SWINBURNE

CENTRE FOR ADVANCED INTERNET ARCHITECTURES

Network Measurement & AAA – Overview of My Previous Work

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Background

- Worked as full time staff member and technical project manager at Fraunhofer FOKUS (1999-2004)

- Fraunhofer-Gesellschaft is the leading organization for institutes of applied research in Europe
- 56 research institutes across Germany (11,000 employees)
- Fraunhofer covers a lot of research fields: communications, energy, microelectronics, manufacturing, transport...
- Fraunhofer research is more short term oriented towards pre-products and project-driven because 70% of the budget is supposed to come from externally funded projects (30% base funding)

Background Con't

- Institute for Open Communication Systems (FOKUS)
- FOKUS is focussed on communication systems research: IP Networking, E-government, UMTS, Mobility, Middleware, Smart Homes/Cars, Multimedia, E-Commerce, etc.
- About 200 employees
- Organized in 10 different Competence Centers (CCs)
- Measurement Technologies and Network Research (METEOR) CC
  - About 15 people (including students)
  - IP performance measurement, AAA, ad-hoc networks, mobility/roaming (WLAN, UMTS), content delivery networks
  - www.fokus.fraunhofer.de/research/cc/meteor

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IP Performance Measurement

- **Policy Based IP QoS Meter Project**
- Industry-funded project (2000-2001)

- Architecture for automatic Service Level Agreement (SLA) validation in a network with heterogeneous meters
- Non-intrusive (passive) one-way delay, loss measurement
- Hardware meter based on DAG board (Uni. Waikato, NZ)
- Software based meter based on Linux box
- Intelligent component for interpreting SLAs, generating and distribution of measurement tasks
- QoS Computation and SLA monitoring component

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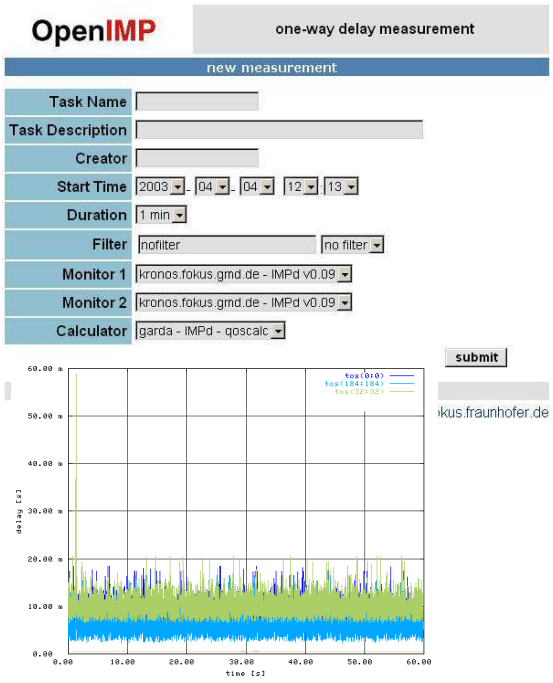
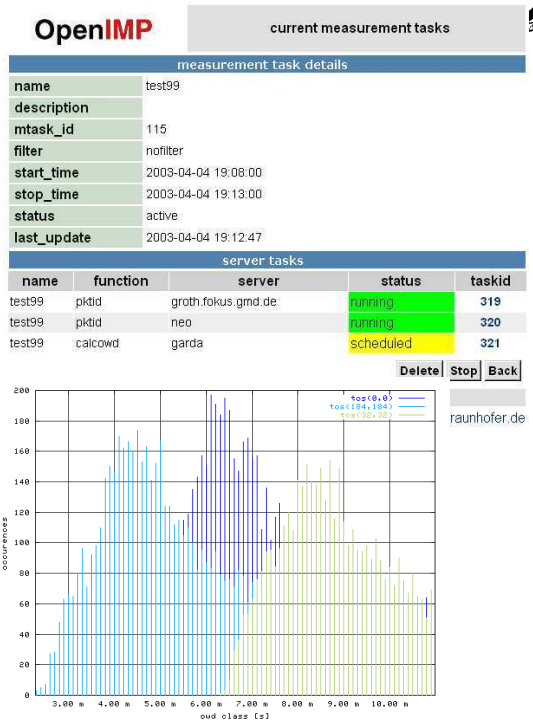
IP Performance Measurement





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Web Performance Measurement

- **Measurement Architecture for CDN and Applications**
- Industry-funded project (2001-2002)

- Architecture for web performance measurement
  - Passive and active measurement
  - Metrics: DNS latency, TCP latency, HTTP transaction latency, web page latency, availability
  - Proxy-awareness
- Components
  - Active meters
  - Passive meters
  - Embedded meters
  - Task distribution
  - Result display

