IRoNet prototype

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QoS paradigm

- Three concurrent problems:
  - Construction of proper forwarding treatments
    - What kind of service structrure best characterises user requirements and operator business
  - Decission of proper forwarding class for the application data stream
    - How network becomes aware of individual data streams and their requirements
  - Engineering the network for committed quality level
    - How network can guarantee service level agreements made for the customers

IRoNet prototype

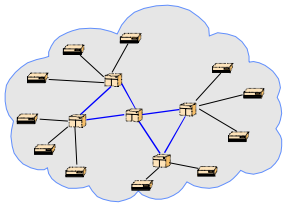
- Is based on following ideas and assumptions:
  - There is a need for a 'QoS' capable network architecture
  - This architecture need **NOT** to provide hard quality for the users
    - i.e. no signaling is required nor are connections reserved
  - Users do not care actual details of the service which they use rather they are interested in using similar network than today

IRoNet prototype

- Our solution is based on:
  - Division of traffic into a number of classes based on their characteristics
    - Real−time conversations (VoIP etc)
      - Low jitter
    - Short interactive flows (HTTP etc)
      - High throughput
    - Long lasting flows (FTP etc)
      - Low packet loss
  - Provisioning of resources for each class based on the usage and policy
  - Allowing a single user to move within the network

IRoNet prototype

- Our prototype has following components
  - FreeBSD based DiffServ edge routers
    - ALTQ is used to engineer the services
  - NECSOM MediaSwitch DiffServ / MPLS core routers
    - Linux traffic control is used to engineer the services
  - CoralReef measurement probes and network policy generators
  - Policy Server with MySQL database farm



Edge routers

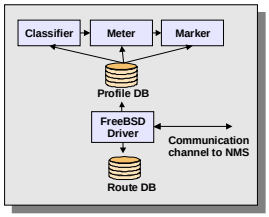
- Standard PC hardware
  - Celeron 433MHz / 128MB
  - D−Link multiport 10/100 Ethernet NICs
  - FreeBSD 4.5 operating system
    - ALTQ−package to add all necessary QoS functions
      - Classification
      - Marking
      - Queueing
      - Scheduling
- ALTQ
  - Alternate Queueing for BSD
    - http://www.csl.sony.co.jp/person/kjc/kjc/software.html
  - Modifies OS−kernel
  - Software modules reside between network device driver and IP forwarding daemon

Core routers

- NECSOM media switch
  - Based of Frame Syncronized Ring −architecture developed in VTT
  - Max 12 10/100 Ethernet interfaces
    - Each carrying own processor
  - Linux operating system
    - Linux traffic control − package to add all necessary QoS functions

FreeBSD policy agent

- Basically software that communicates with
  - **ALTQ API** for manipulating interface dependent parameters
    - Filter lists for different classes
    - Profile values for metering, policing and marking
  - **Kernel routing table** for installing precalculated routes
  - **Policy server** for current information about provisioning



Policy Server

- Database server storing
  - Records of individual users service level agreements
    - User is allowed to use
      - 256kbps webtraffic
      - 64kbps VoIP
  - Network device information
    - Routers and their configurations
  - Topology information
    - Physical topology
    - Routes

Policy Server

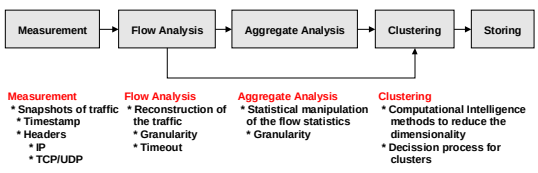
- Routing and provisioning server
  - QoS routing simulator performing optimization of routes
    - Combination of offline and online operations
      - Real−time collection of network status data (LSA)
      - Non−real−time processing of the information
        - » Simulation of best possible implementation of policy
        - » Installing the routes into the network database

Policy Server

- Network profile server
  - Processing of measurement data collected inside the network
    - Centralized processing
      - All traffic data is postprocessed inside the server
    - Distributed processing
      - Most of the data is preprocessed within the network

