



I-Mode Performance Monitoring

Use of ROOT in telecommunications at KPN

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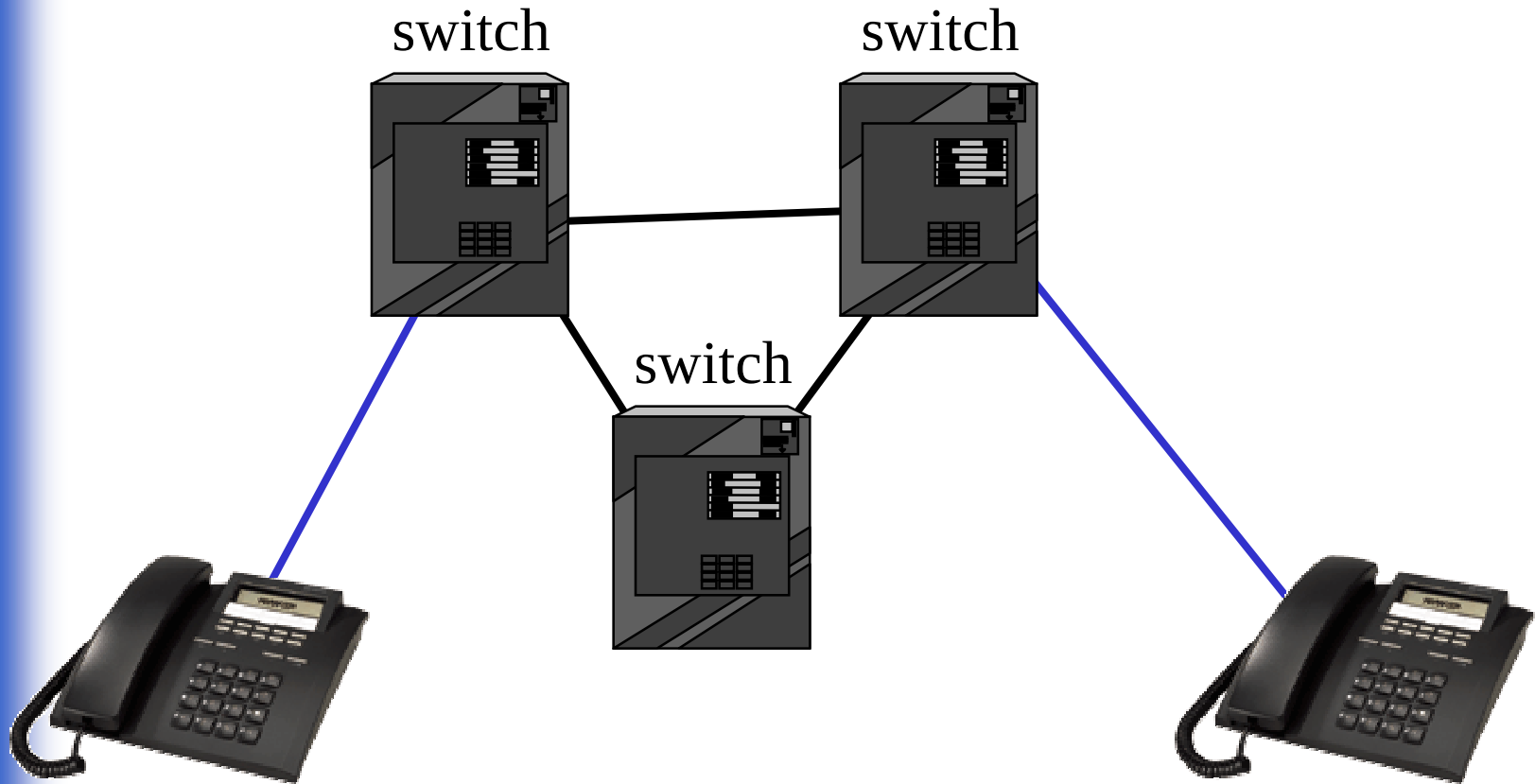
Contents

