Timing Update

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UTS Timing Project

- Continues SyncLab Project formally at Uni of Melbourne
  - New testbed with
    - Two 7.5G4 DAG cards
    - Low latency taps
    - Rubidium atomic clock (SRS FS725)
    - Several roof mounted GPSes (Trimble and Symmetricom)
    - Time distribution hardware
    - /26 public IPv4 addresses
  - Companion testbed at PolyU (Rocky Chang, Peter Membrey)
RoofLab

Yi Cao
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- Overarching Goal `Perfection of Networked Timekeeping`
  - Continues to develop and support RADclock (see AIMS 2015)
  - New foci in Trusted Timing and the Internet of Things
    - New ARC funding 2017–2012 (Barford, Paxson, Wouters)

- Major Activities
  - Server Health Monitoring (SHM)
  - Network Timing Core (NTC)
Australia’s UTC Clock at the NMI
Recent Work

- **Rot at the Roots? Examining Public Timing Infrastructure**
  - INFOCOM 2016
  - Looks at anomalies in ~100 public Stratum-1 servers

- **Network Timing and the 2015 Leap Second**
  - PAM 2016
  - Leap Second behaviour of ~170 public Stratum-1 servers

- **2016 Leap Second and Anomaly experiment (Dec 2016– Jan 2017)**
  - ~500 public Stratum-1 servers (includes all NTPpool servers)
  - Polling up to 1 per second (previously 64s)
  - Still only 1 vantage point.. Ark!

- **Time to Measure the Pi**
  - IMC 2016
  - Potential of Raspberry Pi-1,2,3 and Pi+PPS as a timing platform
Server Health Anomalies are Real

No RTT `events’:

→ no routing changes
→ no major congestion
→ R(i) should bound A(i)

Large Asym events:

→ can’t be routing
→ can’t be congestion
→ must be server

Longitudinal study (2011,2015)
Out of 102 servers, 37 bad over entire period!
Server Health Monitoring

- Health and Vulnerability of Today’s Internet Timing
  - Stratum-1
  - Generally
  - Main expansion dimensions:
    - assess all IPv4 Stratum-1
    - assess entire IPv4 forest
    - move from single to multiple vantage point

- Statistically sound server anomaly detection
  - Principles; algorithms; code; rigorously evaluated
  - Developing its use:
    - vetting tools [use by experts, anyone]
    - incorporated into timing algorithms and protocols
    - as a service [CAIDA? later taken over by ntp.org?]
Network Timing Core

Stratum-1

Stratum-2

Stratum-3

Stratum-4
NTP Hierarchy — take II

Stratum-1

Stratum-2

Stratum-3

Stratum-4
NTP Forest
But how would we know? No tools!
Idea Behind NTC (‘DNS for timing’) 

- **Deal with multiple key problem in one architecture**
  - Failure to address path asymmetry errors
  - Dysfunctional ‘hierarchy’
  - No effective cross validation across the Stratum-1 roots
  - No sync-friendly server selection or load balancing
  - No trust (malicious or incompetent? who cares)

- **Architecture**
  - NTC Fuses Stratum-1’s and privileged Stratum-2’s into a unified layer
    - Rare Stratum-1’s NOT public
    - Many more Stratum-2’s
      - public
      - located within network provider’s networks
    - Self vetting using SHM and voting algorithms
  - Asymmetries
    - directly measurable within Stratum-1 mesh
    - achieved throughout the NTC by calibration
Meshed Stratum-1 + Privileged Stratum-2

NMI and AARNet have agreed to support public trails.
What I Want

- What kind of timeserver vetting/trust do you want/need?

- Developers & Collaborators for
  - NTC
  - RADclock
  - Timing for IoT devices