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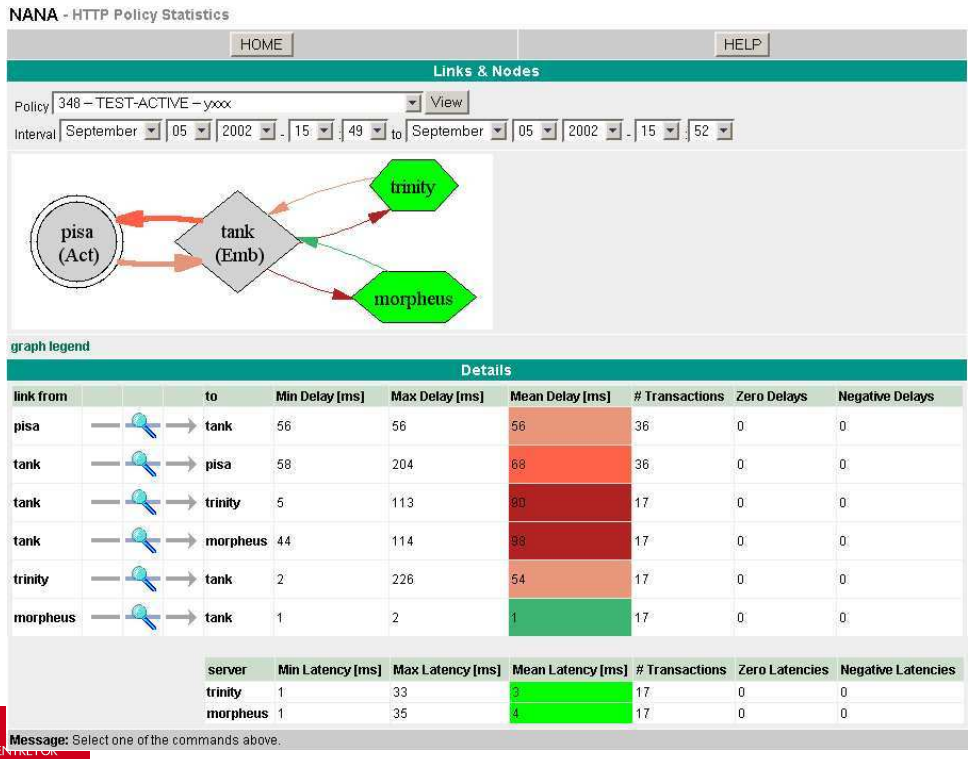
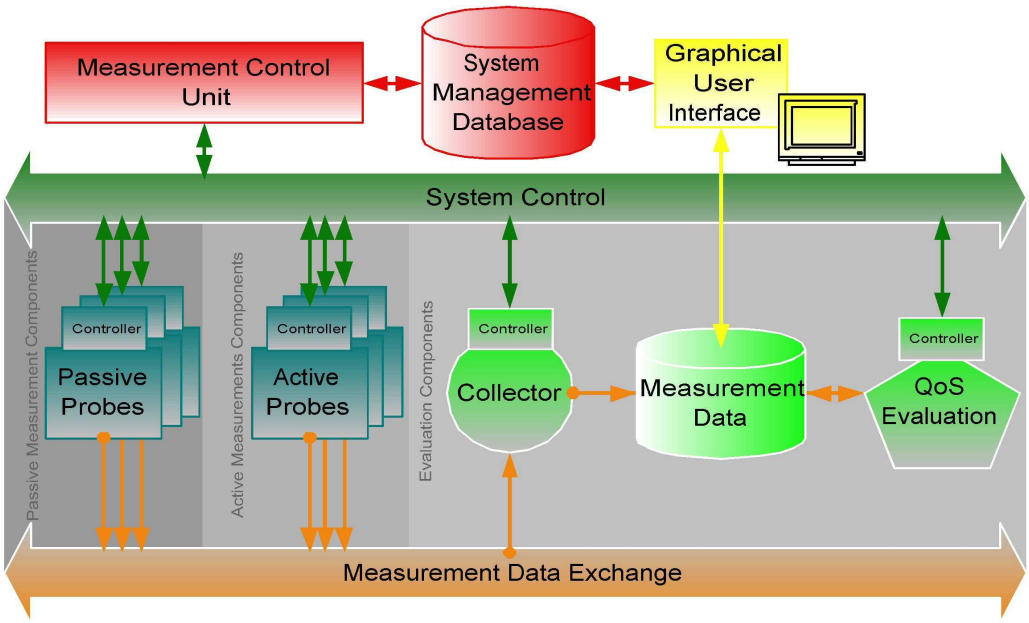
Web Performance Measurement



