IRONET RESULTS SEMINAR

Research Problem: Advance IP technology in such a way that it can be used for delivering all communication services.

raimo.kantola@tkk.fi
+358-40-750 1636
http://www.netlab.tkk.fi/tutkimus/ironet

IRONET Project

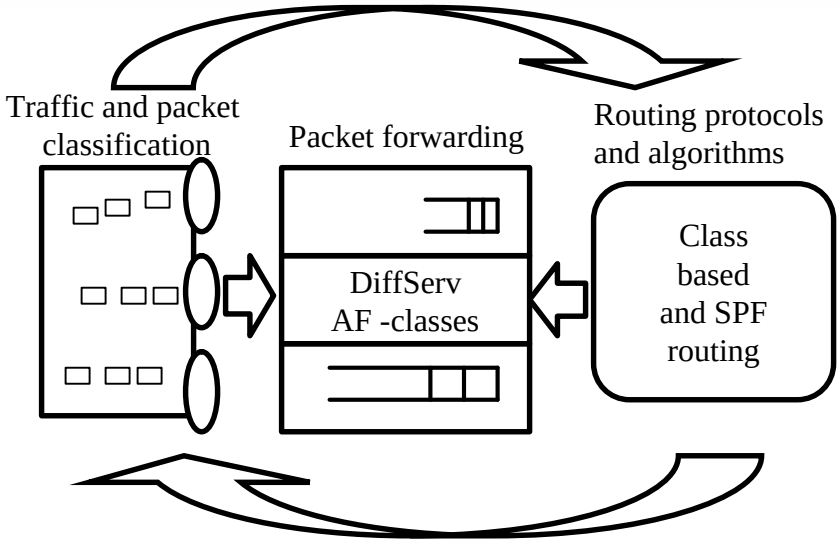
- At the Helsinki University of Technology
  - Department of Electrical and Communications Engineering
- 3 Chairs involved in IRoNet:
  - Prof Jorma Virtamo, Teletraffic theory
  - Prof Raimo Kantola, Networking technology
  - Prof Heikki Hämmäinen, Networking Business
    - IRoNet kick-started the group
- Ca. 12 Man years during 2004

Partners: NRC, Defence Forces, Tellabs, NECSOM
Advisory: Elisa, TeliaSonera, CSC/FUNET

Outline

- Research framework and Central hypothesis
- Result areas during 2004
  - theory
  - prototyping
  - measurements
  - simulations

How to build QoS into the Internet: components of the solution



Central hypothesis

- Assigning one per-hop behaviour to applications that behave in a similar manner improves predictability of QoS.
  - classification reduces chaos
- Only a small number of classes can coexist such that we can hope to meet class behaviour assurances.
- NB: Following the money does no provide QoS in aggregate systems such as DiffServ!

Results: Theory

- Traffic Classification methodology
  - Learns the nature of applications and groups applications that behave similarly in the packet/flow space into a class
  - Uses supervised learning
  - Is not (and does not need to be) absolutely accurate
  - Protocol Independent
- TCP bandwidth sharing based on Processor Sharing models taking into account packet losses and variable Round trip times
- Initial work on Insensitive routing and load balancing based on Balanced Fairness
- The target is an Internet that provides a BE service and that can tolerate greedy and malevolent users
  - manage bandwidth, applications and services
  - balance user interests according to policy

Results: Prototyping

- Competence: can now verify an idea in a FreeBSD/ Linux router prototype in a few weeks.
- Have Implemented Traffic Classification, Policy based Management, Centralized routing, SIP CC, Charging.
  - changes user's traffic filters on-the-fly
- Found defects in QoS implementation in FreeBSD/ALTQ and Linux Traffic Control
  - once again confirms that theory and practice are two different things
- Evidence in favor of the central hypothesis
- Initial Implementation of Multi-Class Routing in OSPF using Zebra

Results: Measurements

- Capturing Traffic from Funet on 2.5Gbit/s
  - Legal hurdles: privacy must be protected
  - Ready to negotiate with commercial ISPs
- Measurements in a controlled prototype
  - QoS performance and Operation
  - Routing convergence

Results: Simulations

- Adaptive Scheduling: HPD – Hybrid Proportional Delay Scheduler is promising.
- IP traffic load balancing both for MPLS and OSPF environments
- More evidence in favor of the central hypothesis
- Quality of Service Routing Simulator
  - focus in routing from simulations to prototyping

End of Opening Address

Concluding Remarks

Summary and Future Direction

Future direction?

- Future of Internet is threathened by
  - Security problems, Viruses, worms, hackers ..
  - SPAM
  - Unpredictable Quality
- Fundamentally two cures can be suggested
  - money talks: Volume charging ← not economically efficient
  - Knowledge Plane to support a BE service for greedy and even malevolent users

Vision for Broadband

- Traffic in Internet Core will grow →1000 fold in 5…10 years → move from Gigabit to Terabit Networks
  - Historical precedent: Internet has seen ca 100% growth in Traffic per year for 30 years
  - Growth rate in Finland in 2004 was 300%/12months: driven by growth in nr of BB customers and growth of (p2p) users among them
  - Some months saw 20% growth
  - Entertainment over IP is the driver e.g. peer-to-peer.
  - Take: one live DVD stream per 10% of households→ will produce traffic:
    20Mbit/s * 300 000 = 6 Terabits/s
    +gaming+ wireless and mobile traffic + Broadcasting + voice + www + …
  - Technology components for such networks exist now.
- In core there will be less room for additional per packet processing.
  Per packet intelligence must move to the edge.
  - Willingness to pay for services per bit varies 1: 1000 000 → requires control.
  - Per packet processing and control especially important in wireless access.
- Overlay networks over IP such as P2P, VPNs etc will be important
  - Personal/family peer-to-peer etc…

Future work

- Autonomous networking
  - Application awareness, service awareness, self awareness and self configuration
  - FE mechanisms, protocol independent measurements, deterministic protocol enhancements for self configuration
  - Policy Control Architecture and mechanisms
  - Measurements, Prototyping, PC based routers, Network Processors
  - Target: BE network for greedy and malevolent users
- Robust, fault-tolerant, mainstream networking
  - fast convergence, overload control
  - PSTN heritage (some protocol development)
- Mobility and Security for the Internet
- New networking paradigms
  - peer to peer: scalability, performance, traffic centric approach
  - Ad hoc: niche user segments, extension of cellular
  - Extreme networking