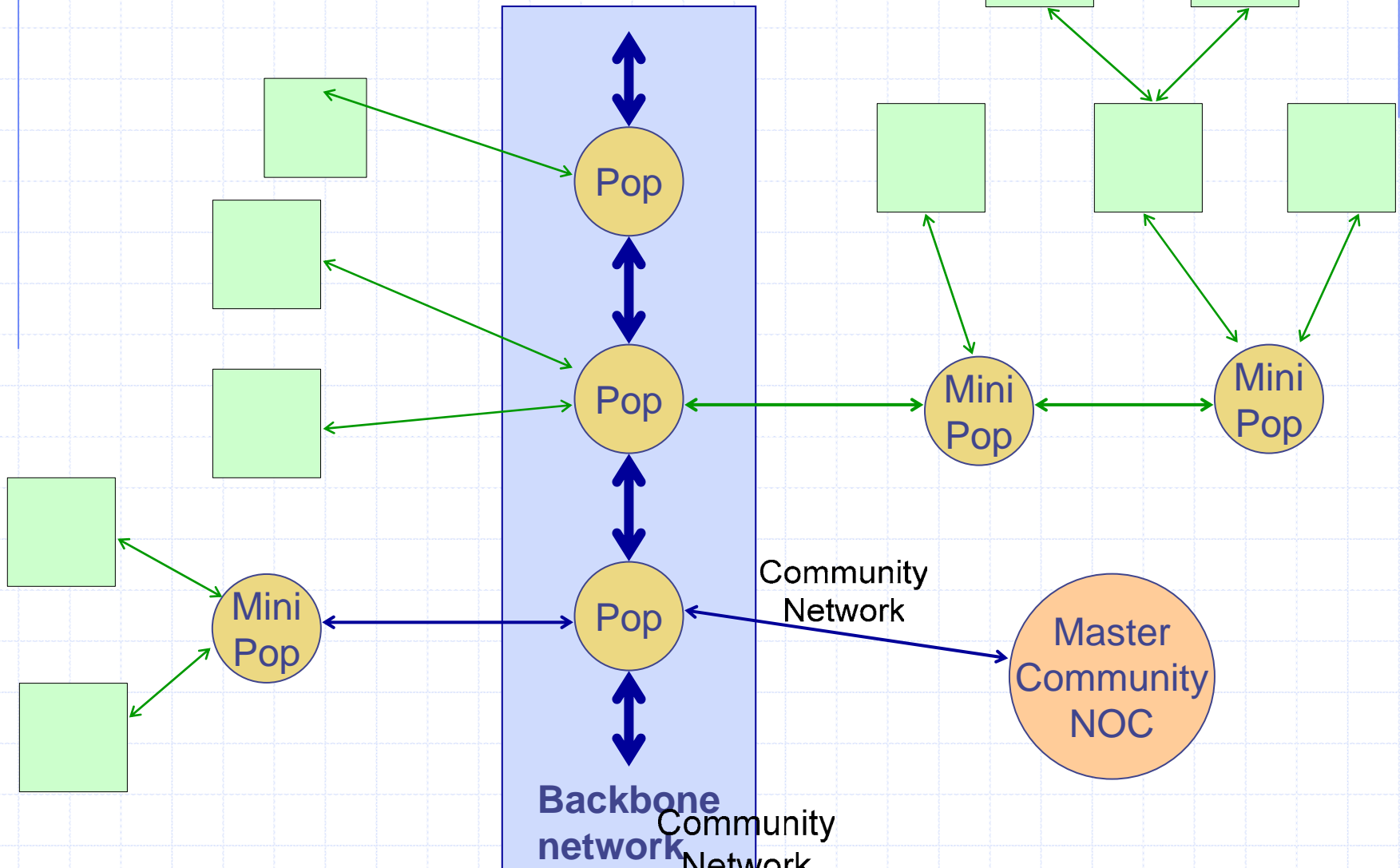
CRCnet

Design Issues

- Low Population density
- Rolling landscape and lots of trees
- Traditional high cost cell deployment not flexible
 - Too small a customer base
 - Locations to cover area hard to find and very poor access
- Low cost, simple to deploy repeaters permit “following” landscape
 - Almost all schools on trial network require a repeater location to reach them