Measurement Architecture

- Passive Software Meter
  - Packet classification algorithms
  - Metric modules
  - Export modules
- Hardware Meter
  - TANYA card
  - DAG
- Active Meter
  - Traffic generation with TANYA card
  - RIPE Box
- Embedded Meter
  - Web Server/Proxy
- Active measurements
  - IPPM metrics (delay, loss, jitter)
  - HTTP, DNS, TCP setup latency
  - HTTP Transmission duration
- Passive measurements
  - Packet capturing
  - Volume, throughput
  - One-way delay and loss
  - RTP loss
  - Jitter
  - RTT (ICMP, TCP, DNS)
  - HTTP, DNS, TCP setup latency
  - Web Page latency

Measurement Architecture



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MOME Project

- **Monitoring and Measurement Cluster Project**
- EU Sixth Framework Coordination Action (2004-2005)
- Resources: 63 MM (100% EU funded)
- Partners
  - Salzburg Research
  - NEC Europe
  - Telefonica
  - University of Brussels
  - Budapest University
  - Politechnika Warsaw
  - Fraunhofer FOKUS
  - TERENA
- http://www.ist-mome.org

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Information Society Technologies

MOME Project

- **Evaluate** of different *active* and *passive* measurement components, tools and interfaces an **promote** that information to running/upcoming FP6 projects via the web

  -> http://www.ip-measurement.org
- **Select** a **measurement data format** satisfying the needs of the different tools and c**ollect measurement data** of different tools to allow access to their measurement results via a unified interface
- **Disseminate** gathered **measurement data** to the community via a simple web-based interface to enable statistical data analysis
- **Co-ordinate standardisation activities**
- **Organise workshops** and **conferences** to build a monitoring and measurement knowledge exchange platform

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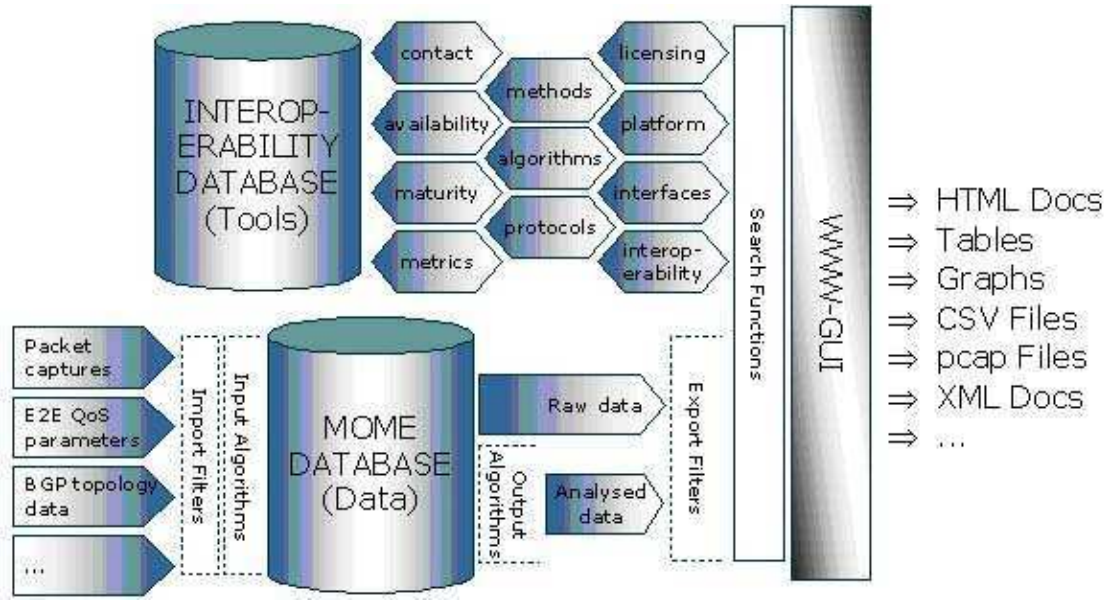
Information Society Technologies

MOME Project



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Information Society Technologies

MOME Project

- Develop questionnaire for EU projects, operators
- Develop measurement tool taxonomy
- Evaluate/classify measurement tools
- Measurement tool DB implementation
  -> http://www.ip-measurement.org
- Standardization reports and plan
- Organize standardization event

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Information Society Technologies

