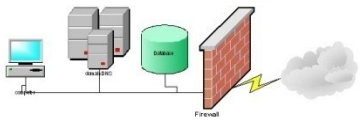
Management of Information Systems

VITMA C02

BME TMIT

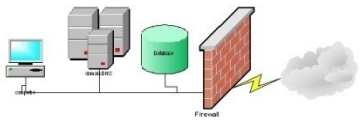
Department of Telecommunications and Media Informatics



Lecturers

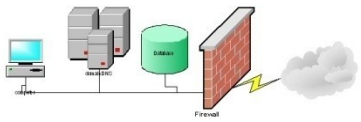
- Dr. Gusztáv Adamis
- Dr. Pál Varga

- Content provided by
  - Dr. Gábor Magyar (Head of TMIT)
  - István Maradi (CTO of Magyar Telekom)
  - György Piszker (Head of IP group, MT)
  - Zsolt Kocsis (Leader of Sys Mgmt Experts, IBM)



Important dates/times

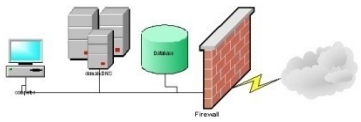
- Lecture:
  - Monday *every week* 14:15-16:00 – Q.B.F11
- Laboratory practise – ONE occasion
  - April 3rd (12:15-16:00)
  - Building „I” arm „B” floor 2nd, room IB210
  - Linux-based System administration



Midterms

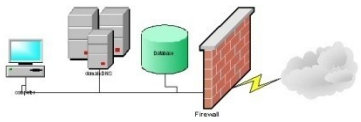
- 1st: April 20th – 14:15, QBF11
- 2nd: May 11th – 14:15, QBF11

- Re-take of _ONE_ of the midterms:
  - May 18th - 14:15, QBF11



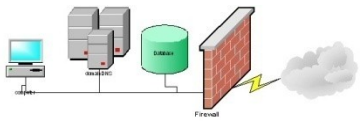
Telecommunications Management Network (TMN)

- overview -



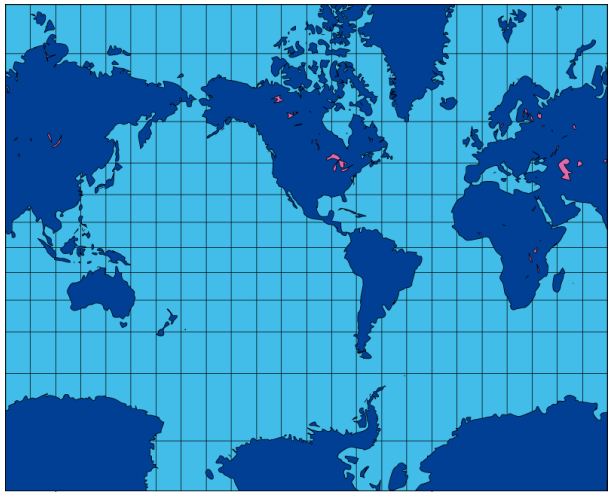
Overview

- Short summary (quality of network services)
  - o Expectations (network serices)
  - o QoS, SLA and SLS (SLSpecification)
  - o end-to-end QoS, user satisfaction, QoE
- TMN – The first standardized telecommunication-management system
  - FCAPS
- Network control methods
  - o Traffic monitoring
  - o Service level analysis
  - o Fault Management