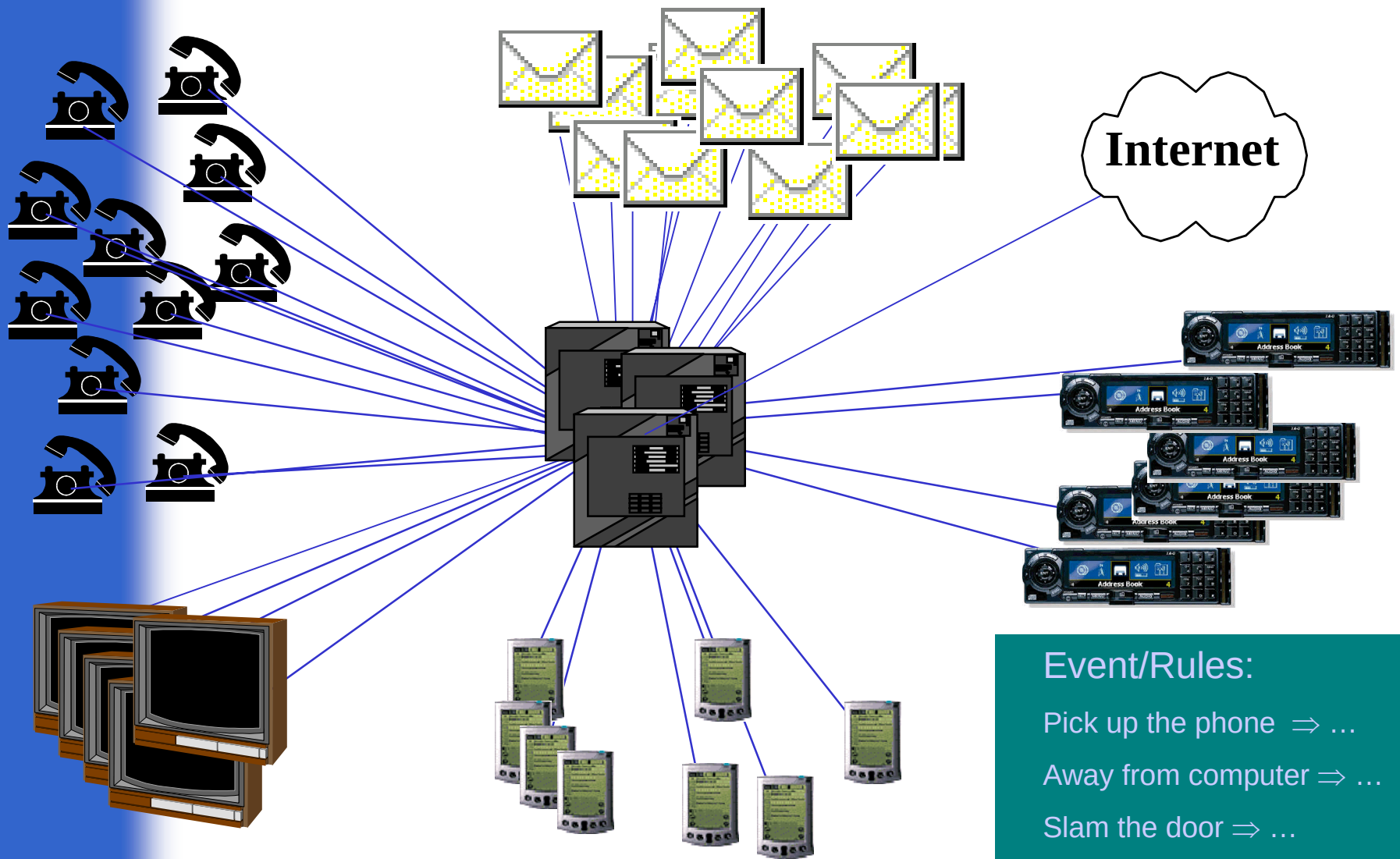
- KPN/KPN Research
- Context
- I-Mode performance Monitoring
- ROOT Usage
- Future developments

What is KPN (Research) ? ♦ ♦ ♦

- Royal Dutch Telecommunications Company
- KPN Research
 - R&D organisation of KPN
 - 350 People (average age 29 years)
 - To become part of TNO, the Netherlands organisation for applied scientific research.

Standard Telecommunications Network





Event/Rules:

Pick up the phone $\Rightarrow$...