NETMATE Meter

- NETwork Measurement and AccounTing systEm (NETMATE)
- Flexibility and Extensibility
  - Runtime loadable metric and export modules
  - Modular architecture (C++ classes)
  - Extensible Ruleset Format (XML-based)
- OS: Linux (SuSE, Debian, Redhat), FreeBSD, Solaris
- Open Source (GPL)
- Configurable Multithreading
- IPv4 and IPv6 Support
- Multiple Classification Algorithms (2 at the moment)
- Automatic flow generation based on arbitrary packet attributes
- Packet Sampling Support

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NETMATE Meter

- Secure Control Interface
- Support simultaneous measurement on multiple interfaces
- Metric Modules
  - Counter, bandwidth, jitter, port usage, packet length, RTP packet loss, packet ID generation (crc32 and md5), capture (tcpdump file), RTT (ICMP echo), text output (similar to tcpdump output),
- Export Modules
  - Text file, binary file, IPFIX (under development), SQL (under development)
- Remote Control via Shell Tool or Standard Web Browser
- Interactive or batch processing of meter commands
- http://www.fokus.fraunhofer.de/research/cc/meteor/projects/ip-qos/netmate

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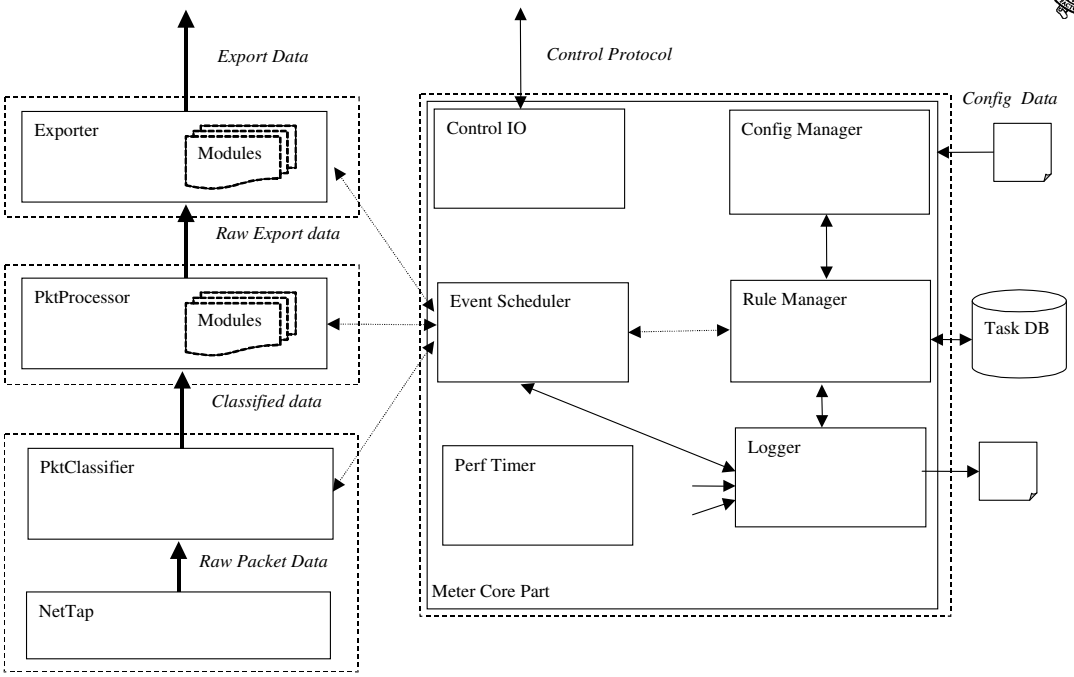
NETMATE Meter