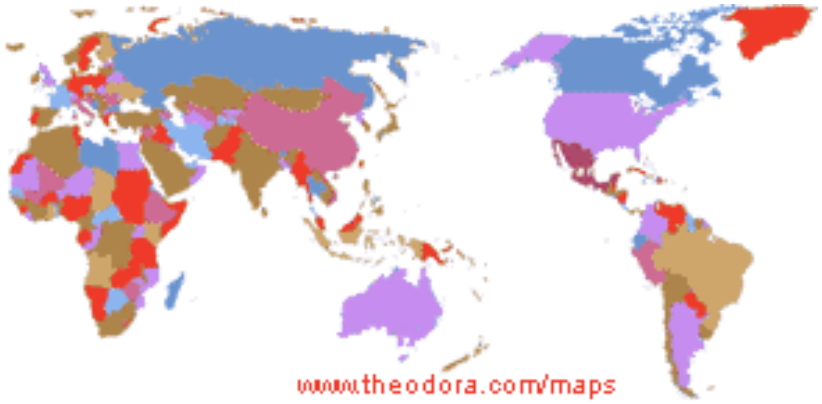


Basic problem: Local and global point of view

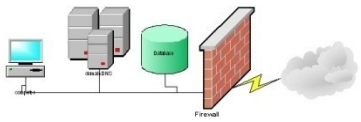
The world from Europe,



from America,



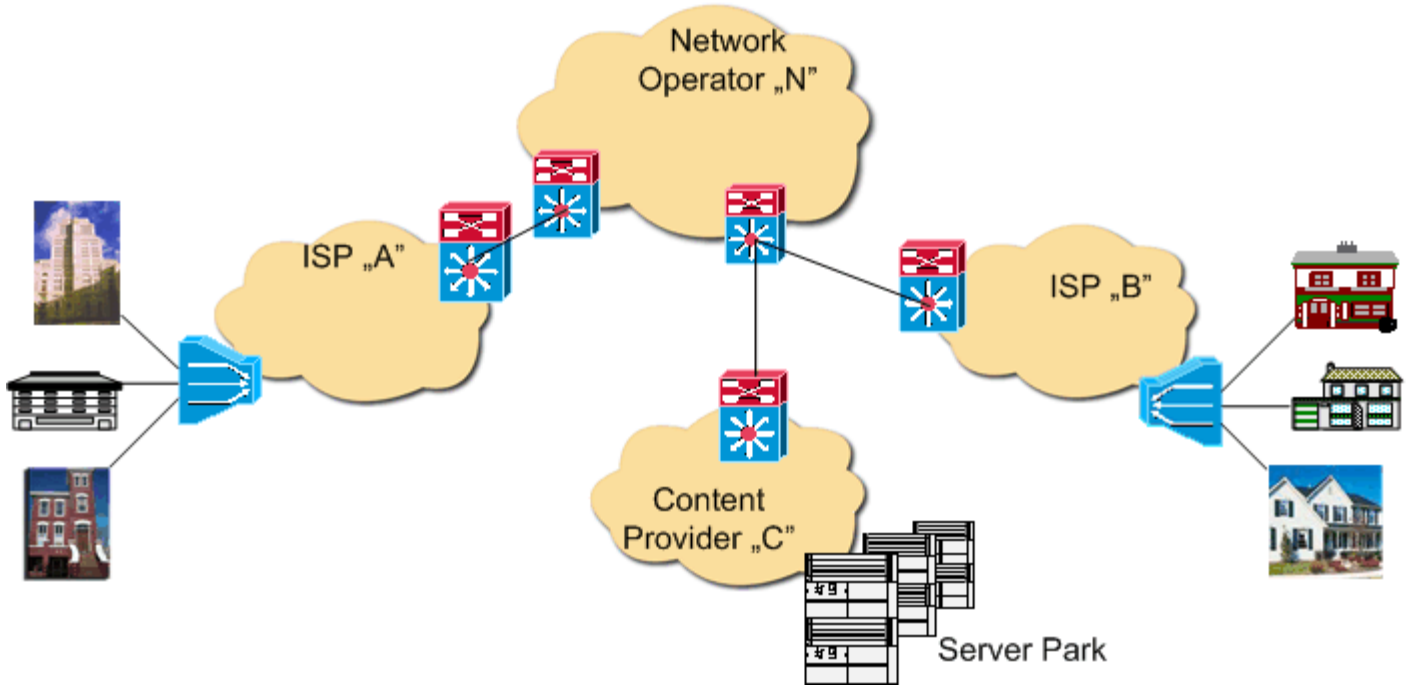
… and Australia



Global „end-to-end” view of the network services

The user satisfied with the services, if

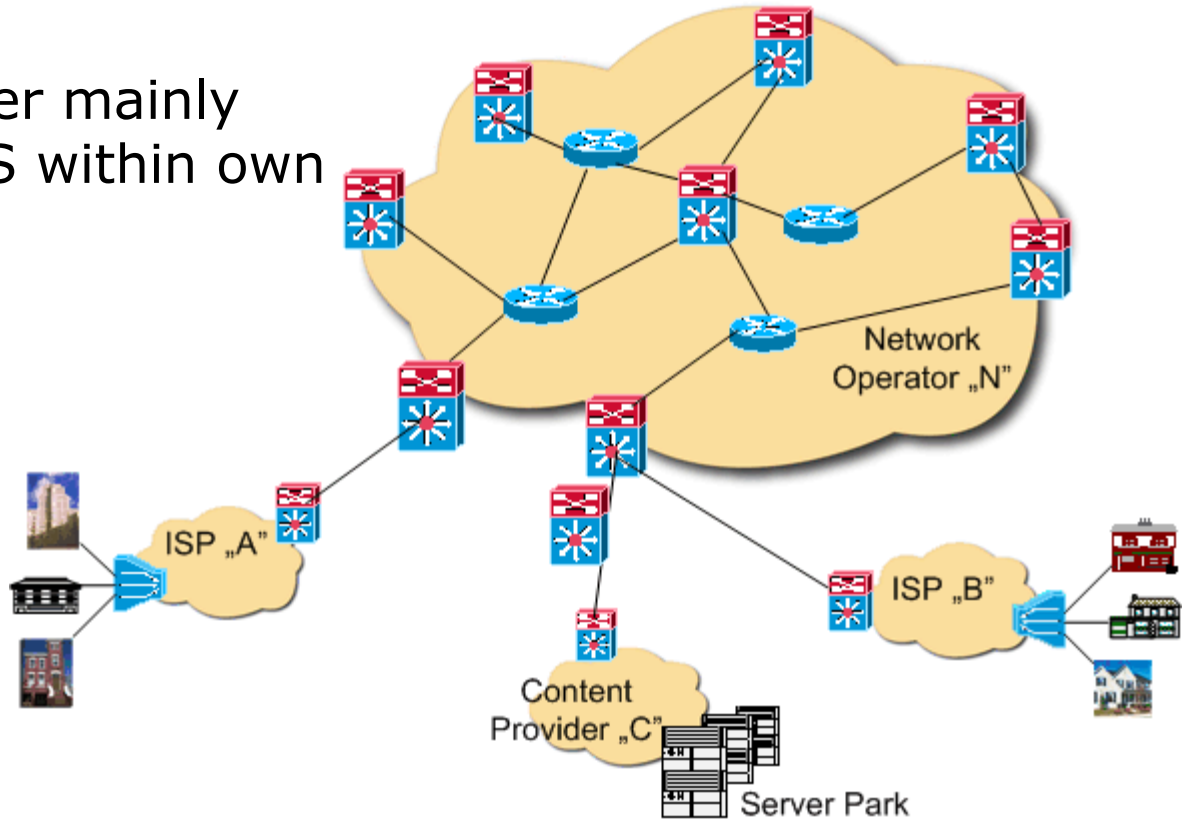
- ☑ his requests are **served**,
- ☑ the **Quality** of Service is satisfactory,
- ☑ the periodic problems **are settled** soon.



The world from the network provider's view - 1

The network provider mainly concentrate the QoS within own network inside…

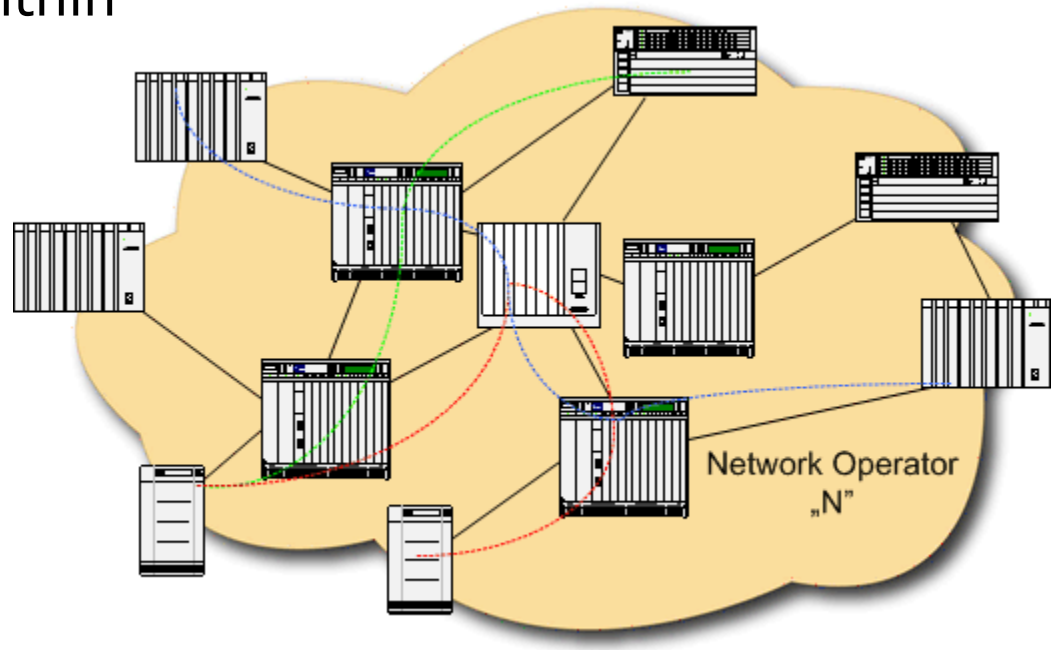
…in lucky case!



The world from the network provider's view - 2

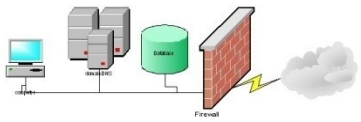
…in a not so lucky case…

The network provider exclusively concentrates on the QoS within own network!!



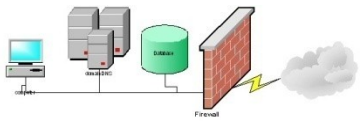
Quality of Service

- Tipical measures:
  - Availability
  - Throughput
  - Delay
  - Jitter
  - Packet loss



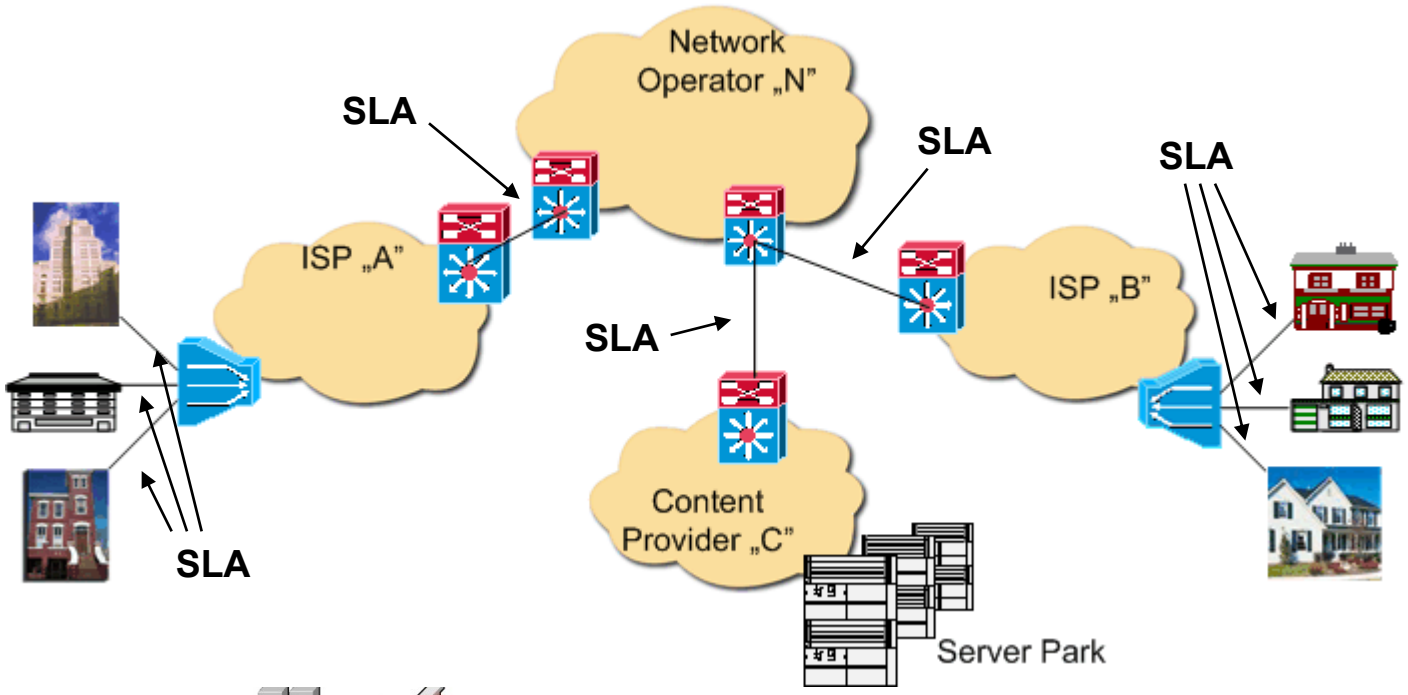
Availability

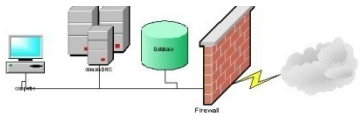
- Manipulating facts of service availability
  - Network availability
    - Physical level, data link level, etc…
    - Network elements
  - Service provider's factor
    - System error



Agreement about the service level -1

- SLA: Service Level Agreement
  - This is the **CONTRACT**
    - between the service- and network-operators
    - between the subscriber and the local service provider



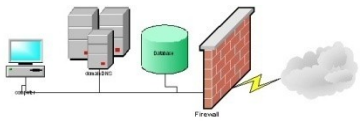


Agreement about the service level - 2

- …The „technical appendix” of the SLA is

  SLS: Service Level Specification

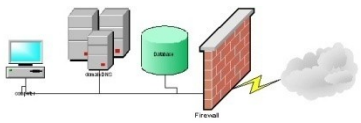
  – The definition of the technical „quality” of service…
    - Throughput - [kbps]
    - Delay
    - Jitter
    - Packet loss rate
  – … and non technical QoS…
    - Availability
    - problem-solving timeframe
  – …parameters and its thresholds.