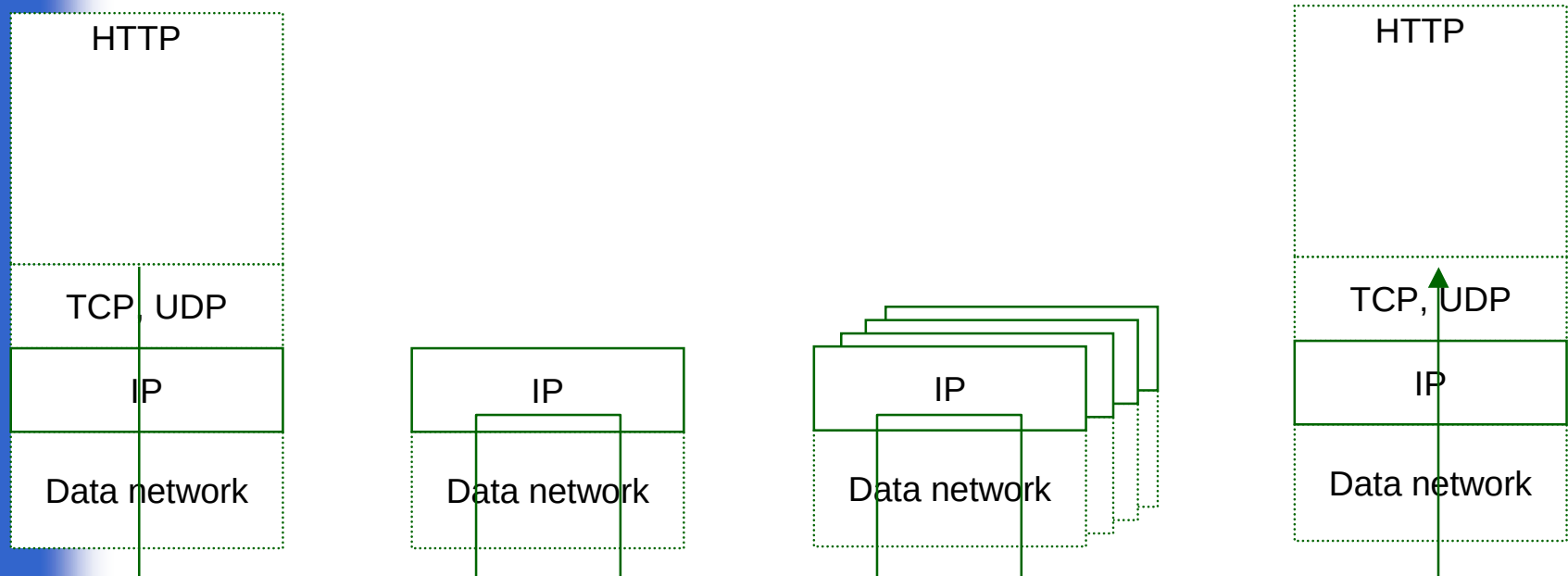
Away from computer $\Rightarrow$...

Slam the door $\Rightarrow$...

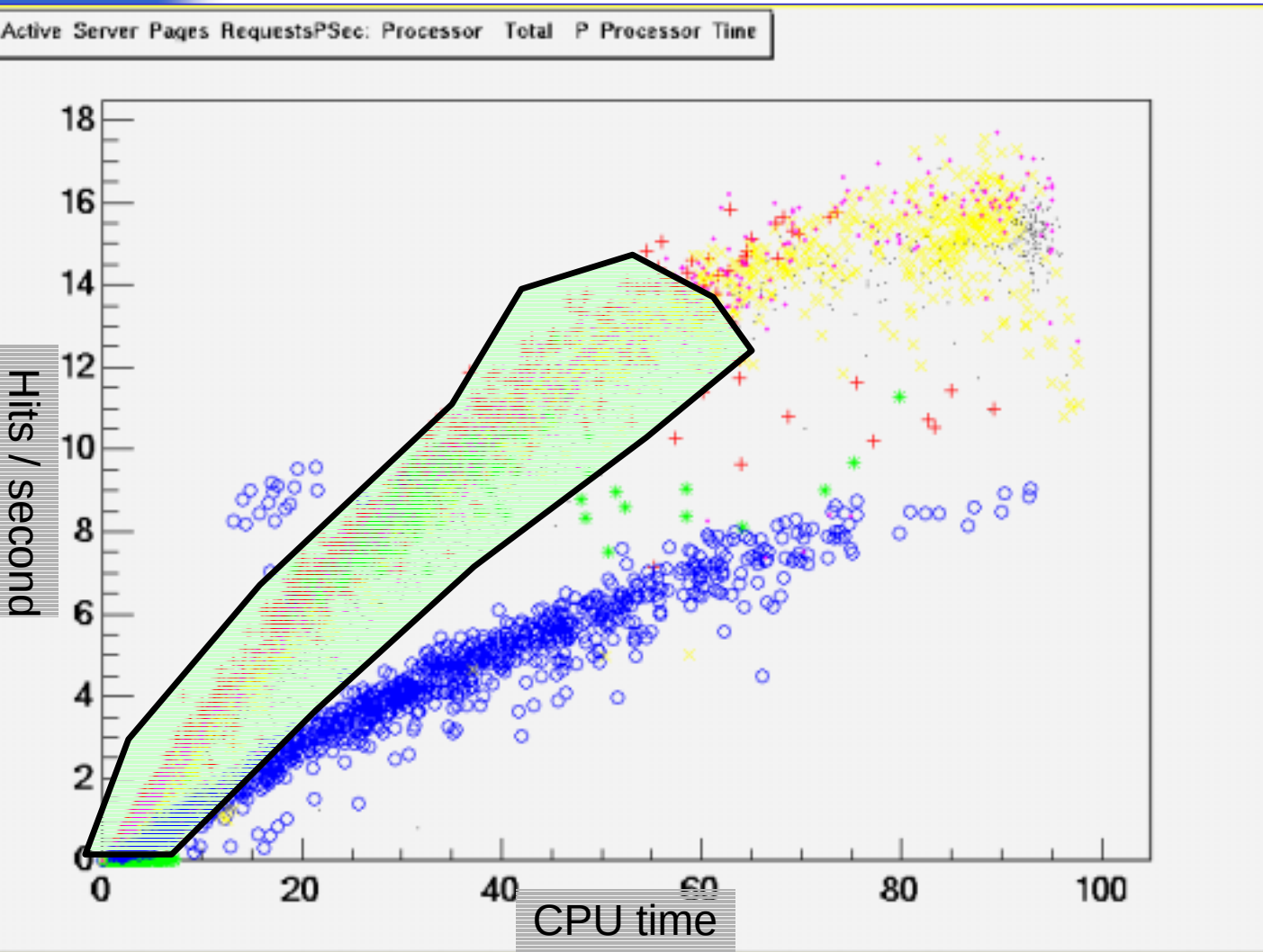
No answer $\Rightarrow$...