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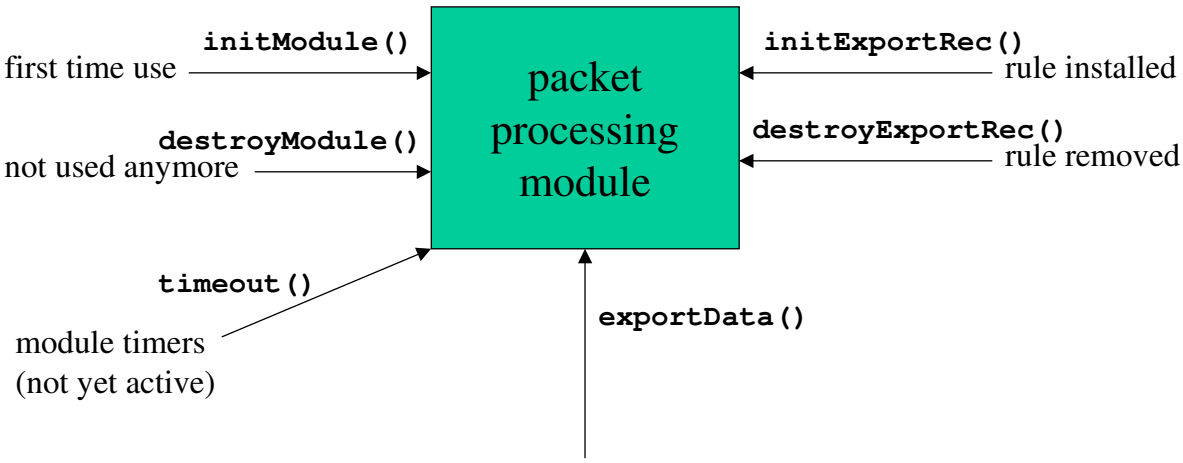
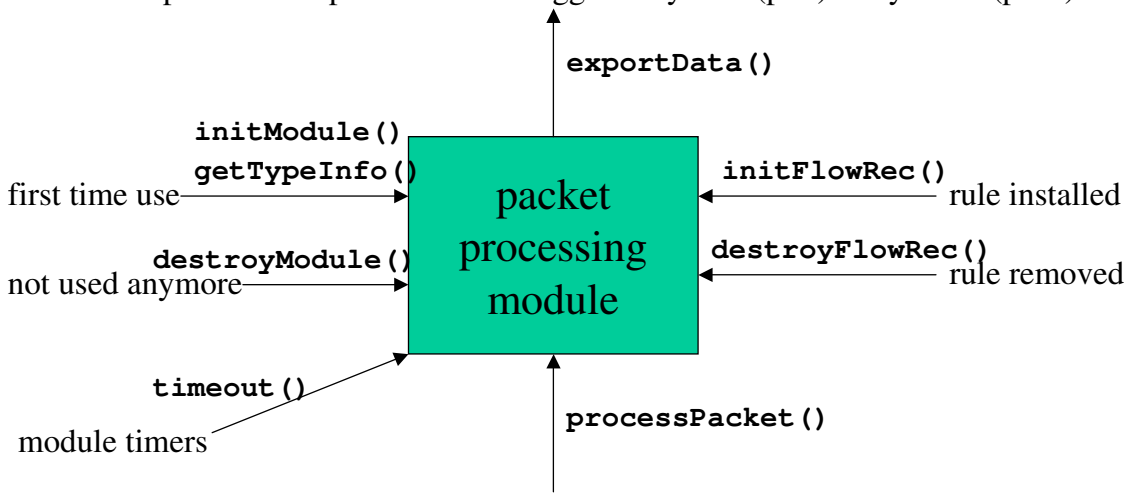
NETMATE Meter



export to external file or collector (triggered by user or by timer)

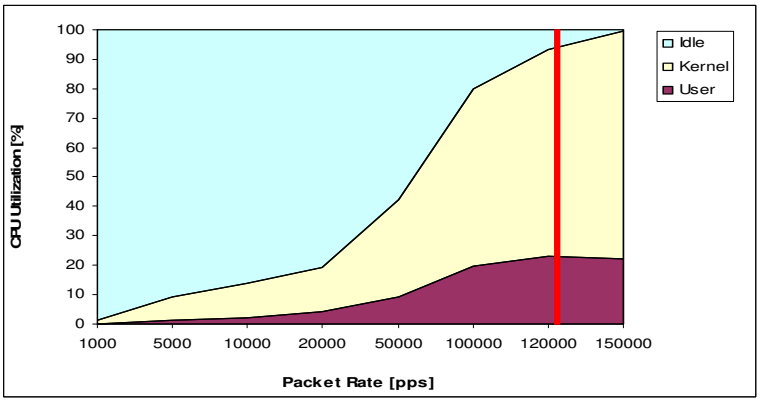
NETMATE Meter

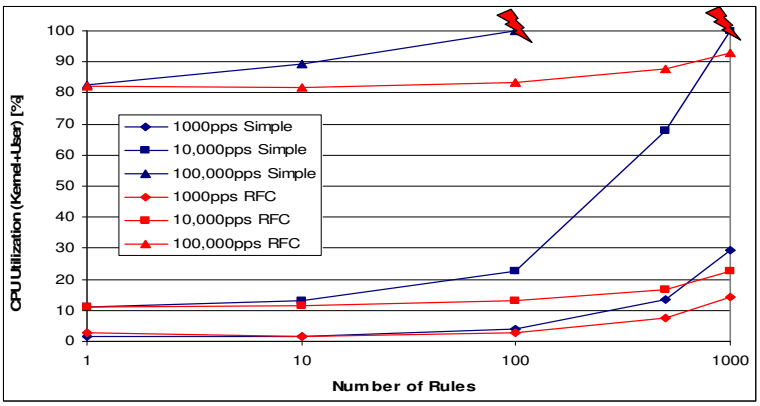
export to an exporter module triggered by user (pull) or by timer (push)