Quality of Experience - QoE

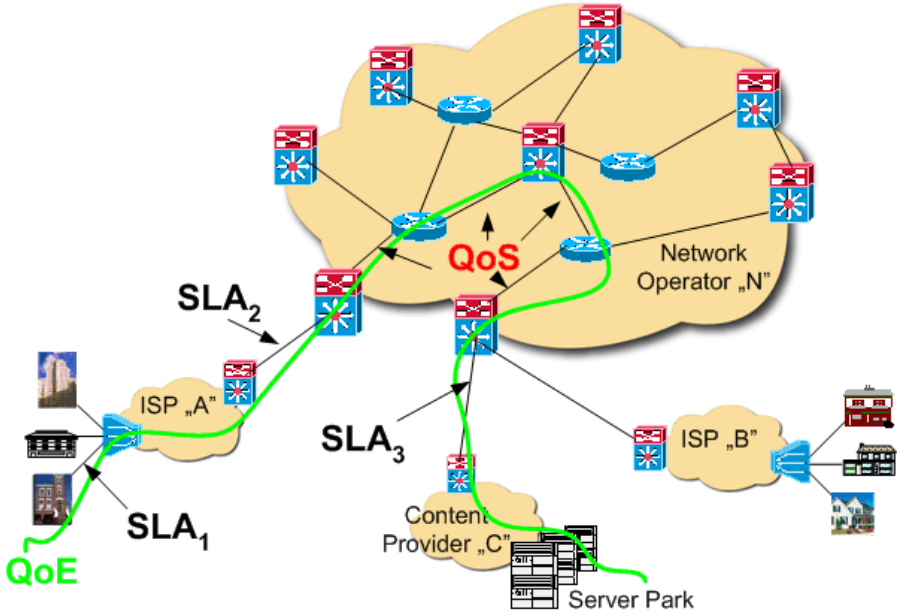
- The user want to use the network services „undetected way” of the network capability.
- The user satisfaction of the network services (QoE) depnds on subjective thresholds.

- Type of QoE:
  - service accessibility
    - Operability of the basic access
    - Application is accessible? Does it answer? (at least once)
  - quality of service
    - „expectations up services”
    - different thresholds by services / „end-to-end” QoS
  - the solving **timeframe and quality** for the occuring problems

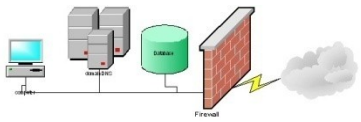


QoE – SLA – QoS

…is there a link between them in the real life?

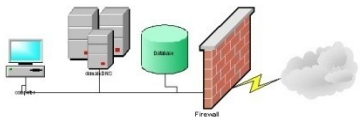


- If not, then in point of „Service-level management” we do not prove a broken reed to the network!
- We need a permanently and reliable working **monitoring system!**



Network monitoring methods

- The TMN theory
  - Logical model:
    - Business-, Service-, Network-, Element-, Network-element-levels
- Traffic monitoring – levels and methods
- Service-level analysis
- Fault management
  - event
  - alarm
  - Event-processig
  - Error-searching



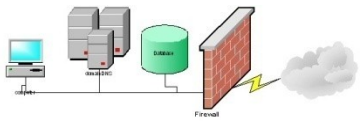
TMN – Telecommunications Management Network

„With TMN the service providers can manage the
- operating systems
- network elements
- network types

over various connection types and communication models.”

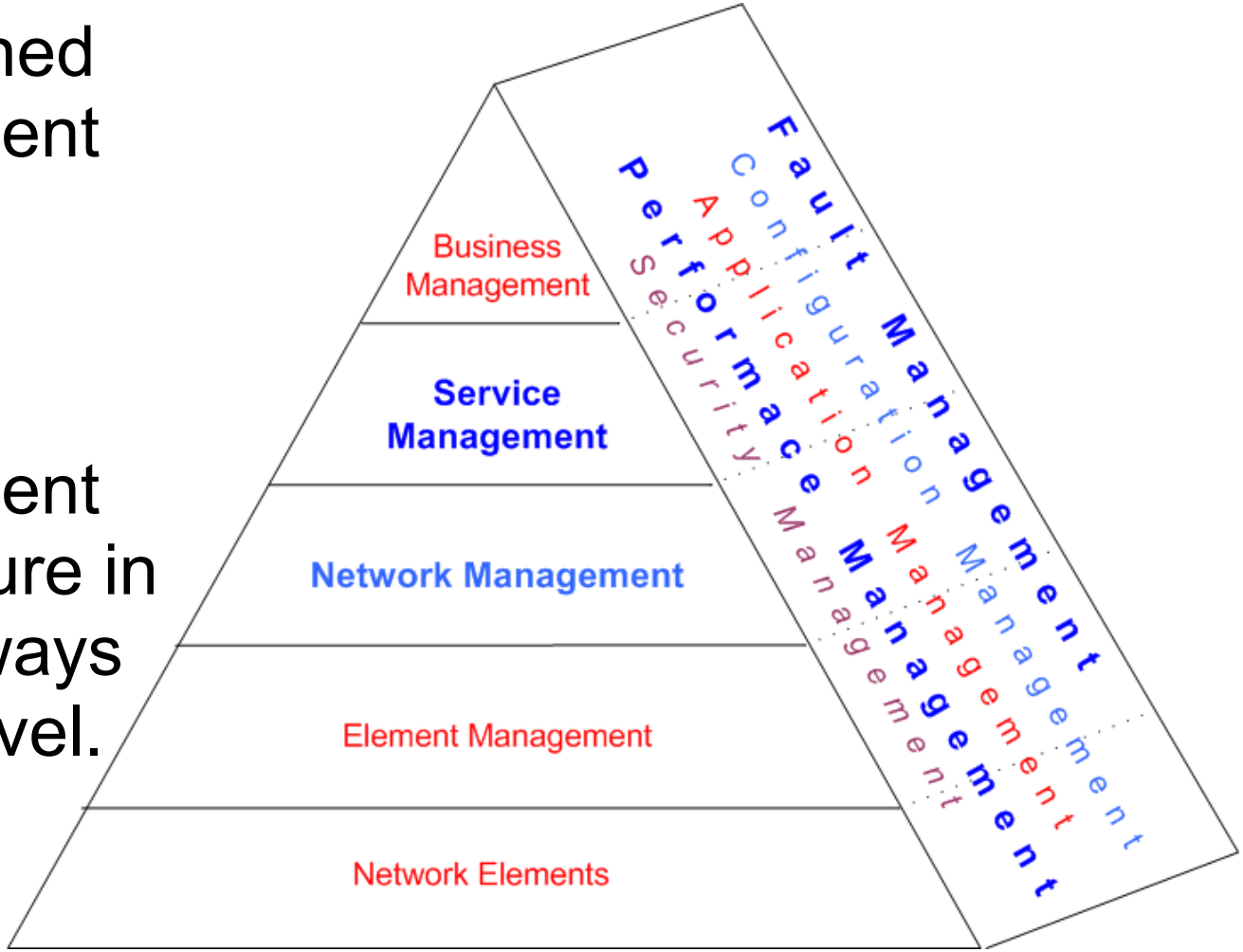
The TMN gives (ITU-T M.3010)
- functional model
- **logical model**
- standard interfaces

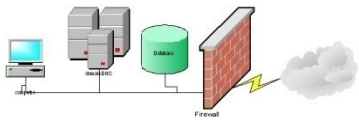
To solve the problem occures in the network management.



TMN: logical model

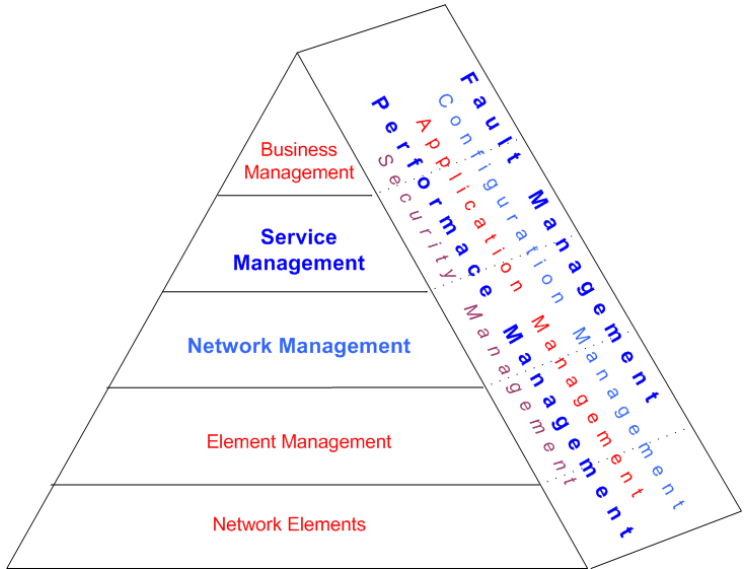
- Well defined management levels
- The same management tasks occure in different ways at each level.