Understanding Large Telco Infrastructures

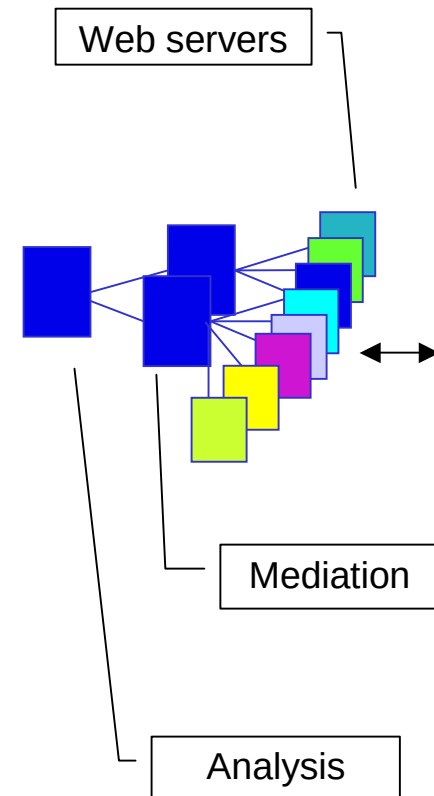
- Systems grow complex
 - Measure what is going on
- Systems are in a hostile environment
 - Measure who is doing what from where
 - Correlation between different layers



Measuring: Key Performance Indicators (KPI)



ication



I-mode Performance Monitoring

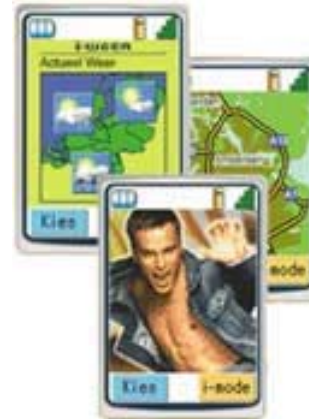
- Wireless Internet via Mobile Phone
 - Web Browsing
 - E-Mail
- Introduced in Japan by NTT DoCoMo in 1999 (now 30 million subscribers)
- Introduced in Germany, Netherlands, Belgium in 2002