incoming packet that matched filter spec for this rule

NETMATE Meter



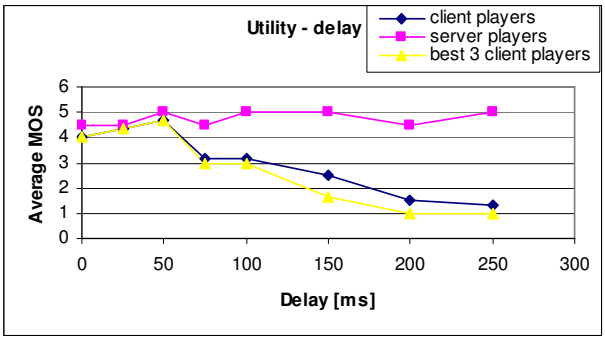


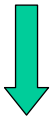
Gaming Usability Trials

- Packet measurement and analysis for XBox
  - Packet inter-arrival times
  - Packet length distribution
- Introducing delay and loss
  - How does user's perceive different network conditions?
  - Do different user's react different to changing network conditions (beginners vs. experts)?
  - How does different network conditions affect their gaming performance (kills, deaths)?
  - For Xbox games the user's must come here anyway so why not ask them a few questions

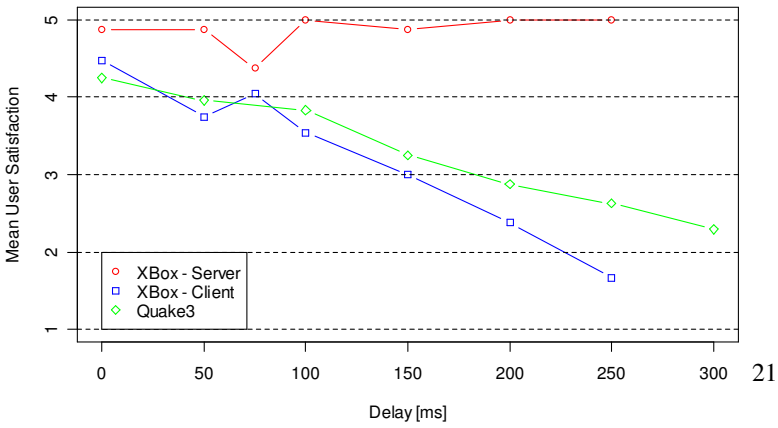
Gaming Usability Trials

Initial trial





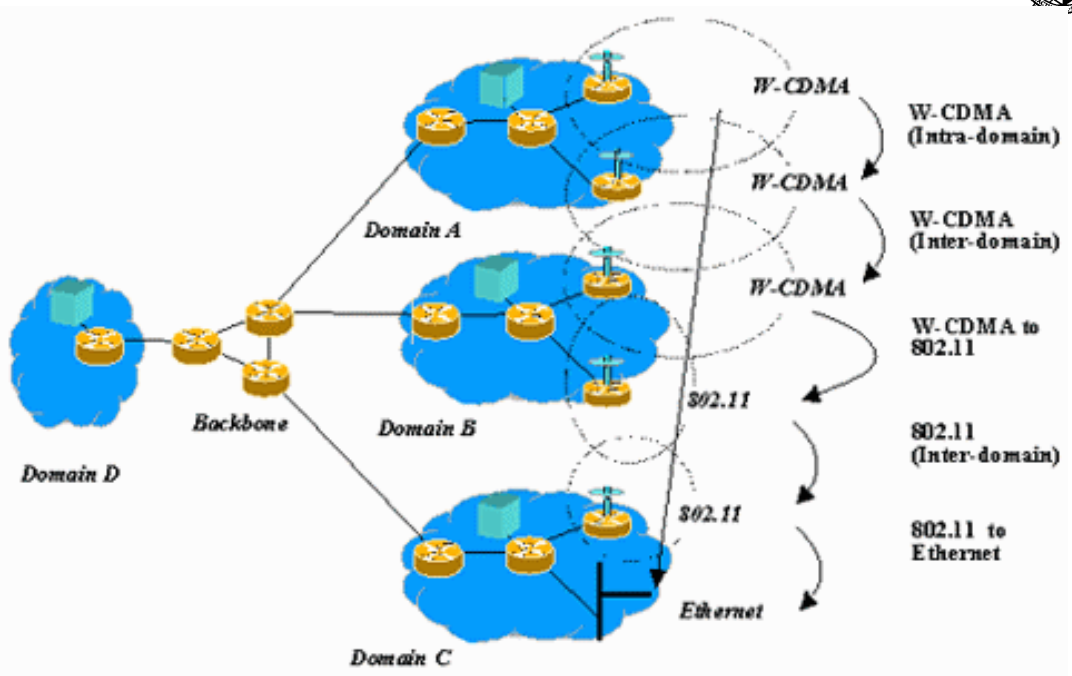
4 Xbox trials,
4 Quake trials



Moby Dick Project