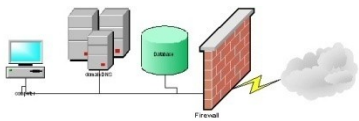




TMN – Business Management

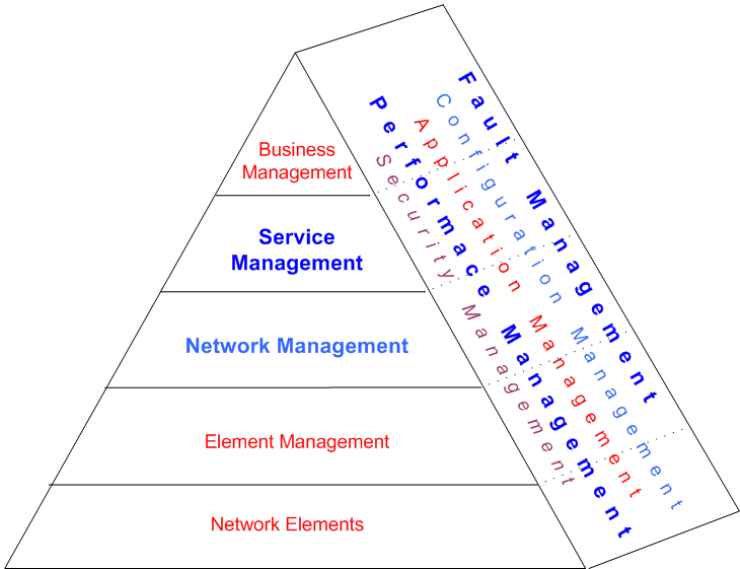
- High level planning
- Budget planning and checking
- **Goal definition**
- Decision-making
- Business Level Agreements – BLAs

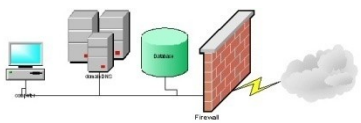




TMN – Service Management

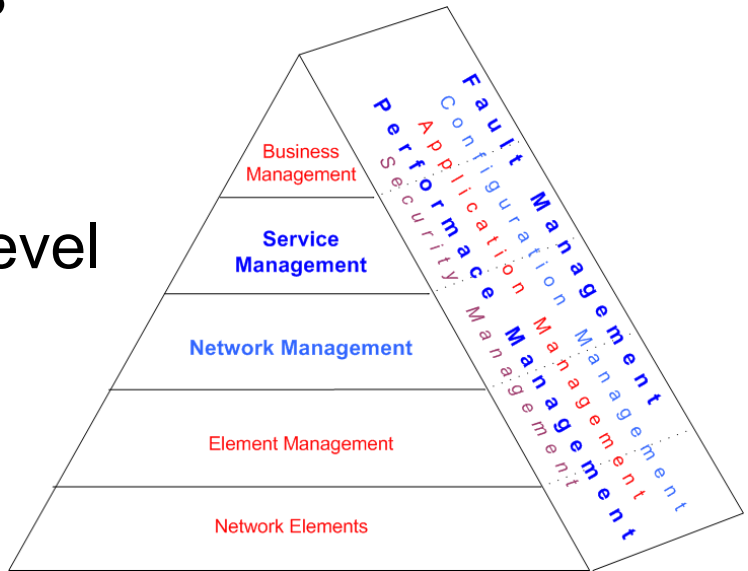
– Keep in touch with the subscriber:
  - service installation and modification
  - billing tasks
  - service quality monitoring and performance (PM)
  - fault management (FM)
– Usage of network level information to support the SLAs between
  - subscriber and
  - other service providers.

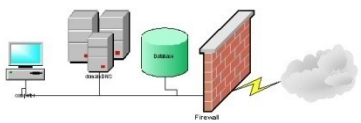




TMN – Network Management

- Monitoring and controlling tasks management of the network, as a separate functional unit
  - each network elements quality
  - network segments
- Usage of arriving information from the network elements
  - network level error – and performance management
  - preparation of the service level tasks

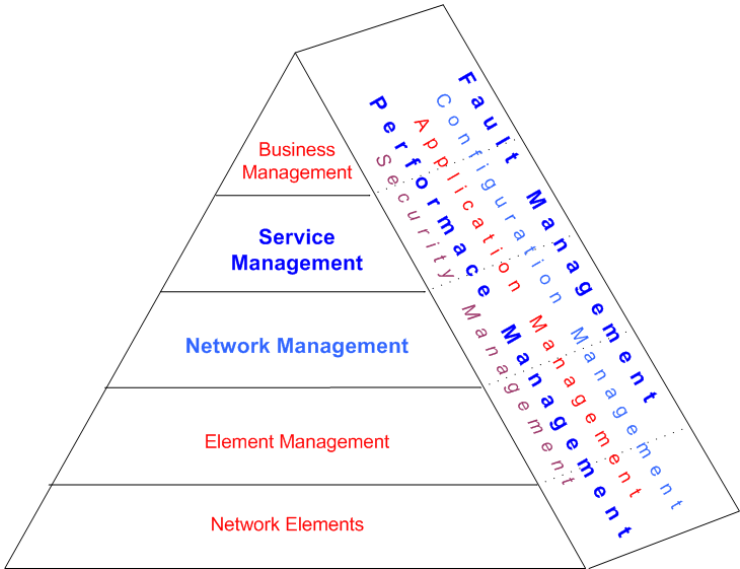


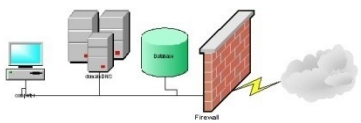


TMN – Element Management

- Each network element, as an individual machine with many functionalities
- Monitoring and controlling tasks

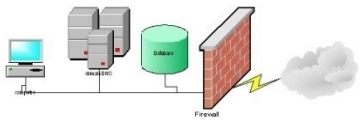
- Typically the system manager's responsibility