CRCnet

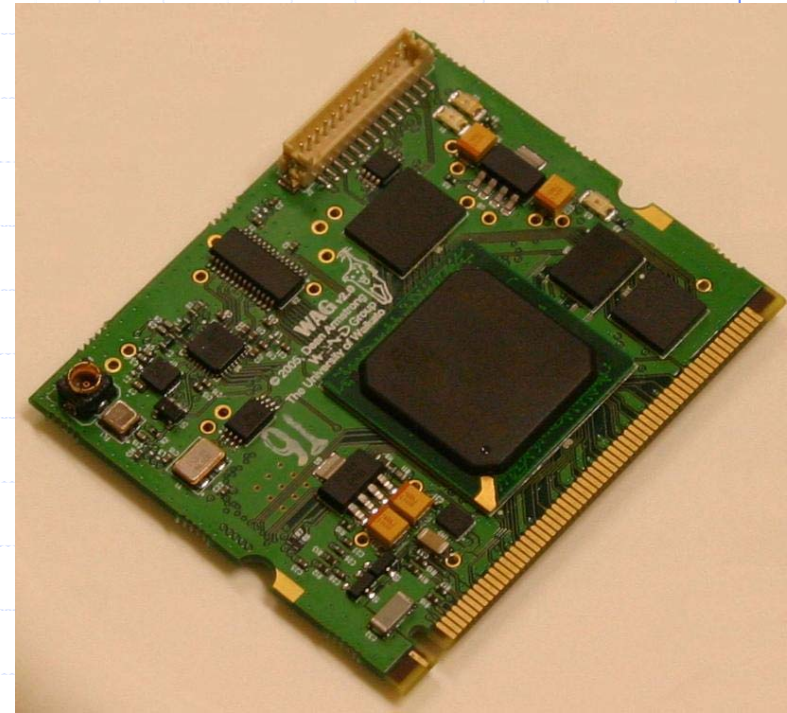
Extending the Community Model



CRCnet

WAND NIC Card

- The group has been developing its own Wireless NIC card
 - Current version MiniPCI
- Enable low level protocol development and testing
- Next version should be able run LINUX



CRCnet

Example Topology



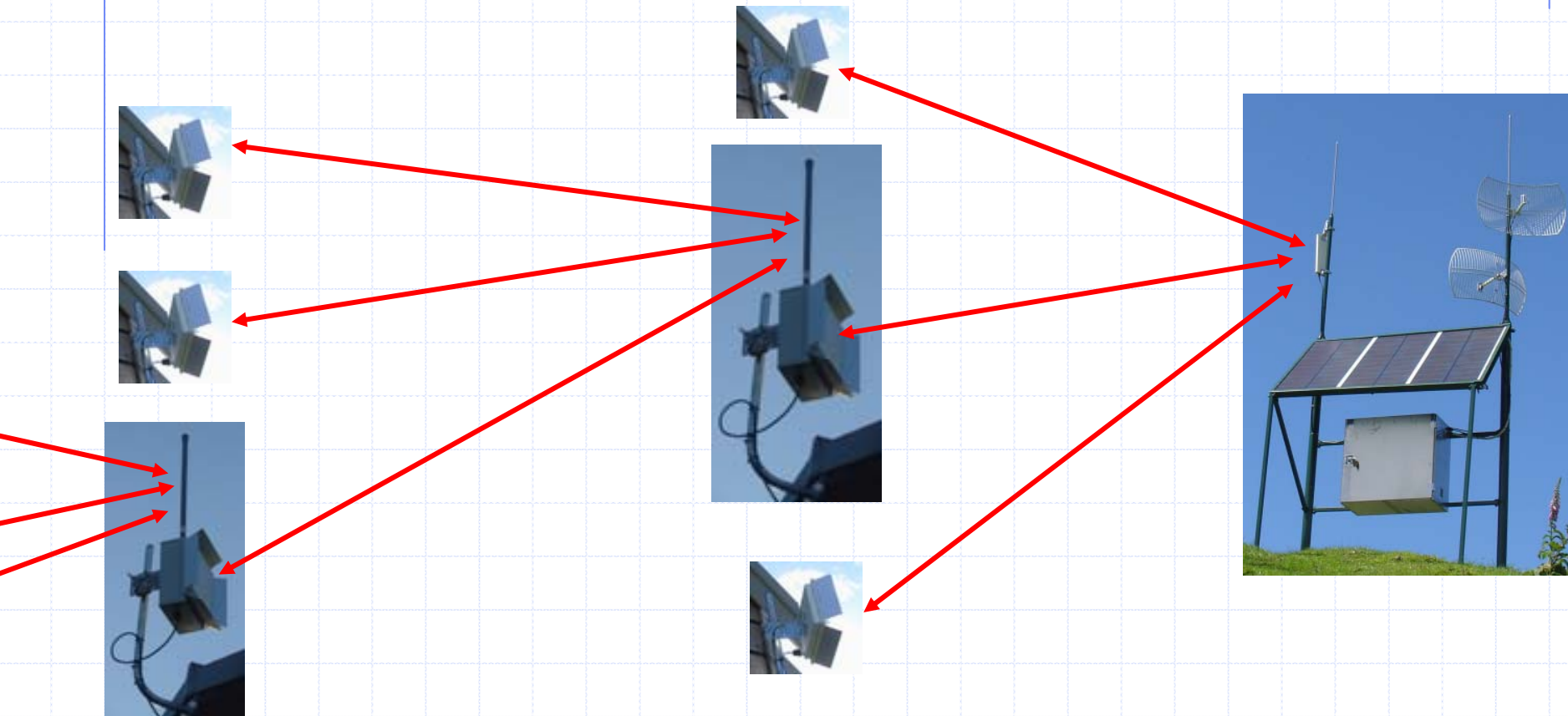
CRCnet

Solar sites



CRCnet

CPE repeater



CRCnet

Telemedicine in South Africa



CRCnet

Rapid Deploy Networks

- Based on experience with CRCnet we believe technology well suited to networks that can be deployed quickly
- Currently looking working on the design of a number of different nodes:
 - Minimise time and expertise to do installation