COMMERCIAL BRAKE



I-Mode Applications

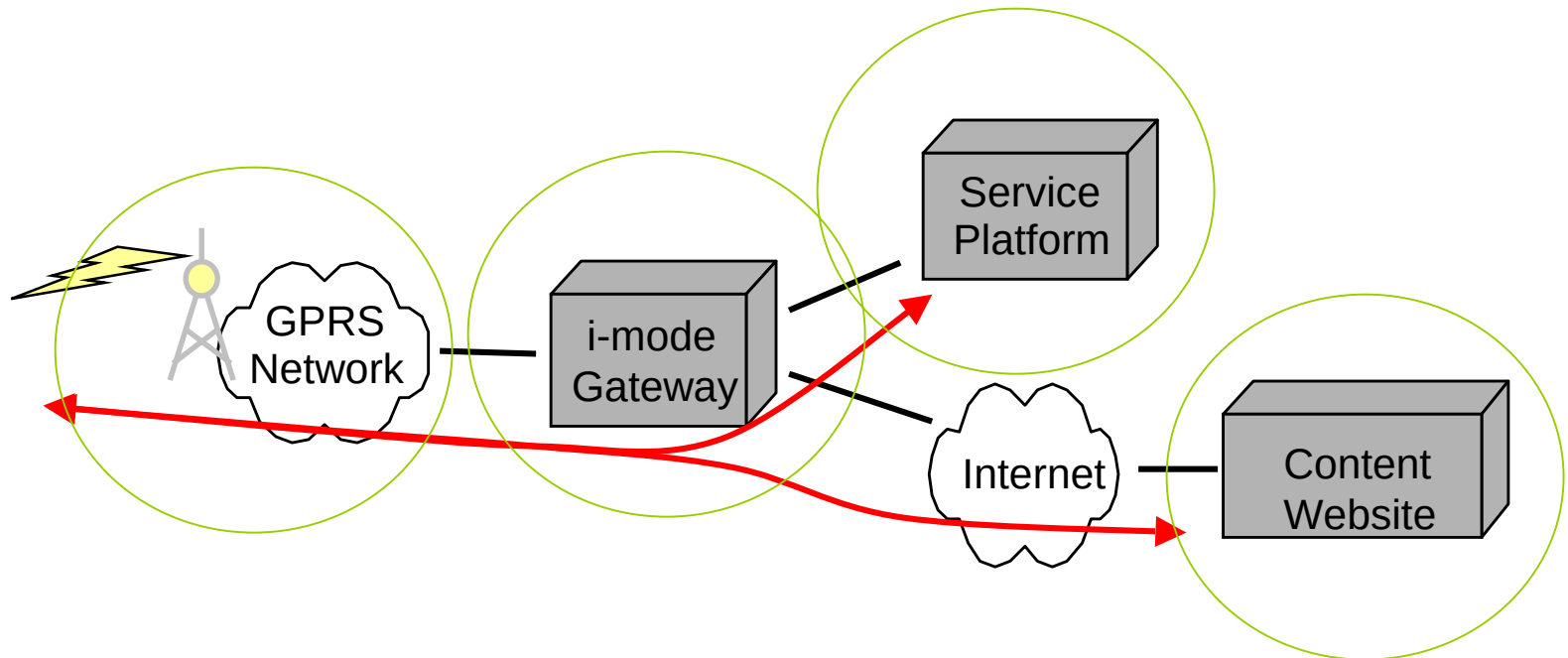
- Ringtones
- Images
- Weather
- News
- Stocks
- Games
- Maps/Route/Travel
- Full Internet Access
- X-Rated Content



I-Mode Platform Overview



*I-mode
terminal*



What is the enduser experience ?

I-Mode Management Issues

- When do we have to upgrade the capacity of our i-mode gateway ?
- Is a change in quality caused by i-mode service platform, Internet, GPRS network ?
- What is the quality of our service compared to one day, week, month or year ago ?