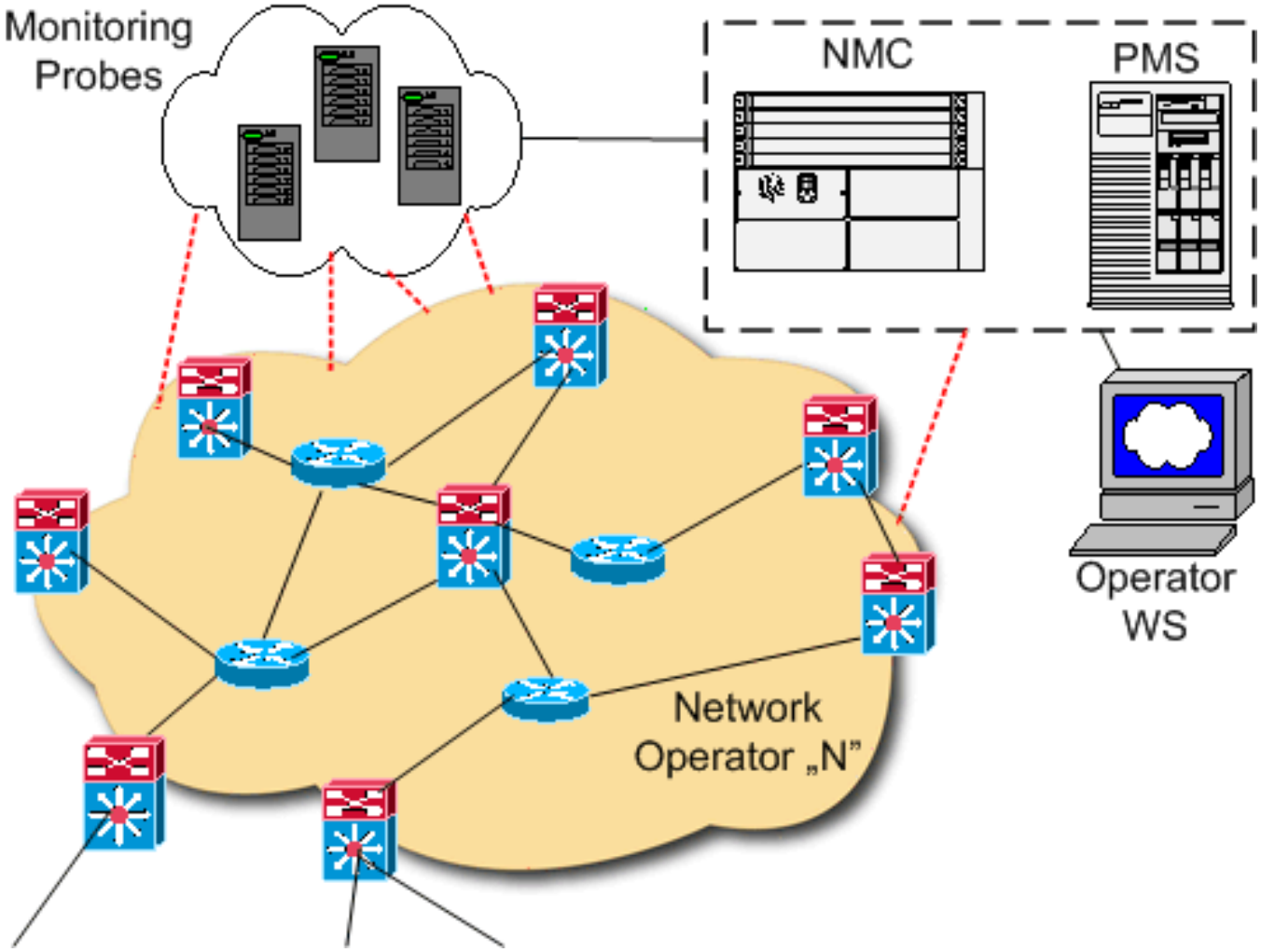


TMN FCAPS

ISO Telecommunications Management Network



TMN FCAPS – monitoring network

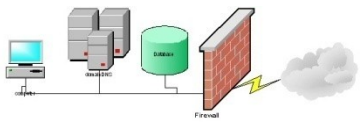


TMN – FCAPS - Fault Management

The FM responsible for service availability.

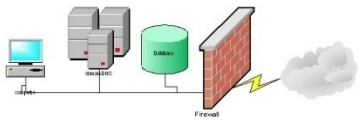
- Event detection
- Event indication to the operator
- Event processing
- Root Cause Analysis
- Fault correction

- Correlating events
  - monitoring and
  - registering.



TMN – FCAPS - Fault Management -2

- The information from the system elements can be Push and Pull type.
  - Examples inside SNMP messages:
    - Push: SNMP trap
    - Pull: SNMP Get, Getnext, Getbulk…



TMN – FCAPS - Configuration M'gmnt

The goals of configuration management include:

- to gather and store configurations from network devices (this can be done locally or remotely) & service & business.
- the modification of network elements, network, service, or business

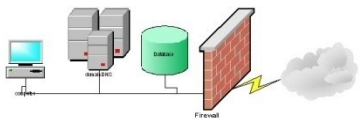
Include:

- Source-utilization
- Network maintenance
- Backup and Restore database handling
- Topography-exploration and record-handling
- Modification-management
- Device- and storage-database (Inventory)

TMN – FCAPS – „A” Management

„A” means:

1. **Applicaton:** Compatibility and update management on applications running in network elements.
    - » Note!, „middleware”!
    - » Management of server application
    - » Update monitoring
2. **Accounting:** Accounting is often referred to as billing management. The goal is to gather usage statistics for users. Using the statistics the users can be billed and usage quota can be enforced.
3. For non-billed networks, "**administration**" replaces "accounting". The goals of administration are to administer the set of authorized users by establishing users, passwords, and permissions, and to administer the operations of the equipment such as by performing software backup and synchronization.



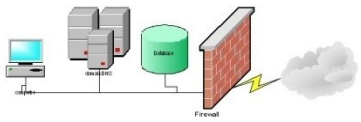
TMN – FCAPS - Performance M'gmnt -1

Performance management enables the manager to prepare the network/service/business for the future, as well as to determine the efficiency of the current network/service/business.

- General tasks
  - Collect the performance indicators (QoS vs. KPI vs. KQI)
  - Evaluation and
  - Indicate when exceed the threshold level
  - Bottlenecks localization in the network and the system,
  - Minimize the bottlenecks effects

- Utilization operational „intelligence" :

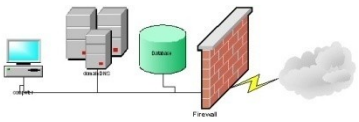
  Bottlenecks types, and they elimination (Action Plan…)



TMN – FCAPS - Performance M'gmnt -2

- System administrator's everyday tasks :
  - Performance-data collection
    - Passive
    - Active

    - Simple counted statistics
    - Correlative, derivative statistics
  - Performance-report
    - generate,
    - collection,
    - archived.
  - Performance data-evaluation
  - Threshold maintnance, overload monitoring
  - Indicate problems (like in FM)



TMN – FCAPS - Security M'gmnt -1

Security management is responsible for protecting the network from unauthorized users and physical and electronic sabotage. Security management is responsible for user authentication and authorization. It also maintains the confidentiality of user information.

AAA:

- Authentication

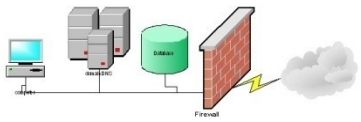
  (username/password)

- Authorisation

  (handling user access/modification authority) ITU-T M.3010

- Accounting

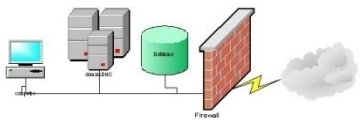
  (billing, data record)



TMN – FCAPS - Security M'gmnt -2

Tasks:

- Authentication system handling, maintenance
- Authorization system
  - Selective source-access hadling
  - User access handling
  - Access log maintenance,processing
- Security event indication
  (event/alarm reporting)
- Security update handling
  (like in configuration management)
- Security audit perfection, modification check



TMN – FCAPS

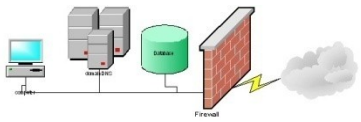
Enlargement on

Network Management

tasks:

Performance Management

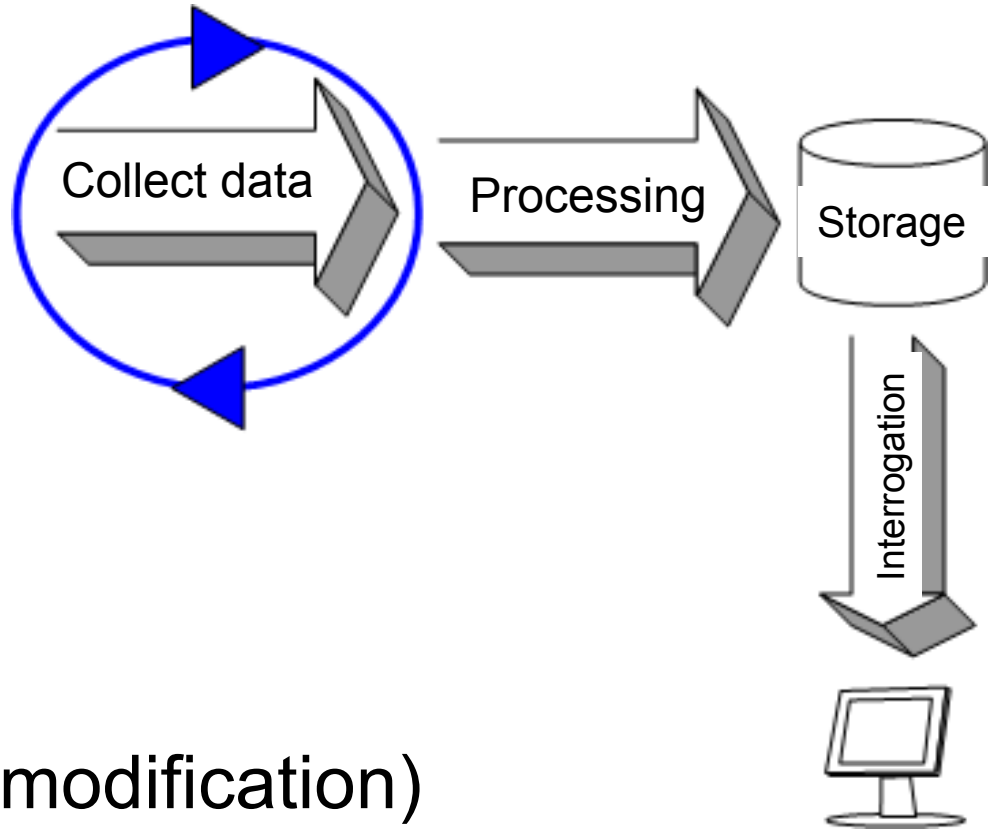
Fault Management



Traffic monitoring

What kind of tasks?

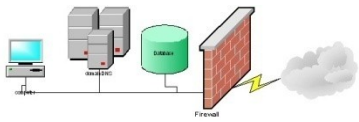
- Network planning
- Network optimalization
- Network monitoring



What does it mean?