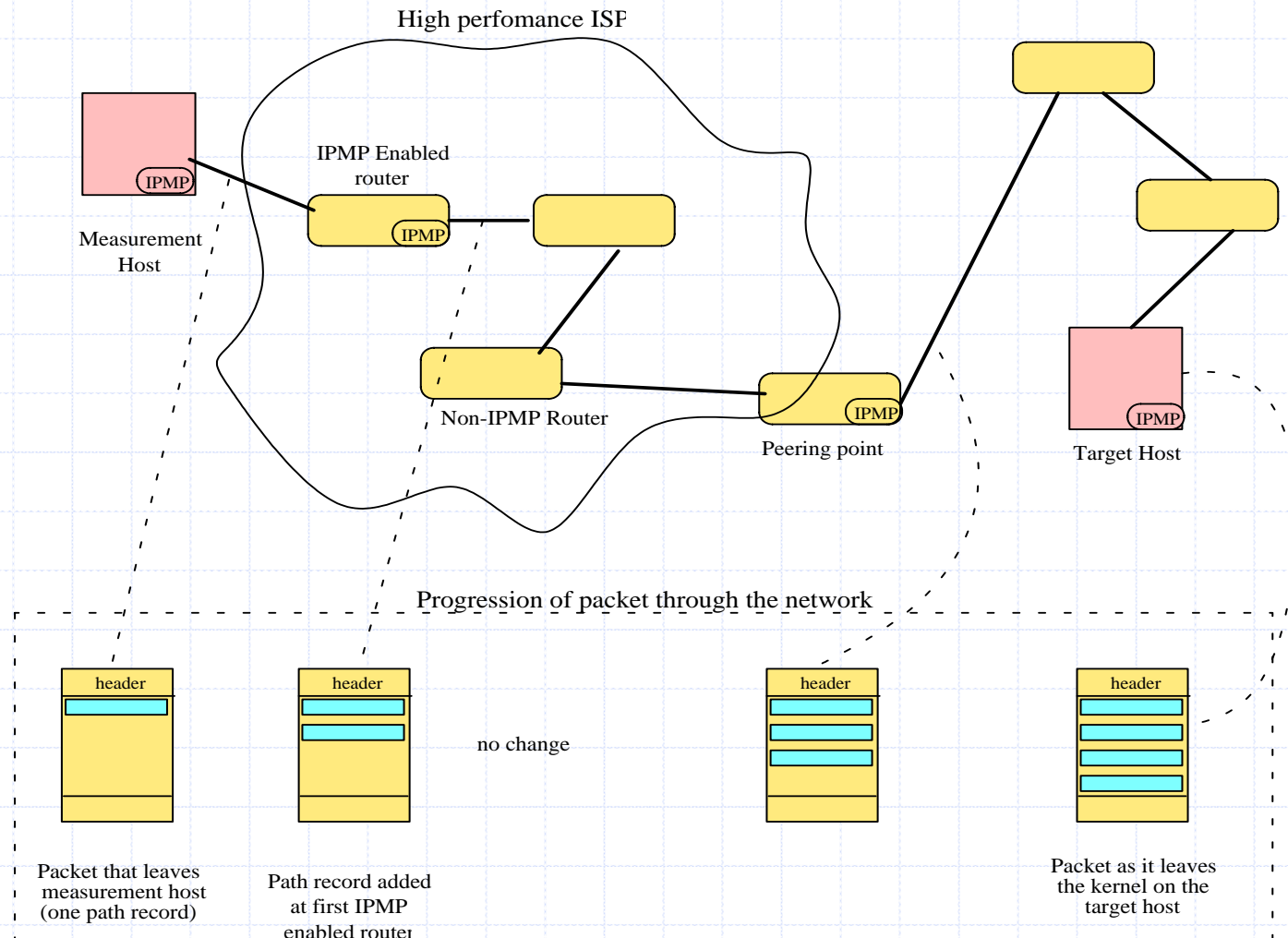


IPMP

Introduction

- Current active measurement protocols have weaknesses
 - multiple packets (overhead, phantom routes)
 - measurement of components (reverse path, CPU)
- IPMP combines path and delay measurement in a single packet exchange with low router overhead

IPMP Architecture



Simulation

Introduction

- ATM-TN based
 - University of Calgary/Waikato partnership
 - parallel
 - BSDLite network stack (sort of)
 - high bandwidth delay, mixed real-time/TCP
- ◆ NS-2 with Real OS stack (e.g. Linux)
 - new work
 - network cradle
- 802.11b link layer