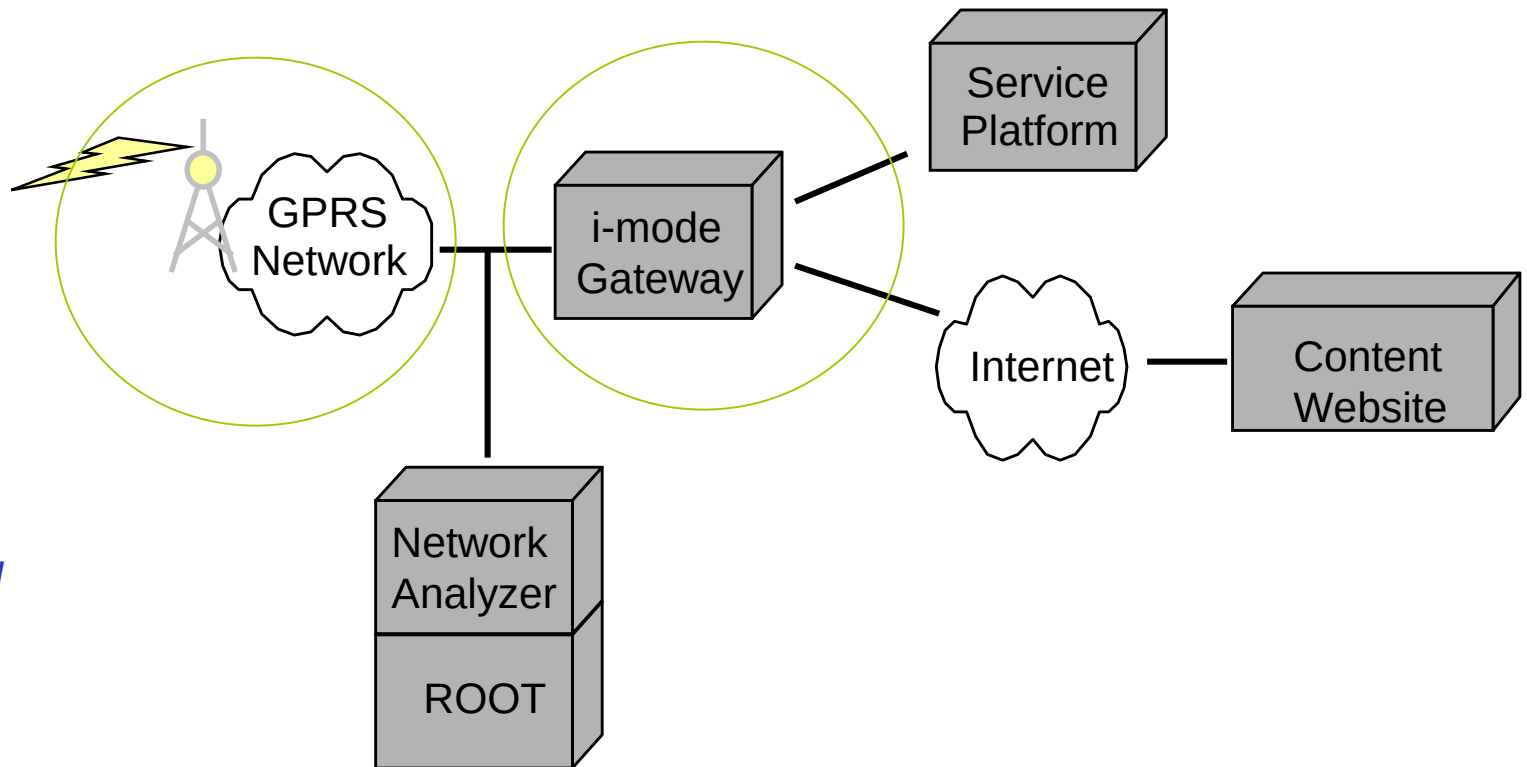
GPRS Network

- I-Mode is based on the GPRS Network
- Faster data transfer
- Packet Switched Network
 - Mobile phone 'has' IP-Number
 - Always on
 - 'You only pay for data transferred'