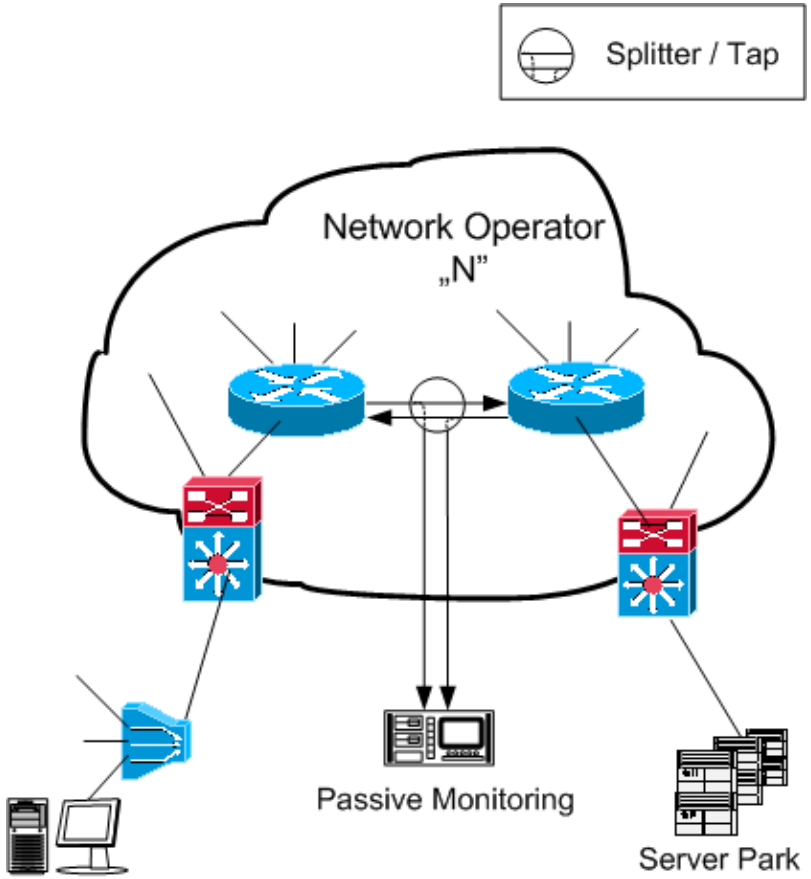
- Attach monitoring equipment
- **Data collection**
- **Data processing**
- Evaluation

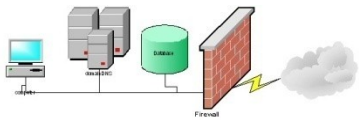
(network/service modification)



Traffic monitoring - Methods

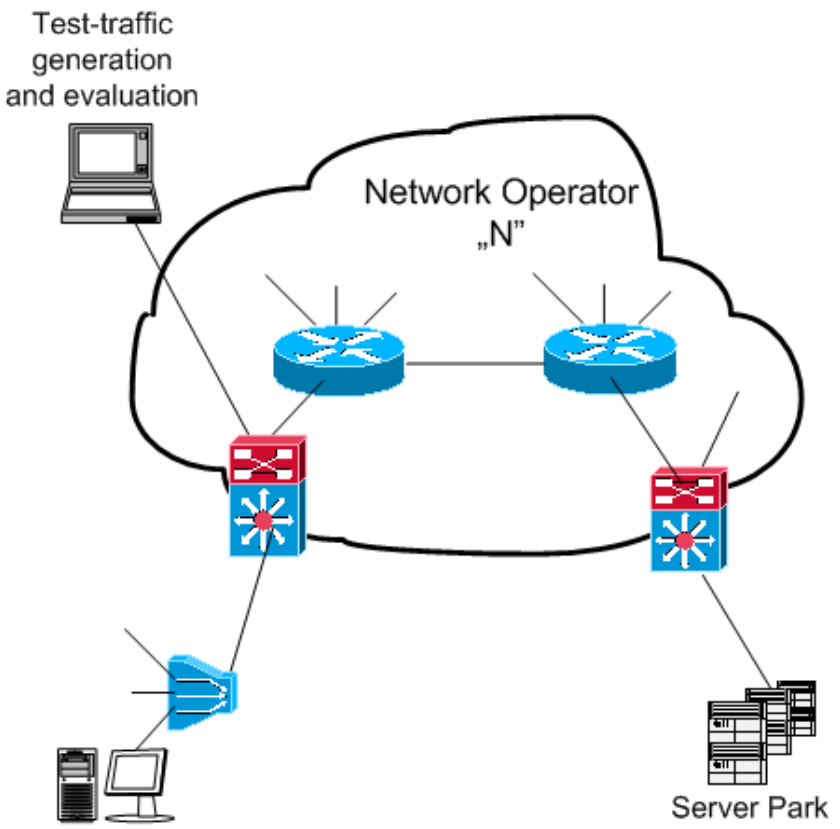
- Passive monitoring
  - Network traffic monitoring, „non-intrusive”
  - uninterrupted, gives transparent picture, in the whole time
  - single connection („link”) monitoring restricts the evaluation scope
  - several (…total…) link monitoring is not feasible, or the data processing is difficult

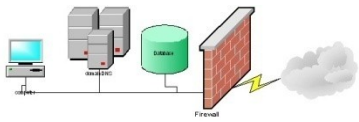




Traffic monitoring - Methods

- Active monitoring
  - Insert of test traffic and evaluate the „effect”
  - The artifical traffic deform the tests
  - plausible end-to-end test
  - non continuous, generate only sampling-type results

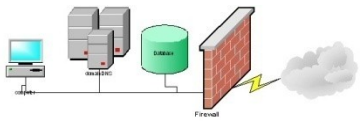




Data collection

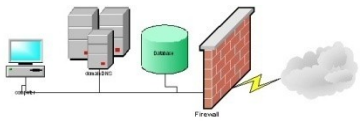
What type of data are we collect and evaluate?

- Raw Traffic data – bit level data, packet headers
  - simple, calculated statistics (network level)
  - transaction records (service level)
  - transaction statistics
- Topological data
- Log files



Traffic data processing - 1

- Simple, calculated statistics
  - Packet level statistics
    - pulling in time distribution characteristic
    - packet size distribution characteristic
    - bursting characteristic
  - Application level statistics
    - application distribution (eg. port)
      - based on applied bandwith
      - based on packet number
    - packet loss ratio

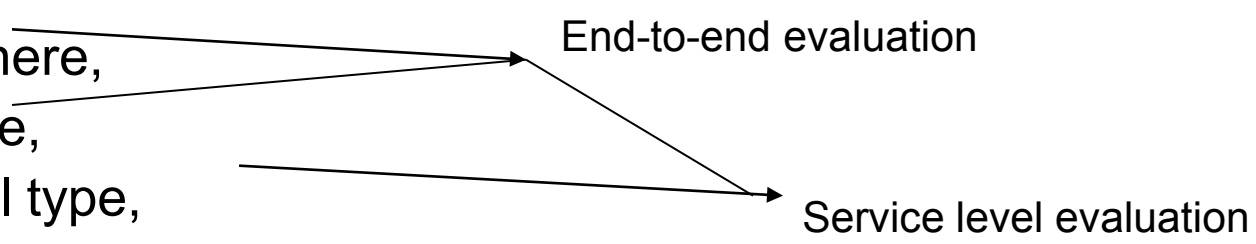


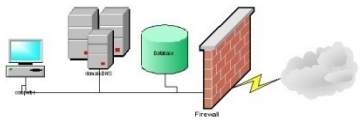
Traffic data processing - 2

- Transaction (stream-level) records

  Identify one transaction:
  - 5-tuple: source IP, destination IP, source Port, destination Port, IP protocol (TCP or UDP)
  - 3-tuple: source IP, destination IP, IP protocol
  - N-tuple…

Record contains:
- when,
- from where,
- to where,
- protocol type,
- how many data,
- ...„how”

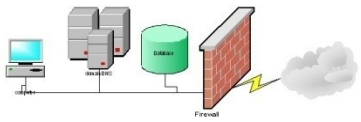




Traffic data processing - 3

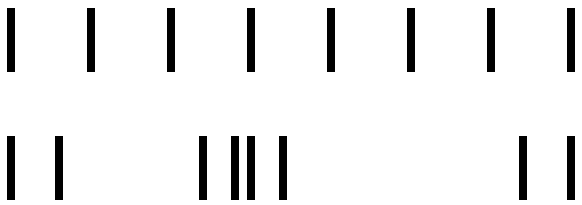
- Transaction statistics
  - o transfered data quantity
  - o Time frame
  - o Transaction burst (jitter)
  - o Pocket loss ratio
  - o Traffic directions, „dispersion”
  - o (information for billing)

… different thresholds of applications and counting methods



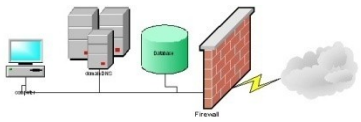
The jitter

- Many definitions exist.
  - Common denomination: the jitter is the variance of the delay
- Rate:
  - Dispersion (average deviation from the average)
  - jitter–buffer dimensioning (eg. p>0,001)
- Utility: jitter time between packages important in interactive voice/video transmission
  - BIG jitter: long breaks between the frames; empty the buffer