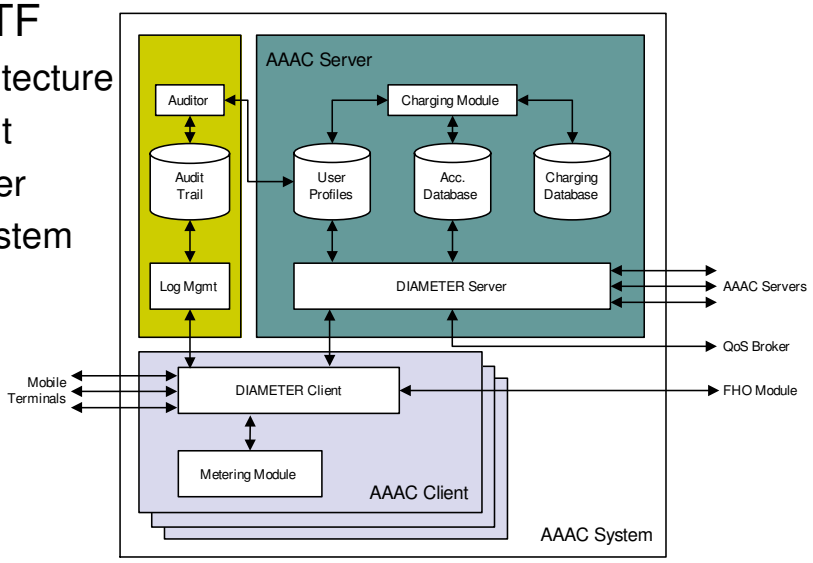
- **Mobility and Differentiated Services in a Future IP Network (Moby Dick)**
- EU funded project (2000-2003)
- Definition of a common architecture integrating QoS, IPv6 mobility, and AAA (out of the separate architectural approaches currently provided by the IETF)
- QoS: bandwidth broker, Diffserv
- Mobility: mobile IPv6, fast horizontal and vertical handovers
- AAA = Authentication, Authorization, Accounting (+Charging)
- Trans-European trial to test the implementation by using SOKRATES-ERASMUS exchange students as test-users
- http://www.ist-mobydick.org (successor www.ist-daidalos.org)

Moby Dick Project

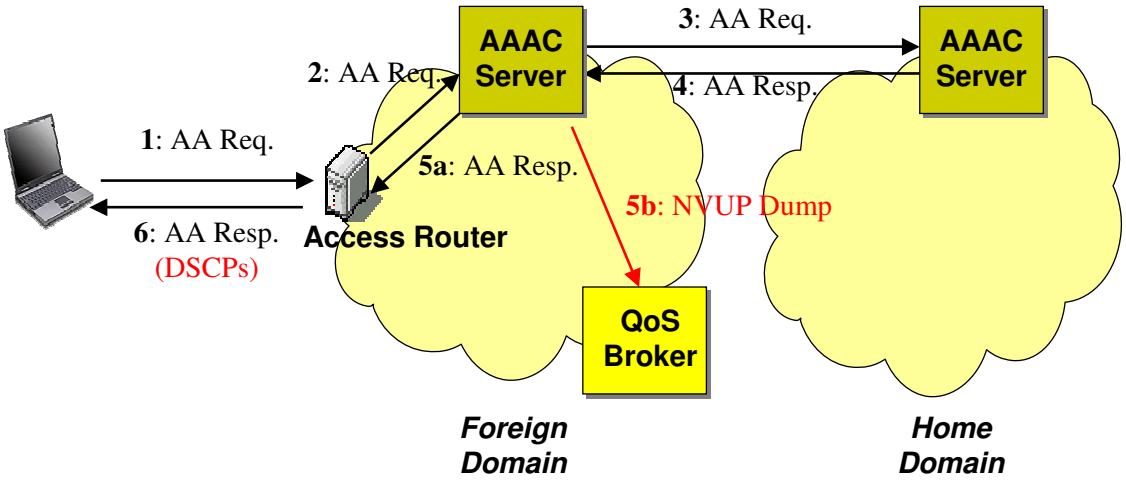


Moby Dick - AAA

- Enhancement to IETF and IRTF
  - AAAC Architecture
  - AAAC Client
  - AAAC Server
  - Auditing System
- Protocols
  - DIAMETER
  - URP
  - COPS