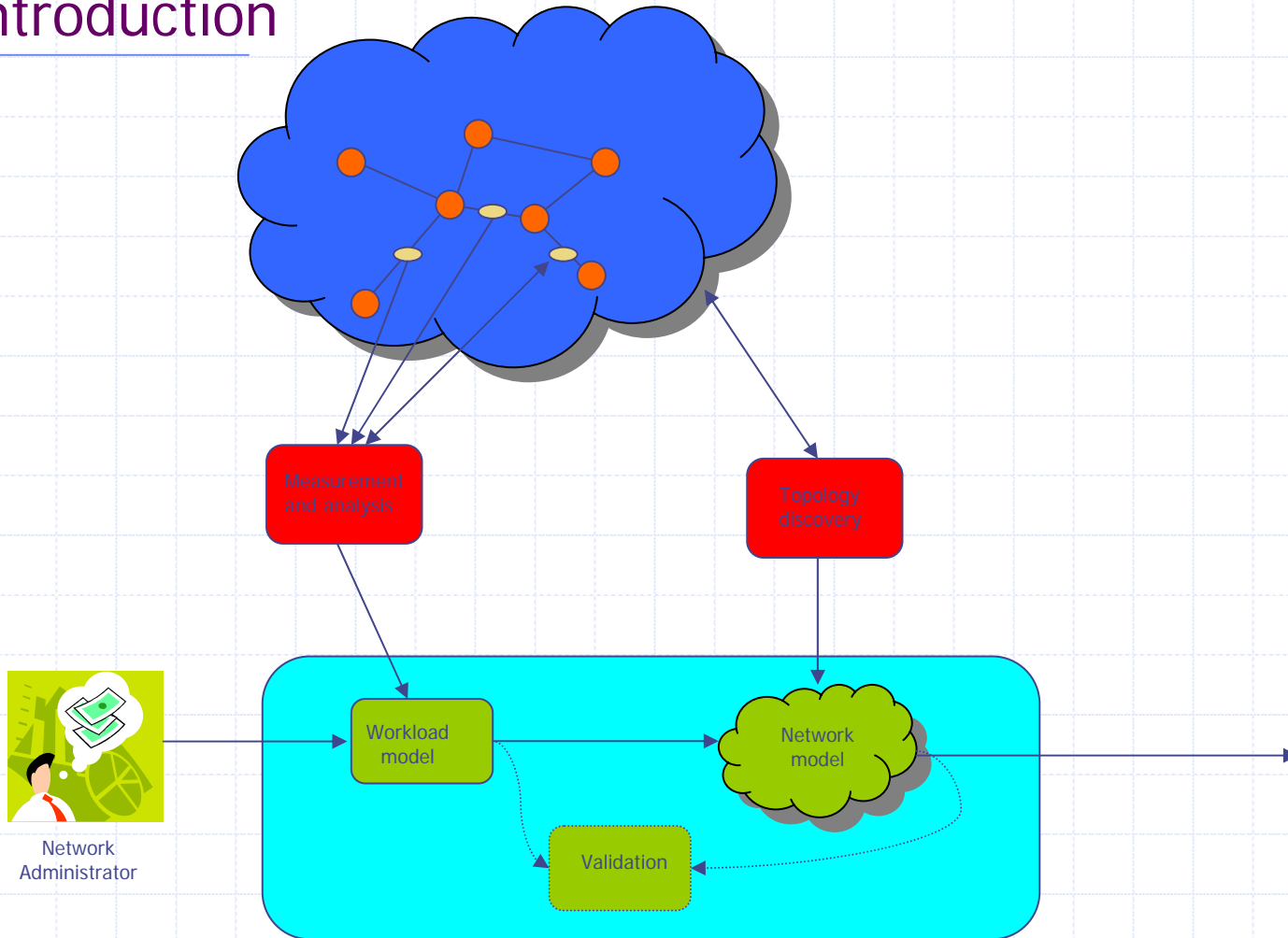
Simulation

Integrated Measurement and Simulation (Messim)

- Simulation is only accessible to very large network operators and users
- AIM: Make simulation available to medium sized enterprises
- Integrate measurement and simulation
- FRST funded