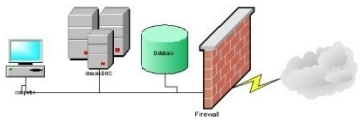
- Time between the poskets by near equal: small jitter

- Traffic with burst: BIG jitter

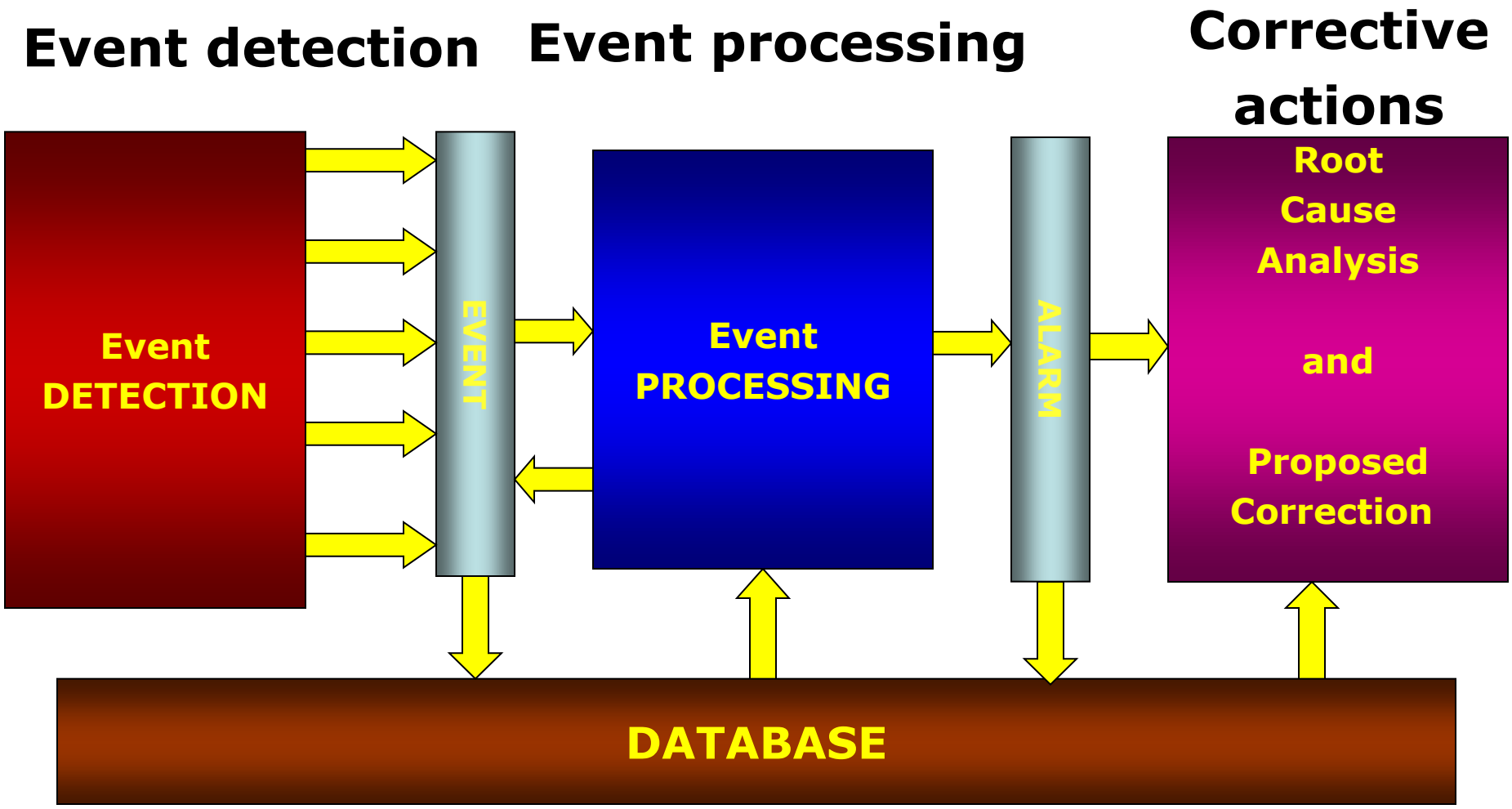


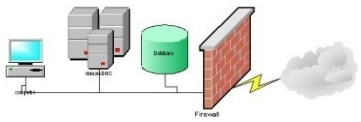
Fault management

- Procedures
- Procedures elements
- Theorethical methods
- Realization possibilities



Fault management procedure

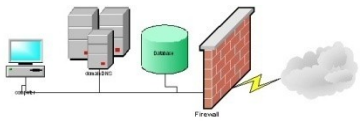




EVENT – ALARM

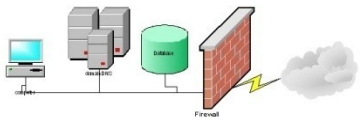
Foundational differences!

- EVENT (Log any kinds of events)
- ALARM (There is a problem, for which the root cause is to be eliminated)



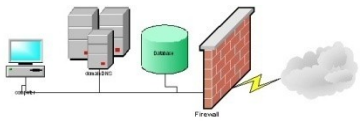
Fault management procedure

- **Event detection**
  - Task: Event detection and indication towards the fault management system
  - Result: **Event** group
- **Event processing**
  - Task: regulate alarm generation process
  - Result: **Alarm** group
- **Root cause analysis and proposed correction**
  - Task: problem clarification
  - Result: Suggestion to repair



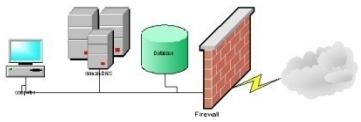
Fault detection

- Use the network integrated fault detection elements, filter service-specific fault indication (eg. Syslog, QoS monitor)
- Use ***information collecting elements***, data monitoring (eg. AAA records)
- **Use *Active monitoring elements***
- **Collect *User-indicated faults***
- Integrated handlig of fault indications collected; and their transmission to fault processing subsystem



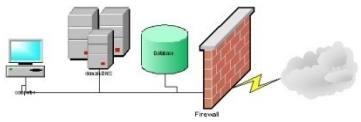
Fault processing - 1

- Filter
  - For arrived events it can define different filtering rules to regulate the event generation
- Correlation
  - Based on **correlation rules** it can make new regulation for event generation
- Trend analysis
  - With long term evaluation, possible to define **trend rules**



Fault signal process - 2

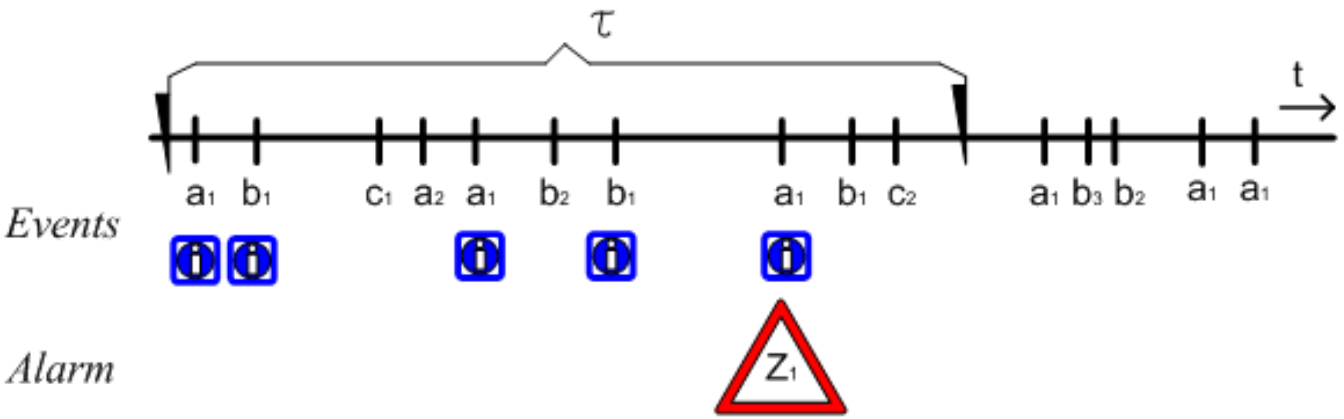
- Filter
  - For arriving events it can define alternative filter rules
    - » Counter
    - » Suppress
    - » Redundancy
    - » Dominance



Fault signal process - 3

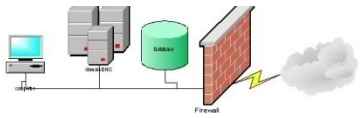
- Correlation

Correlation rule: *if* during $t<\tau$ events $(\alpha_1 a_1 | \alpha_2 a_2 | \alpha_3 a_3)$ & $(\beta_1 b_1)$ arrive
then: report alarm Z_1



where

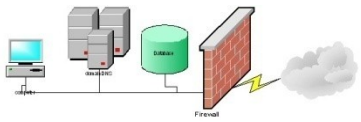
a,b,c,... z	- event types
1,2,3	- priority of the event/alarm
$\alpha,\beta,\gamma,\ldots\omega$	- counter thresholds
A,B,C,...Z	- ALARMS