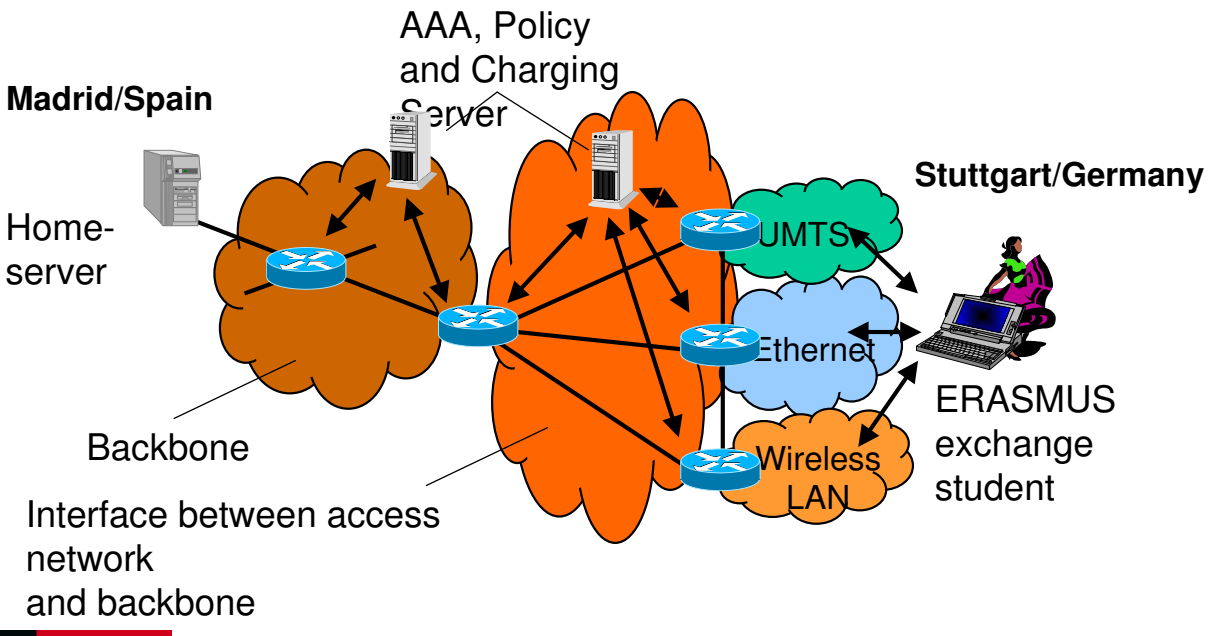


Moby Dick - AAA



NVUP (Network View of the User Profile) = Class of Service, Bandwidth, Priority, Timeout

Moby Dick - Trials



BIB3R Project

- **Berlin´s Beyond-3G Testbed and Serviceware Framework for Advanced Mobile Solutions (BIB3R)**
- German Science Ministry funded (2003-2006)
- Our contribution
  - Authentication, Authorization and Accounting (AAA)
    - Layer 2 (Network Access) and Layer 3 (Mobile IPv6)
    - Single sign-on and central point of administration
    - Seamless mobility, intra/interdomain handover
    - Using existing (extended) IETF standards (RADIUS, Diameter)
  - IP Performance Measurement
    - Measure QoS for traffic engineering/network planning, Service Level Agreement (SLA) validation, adaptive applications
    - Non-intrusive real-time one-way measurements (IPv6)
    - Support performance metrics standardized by IETF (IPPM)
- http://www.bib3r.de

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IETF Standardization

- **IPFIX (IP Flow Information Export)**
  - Protocol for exporting IP flow (and packet) information
- **AAAARCH (Authentication, Authorization, Accounting Architecture Research)**
  - Next generation AAA architecture
- PSAMP (Packet Sampling)
  - Packet Sampling Framework
- IPPM (IP Performance Metrics)
  - OWD, OWL, RTT, bulk transfer capacity, IPDV
- AAA (Authentication, Authorization, Accounting)
  - DIAMETER protocol
- PANA (Protocol for carrying Authentication for Network Access)
  - IP-based client authentication protocol

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The End

Thanks for your attention!