Messim

Introduction



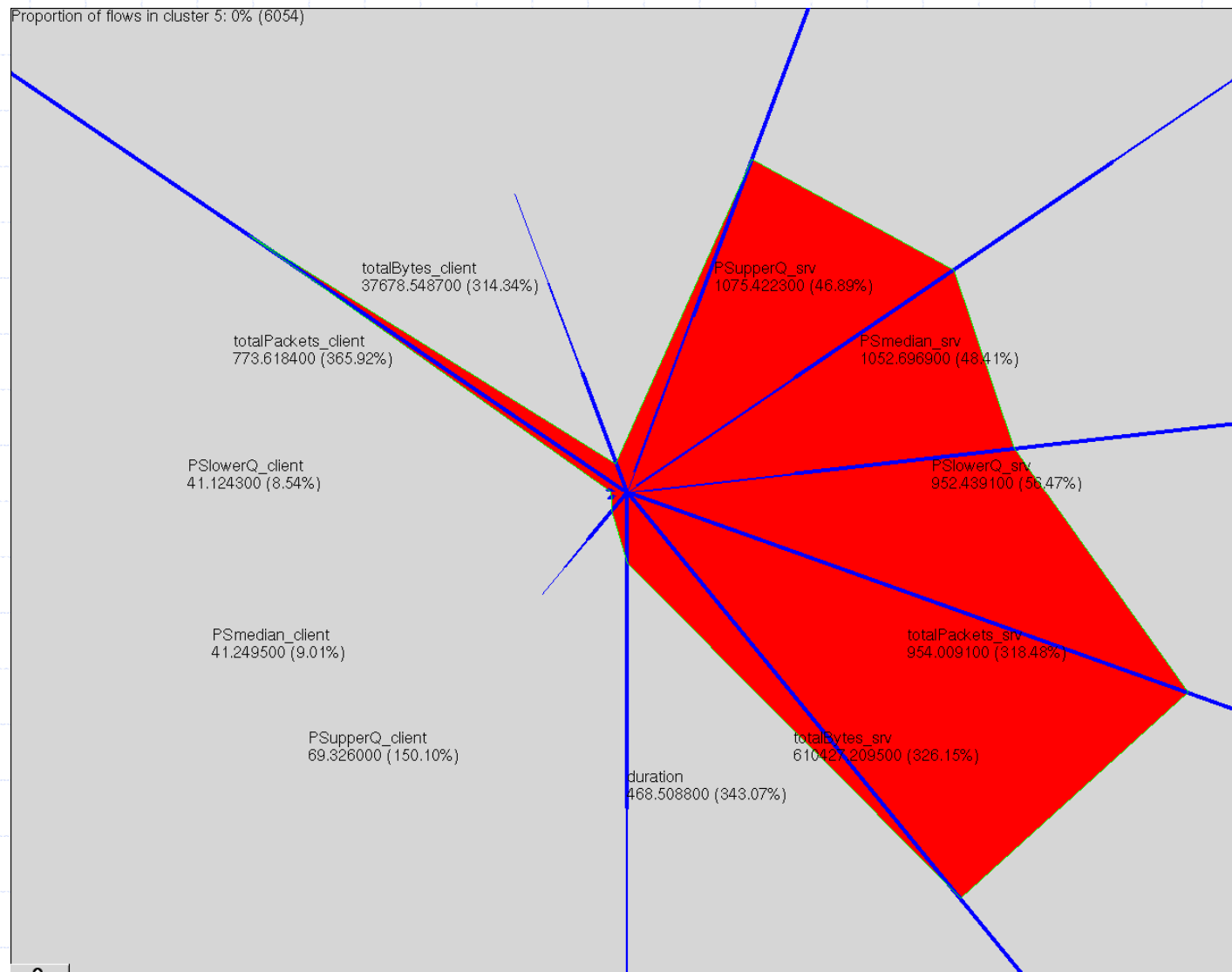
Messim

Generic models

- Use WEKA machine learning algorithms to
 - cluster
 - classify
- For each cluster
 - simplify the rule set into terms for a network manager
 - produce an empirical distribution for each
- Allow simulations with different proportions of traffic