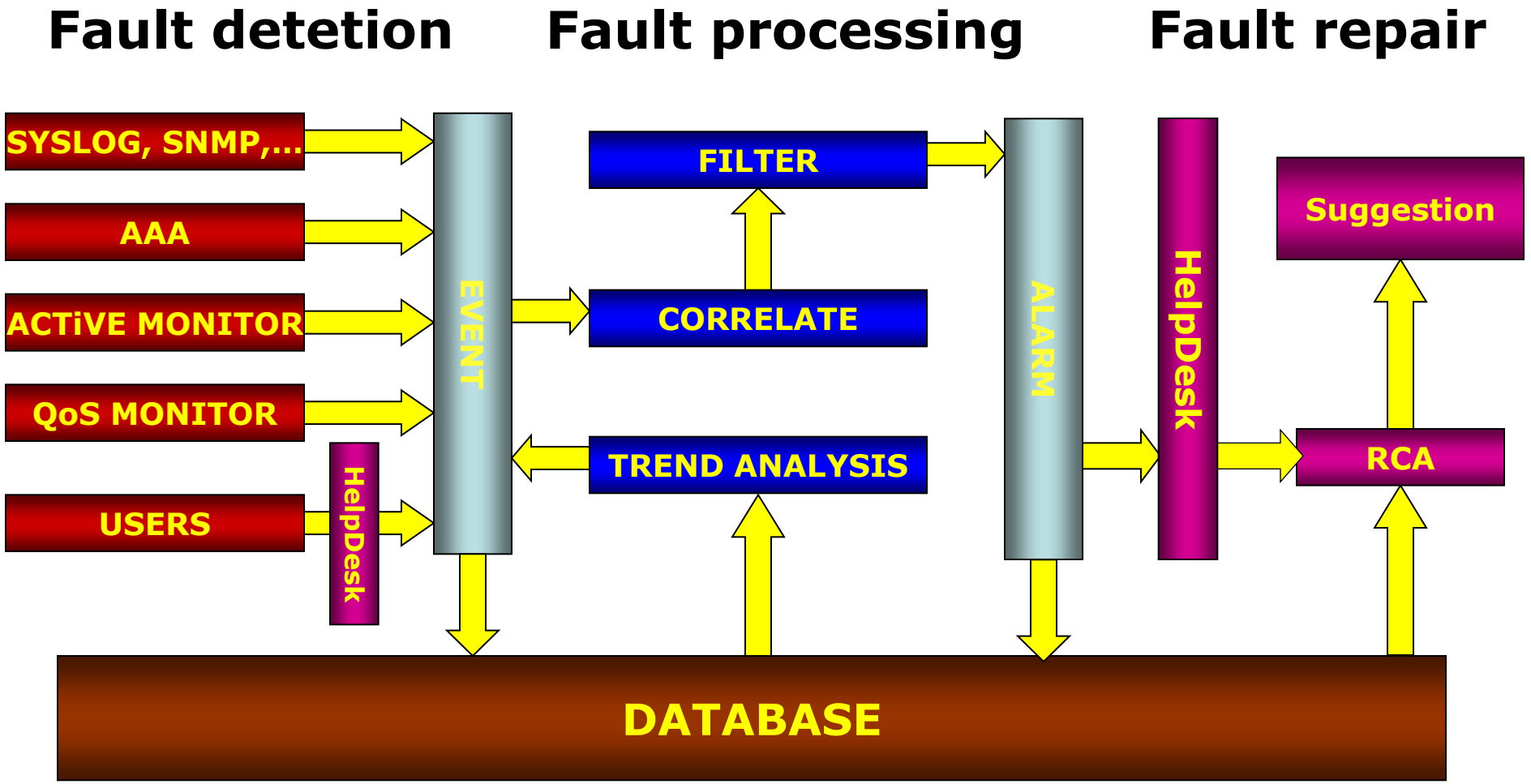
Root Cause Analysis and Proposed Correction

- Root Cause Analysis
  - o Simple, Correlation base
  - o Algorithm…

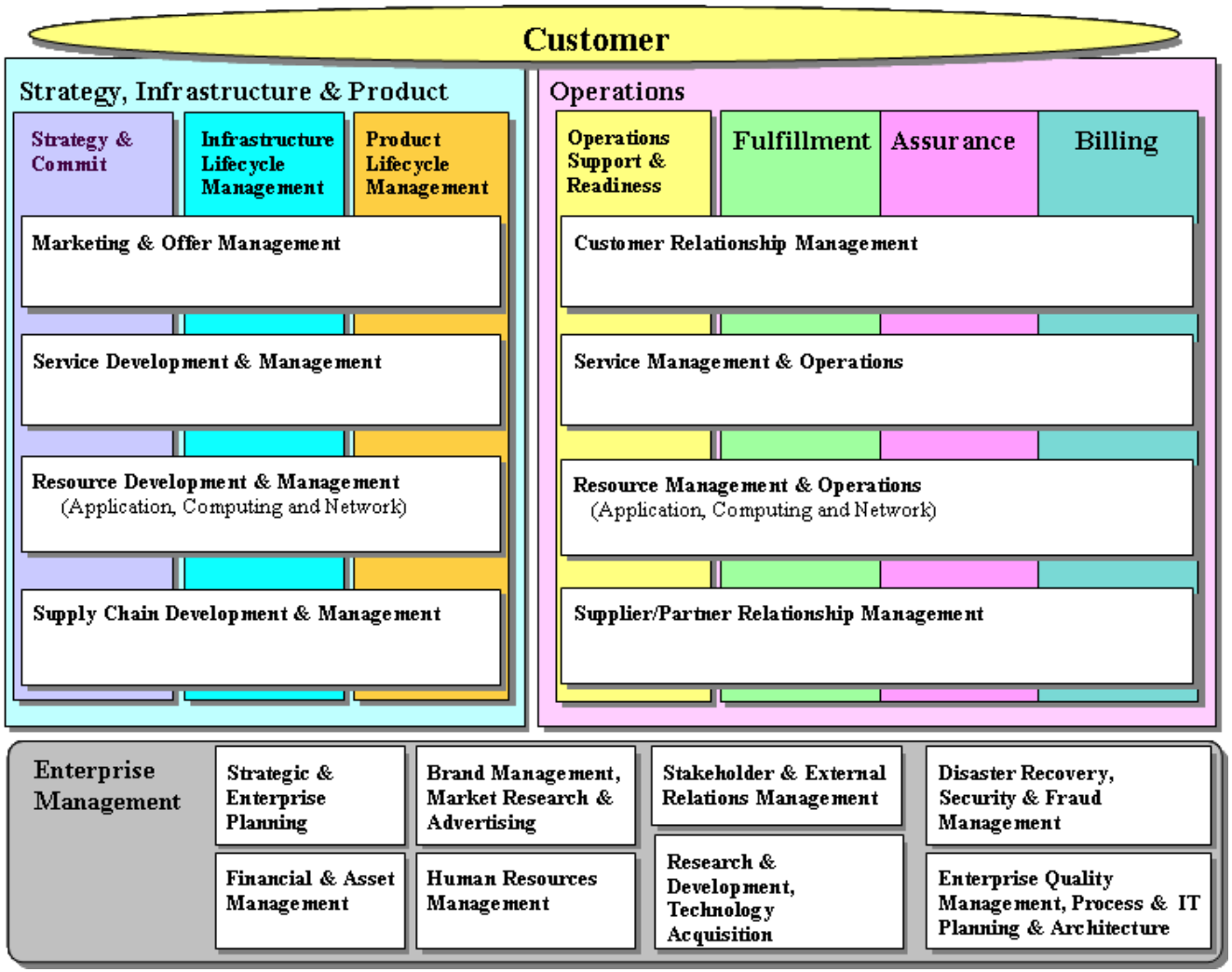
- Fault reparation
  - o Suggestion
  - o Fault repair by network maintenance



Case Study: VoIP service



Summary


Customer
Strategy, Infrastructure & Product
Strategy & Commit
Infrastructure Lifecycle Management
Product Lifecycle Management
Marketing & Offer Management
Service Development & Management
Resource Development & Management
(Application, Computing and Network)
Supply Chain Development & Management
Operations
Operations Support & Readiness
Fulfillment
Assurance
Billing
Customer Relationship Management
Service Management & Operations
Resource Management & Operations
(Application, Computing and Network)
Supplier/Partner Relationship Management
Enterprise Management
Strategic & Enterprise Planning
Brand Management, Market Research & Advertising
Stakeholder & External Relations Management
Disaster Recovery, Security & Fraud Management
Financial & Asset Management
Human Resources Management
Research & Development, Technology Acquisition
Enterprise Quality Management, Process & IT Planning & Architecture