MLPA



*I-mode
terminal*

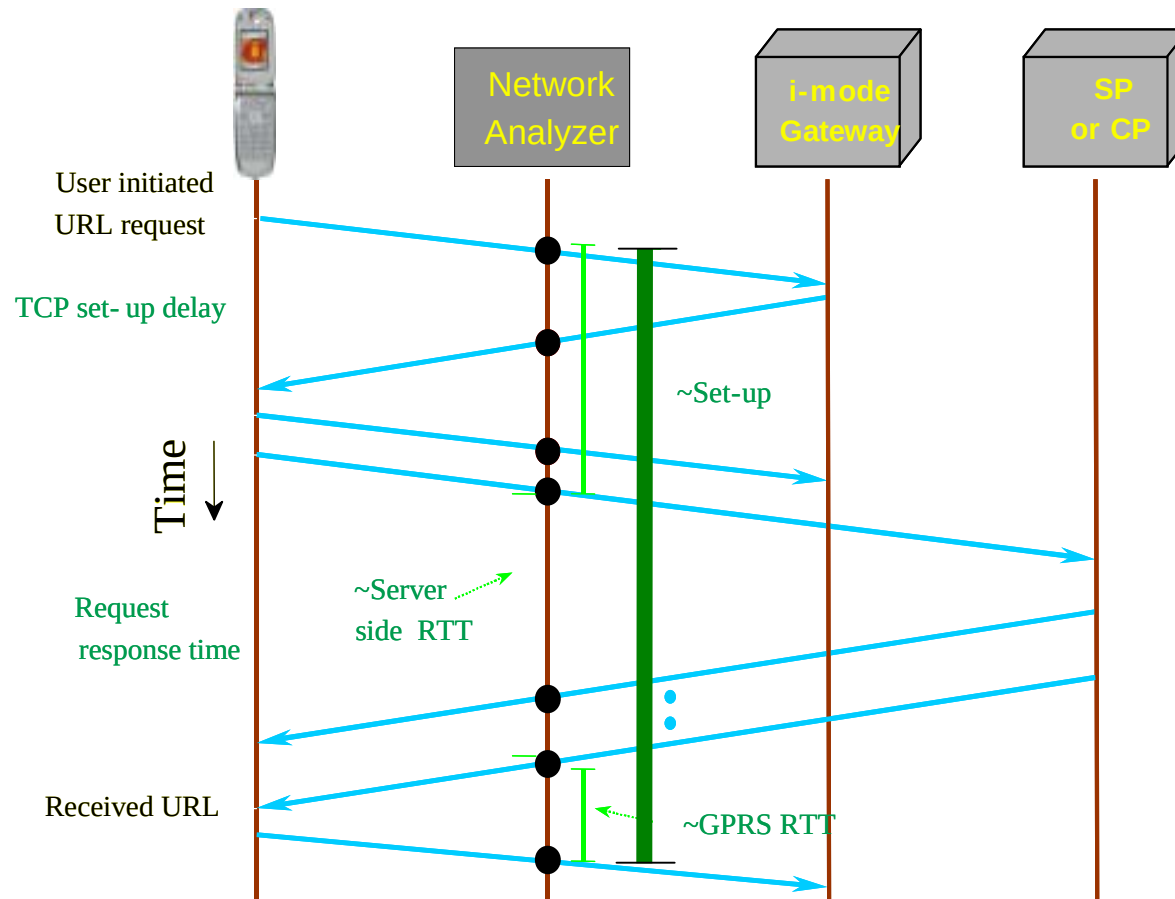


MLPA



- Multi Layer Packet Analysis
- Capturing and Storage of:
 - timestamped TCP/IP Headers
 - timestamped HTTP Headers
- Correlating TCP/IP and HTTP
 - HTTP 'transactions'
- Calculation of
 - 'End-to-End' response times
 - Responsetime as experienced by user
 - HTTP arrival rates
 - tcp/ip quality
 - ...