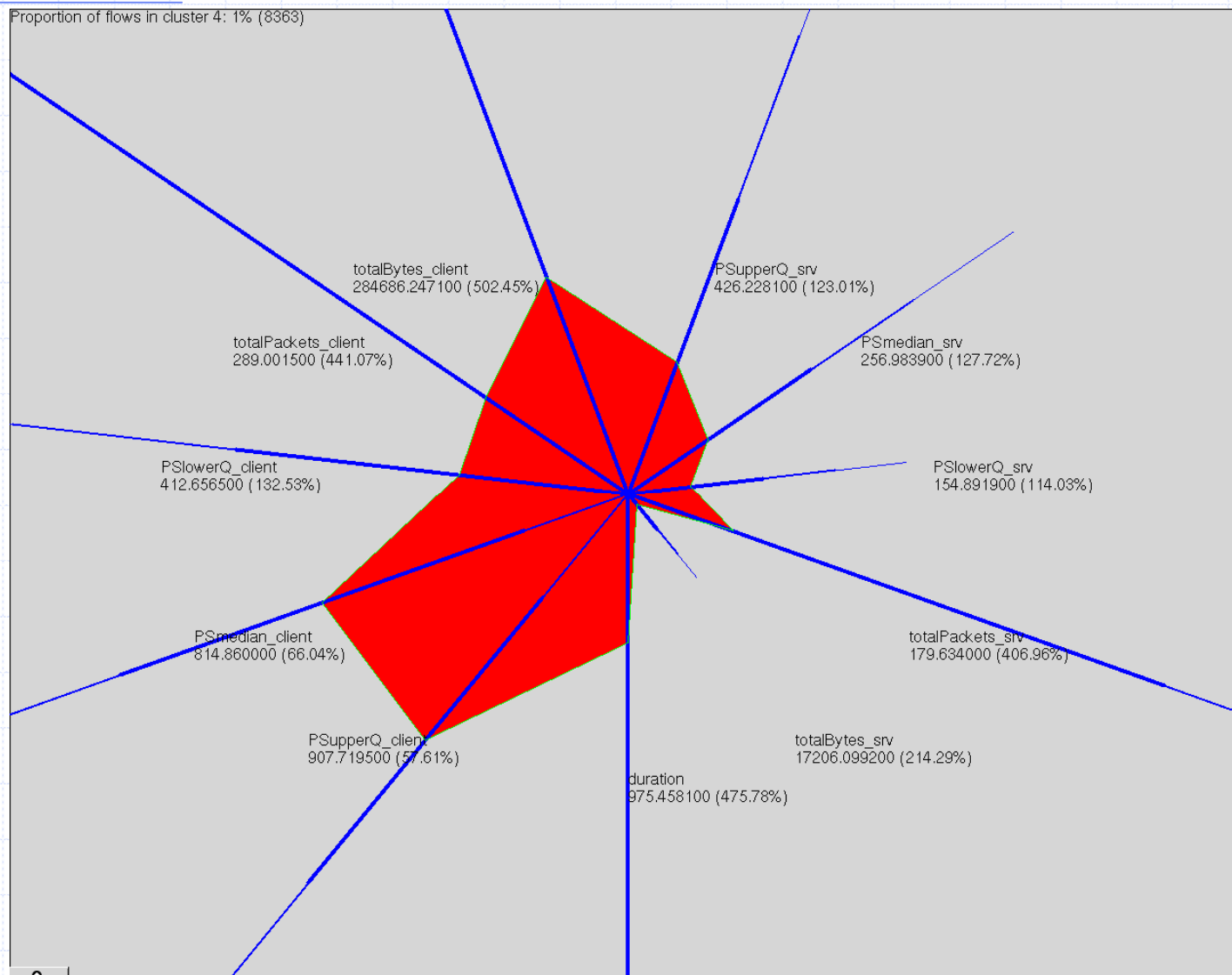
Messim

Generic models



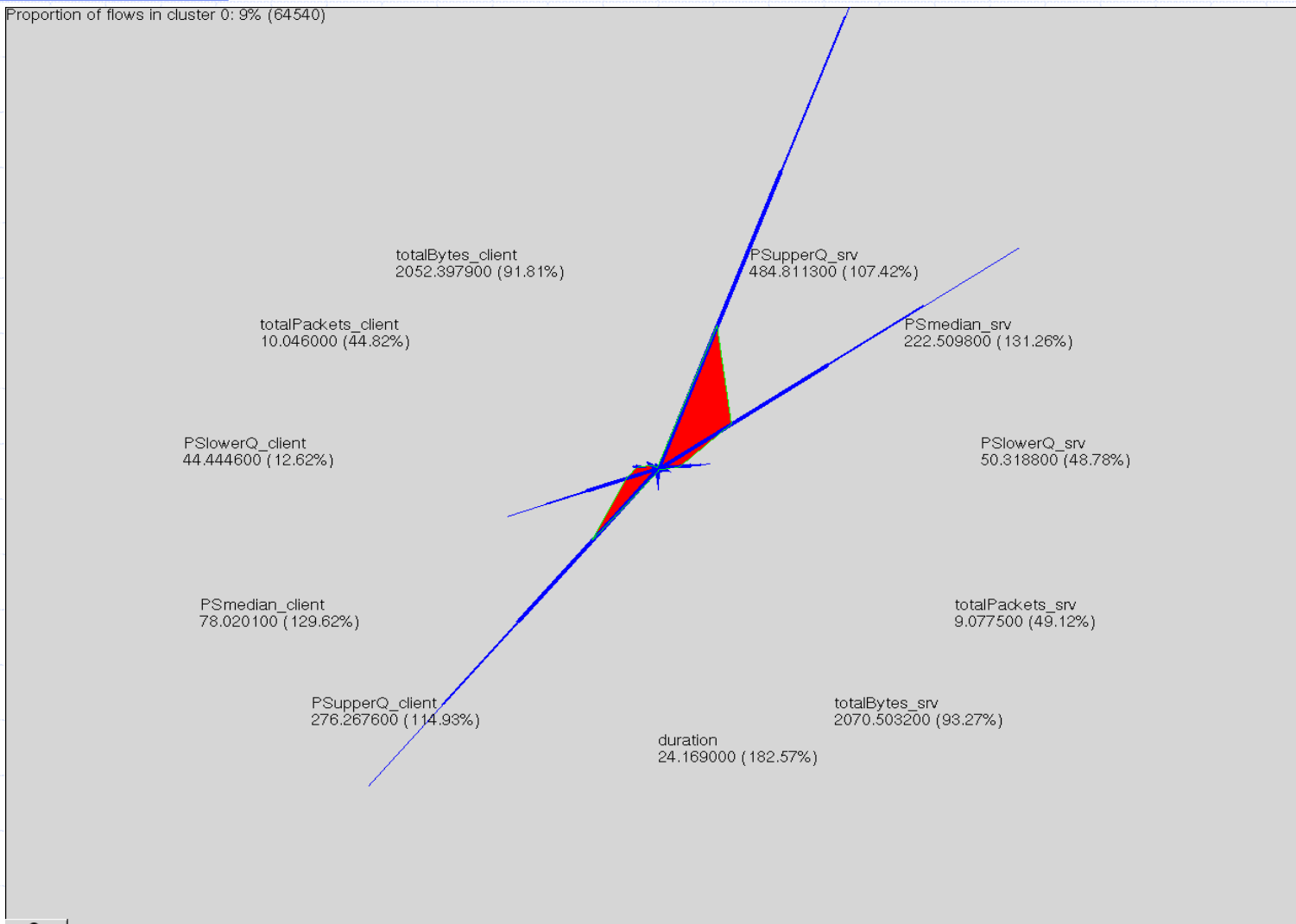
Messim

Generic models



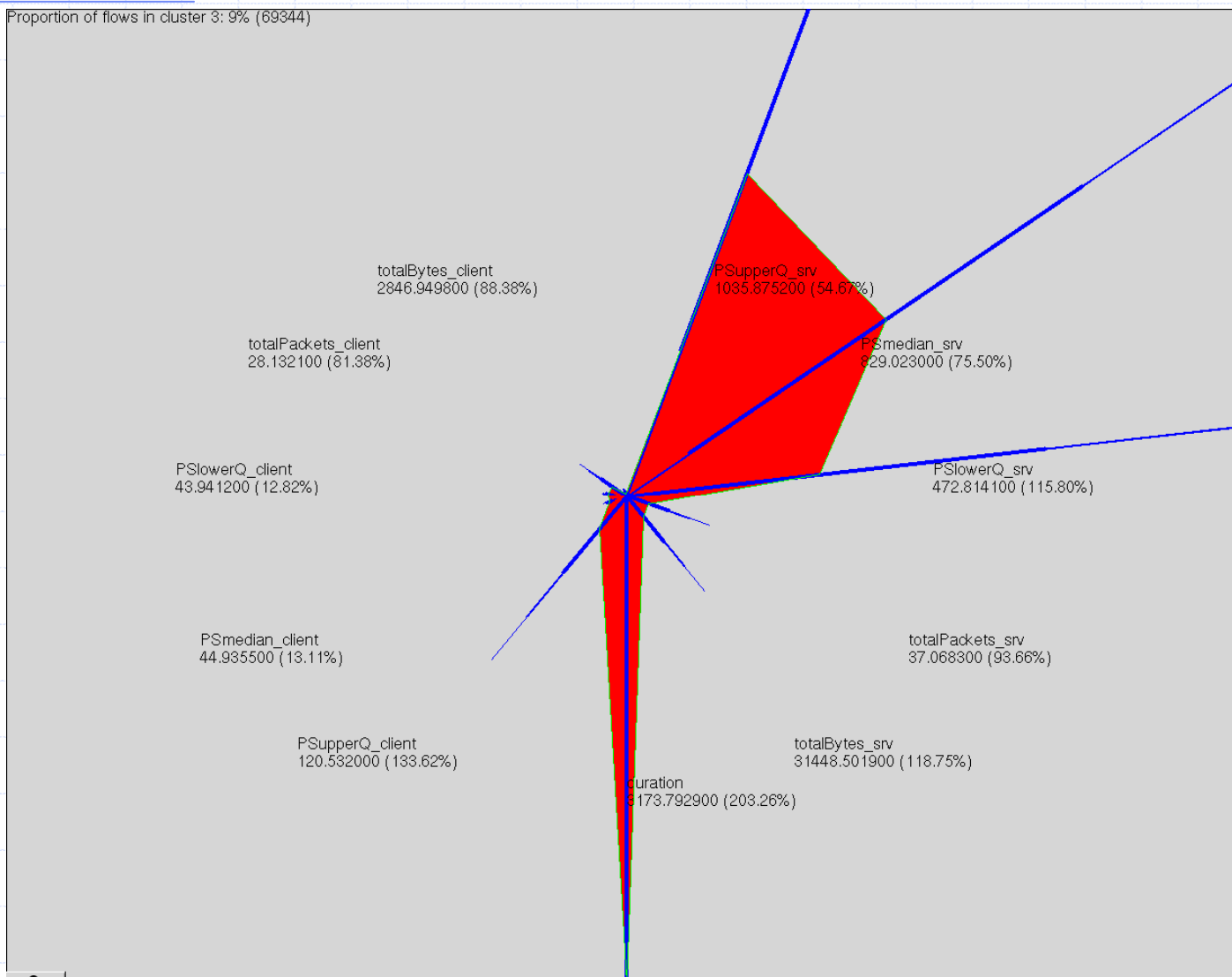
Messim

Generic models



Messim

Generic models



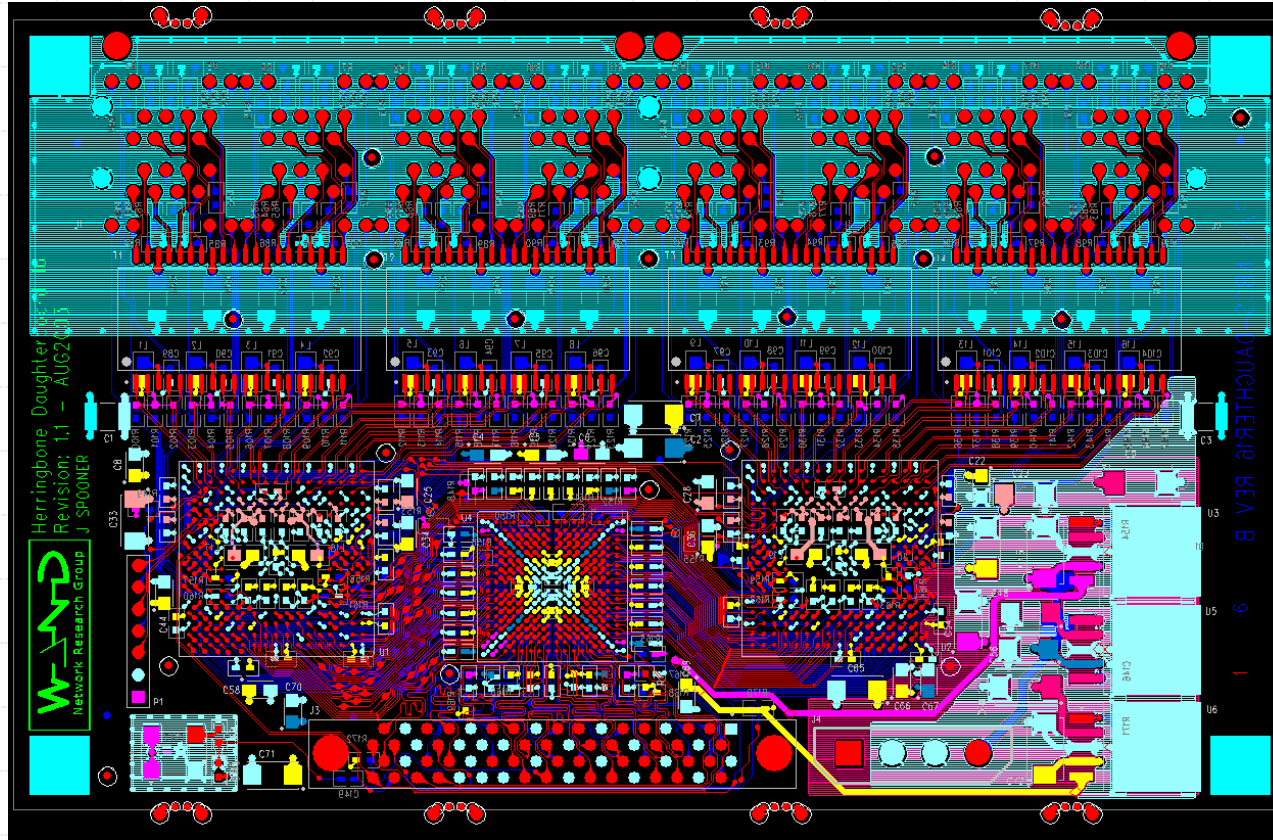
Crossbar Switch

Introduction

- 64 Port FastEthernet Crossbar switch
- Fast / Flexible Reconfiguration
- Link Monitoring
- Latency Control

- Bandwidth limiting
- Self Documenting Network Topology
- Centralised Control

Crossbar Switch Daughter board Layout



IPv6 Stacks

Overview

- Small devices
 - One of the motivators for IPv6 is to provide addresses and other support for small devices
 - a.k.a. cell phones
 - implementing a stack for embedded devices
 - little ram
 - moderate CPU speeds
 - prototype hardware development
- Fast handover between cells
 - normally may exceed 2s
 - reduce to around 150ms, I2 triggers, L3 preparation for handover and timing improvements in protocols

Allied Telesyn

Introduction

- Worldwide layer 3 development in Christchurch, NZ
- Strong focus on IPv6
- Supporting world wide IPv6 initiatives

Genkai Project/APAN Joint Project Remote Medical

The first world test bed for IPv6 Multi channel unicast