Policy Server

- Network profiles are generated based on the traffic flow observed on the representative points within the network
- Policies (filters) for differentiating the traffic into the classes are generated based on the network profiles



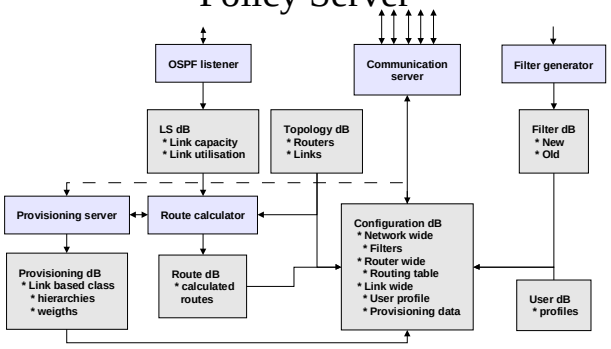
Measurement
* Snapshots of traffic
* Timestamp
* Headers
  * IP
  * TCP/UDP

Flow Analysis
* Reconstruction of the traffic
* Granularity
* Timeout

Aggregate Analysis
* Statistical manipulation of the flow statistics
* Granularity

Clustering
* Computational Intelligence methods to reduce the dimensionality
* Decission process for clusters

Policy Server



Where are we now ...

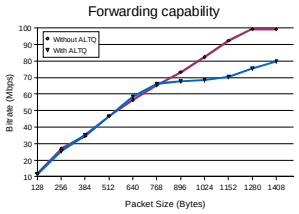
- So far we have deviced first version of the edge router, policy server and measurement probes
  - Capabilities which they currently have
    - **Edge router**
      - Full user plane operation
      - Communication channel to the dB
    - **Policy server**
      - User dB
        - » SLA
        - » Authentication
      - Network policy dB
        - » Filterlists making the differentiation

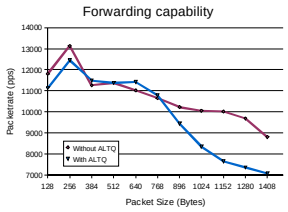
Where are we now ...

- **Measurement probe**
  - Line rate capturing capability
    - » tested up to 155Mbps bi/dir
    - » now in process of modifying software for 2.4Gbps bi/dir
  - Flow and aggregate statistics processing

Performance data

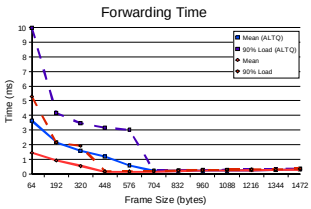
- Edge router forwarding capability
  - Sensitivity to packet size
  - Sensitivity to added processing





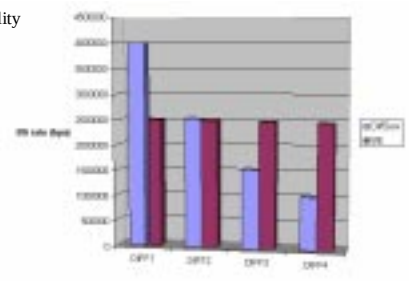
Performance data

- Edge router forwarding time
  - Sensitivity to packet size
    - Small packets
    - Large packets
  - Sensitivity to added processing
    - Without ALTQ
    - With ALTQ



Performance data

- Edge router isolation capability
  - No differentiation
  - Four classes
    - Class 1: 4 Mbps
    - Class 2: 2.5 Mbps
    - Class 3: 1.5 Mbps
    - Class 4: 1 Mbps



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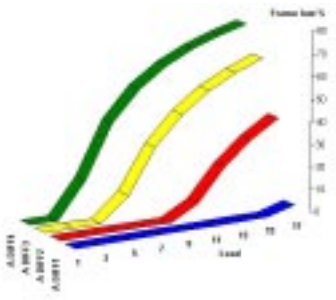

Conclusions

- Prototype is building up piece by piece − however, it takes a while before we have all pieces together
- Next year we will have routing and provisioning server, and core router ready
- New ideas have came up and will be added to the prototype
  - SIP control for adding possibility to signal connections based on time charging
- Questions ???