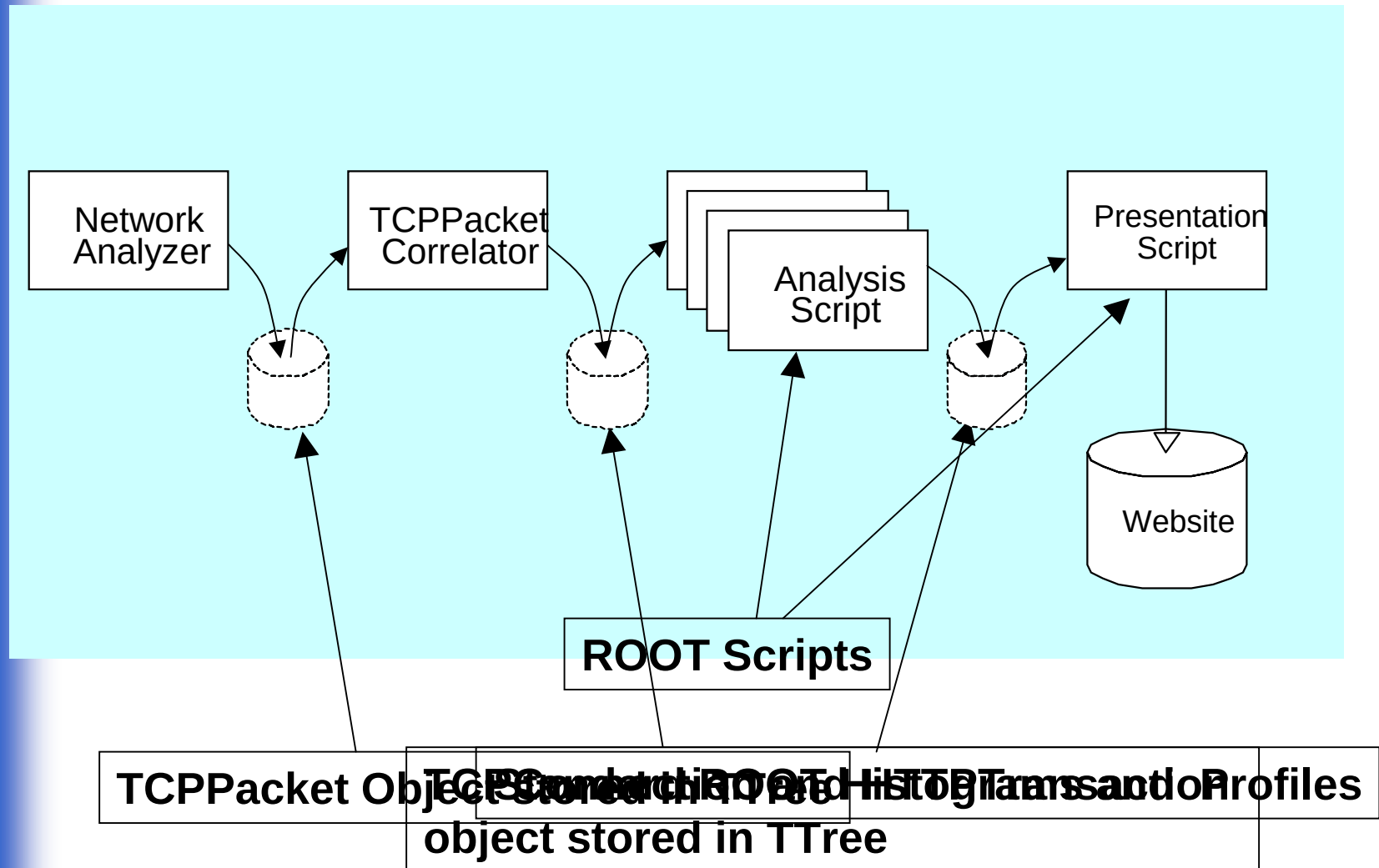
Correlating TCP/IP and HTTP Traffic



Technical MLPA details: Software

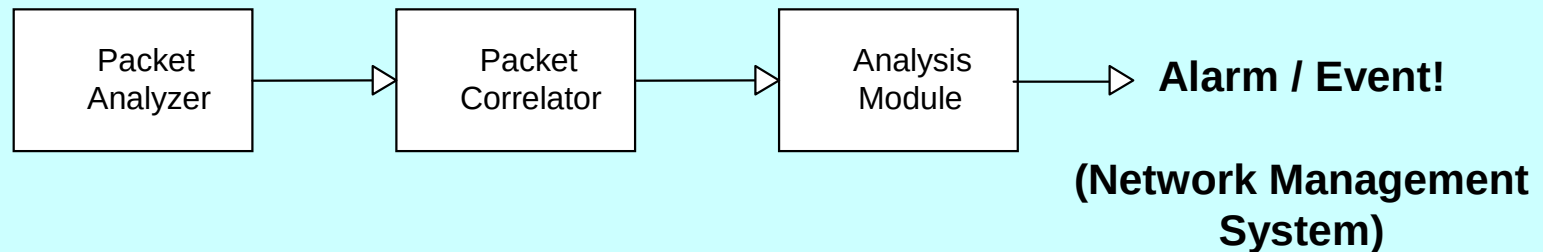
- 1. Packet Analyzer
 - Save time-stamped TCP/IP and HTTP Header information
- 2. Packet Correlator
 - Calculate TCP/IP to HTTP Correlation
 - TCP Connections
 - HTTP Transactions
- 3. Analysis modules
 - HTTP request arrival rates
 - HTTP response throughput
 - End-to-end HTTP response time (time-plots, distributions, statistics)
 - TCP statistics
 - Retransmissions, fragmentation, connection setup time
- 4. Presentation Module
 - Convert analysis results to html format
 - ... (presentation to other output formats/databases/...)

Standard MLPA monitoring & analysis process ♦ ♦



SLA monitoring

Real-time MLPA analysis process



Realtime Event Based Operation

Network Management

Implementation



- Installation
 - Attached to 'monitoring port' of incoming/outgoing router (G_i interface between GGSN and i-mode gateway).
- Software
 - Database, Object I/O: ROOT (<http://root.cern.ch>)
 - Network Analyzer: Libpcap (ethereal, tcpdump)
 - Graphics conversion: Imagemagick
 - Administration: ssh
- Supported operating systems
 - Unix based (Linux, Solaris)
 - W2K
- Security options
 - TCP/IP anonimisation
 - HTTP header cleanup (XID, Cookies, Content, Form Variables)

Demonstration

ROOT



- Rapid Development through scripts
- Trees, Histograms, Profiles
- No modelling/simulation (outside root)

Results & Future Work

- Performance Improvements
 - Detection of bugs in TCP stack software
 - Comparison between different terminals (speed)
 - Network optimisation
 - Future versions of platform/terminals
 - Many more
- Introduction in operational environment
 - Realtime alarm generation
 - Connection to network management software
 - SNMP, SOAP,...
 - Stability

