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Issues and Challenges in IP Network Management

ITG Workshop „IP Netzplanung, Optimierung und Netzmanagement"

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Overview

▷ **Challenges in IP Network Management**

▷ IETF proposed mechanisms/models/methods for Internet performance management

- IP Performance Metrics

- Traffic Flow Measurement

- Policy Management

 – Policy Framework

 – COPS (Common Open Policy Service protocol)

- Traffic Engineering

 – Load Distribution

▷ Conclusion

Challenges in IP Network Management

▷ *Introduction of new technologies*

- QoS-enabled IP networks (DiffServ)
- MPLS (Multi protocol label switching)
- Wireless-IP, UMTS
- new applications: Voice/Multimedia-over-IP

▷ *Increased importance of communication networks*

- mass communication system
- workflow management
- E-Commerce (retailing),Business-to-Business communication (B2B, supply chain management)

▷ *Competition in the market*

- multiple Internet Service Provider
- deregulation of telecommunication sector
- business-case-orientation, information advantage

What is ... ?

▷ **IP Network planning:**

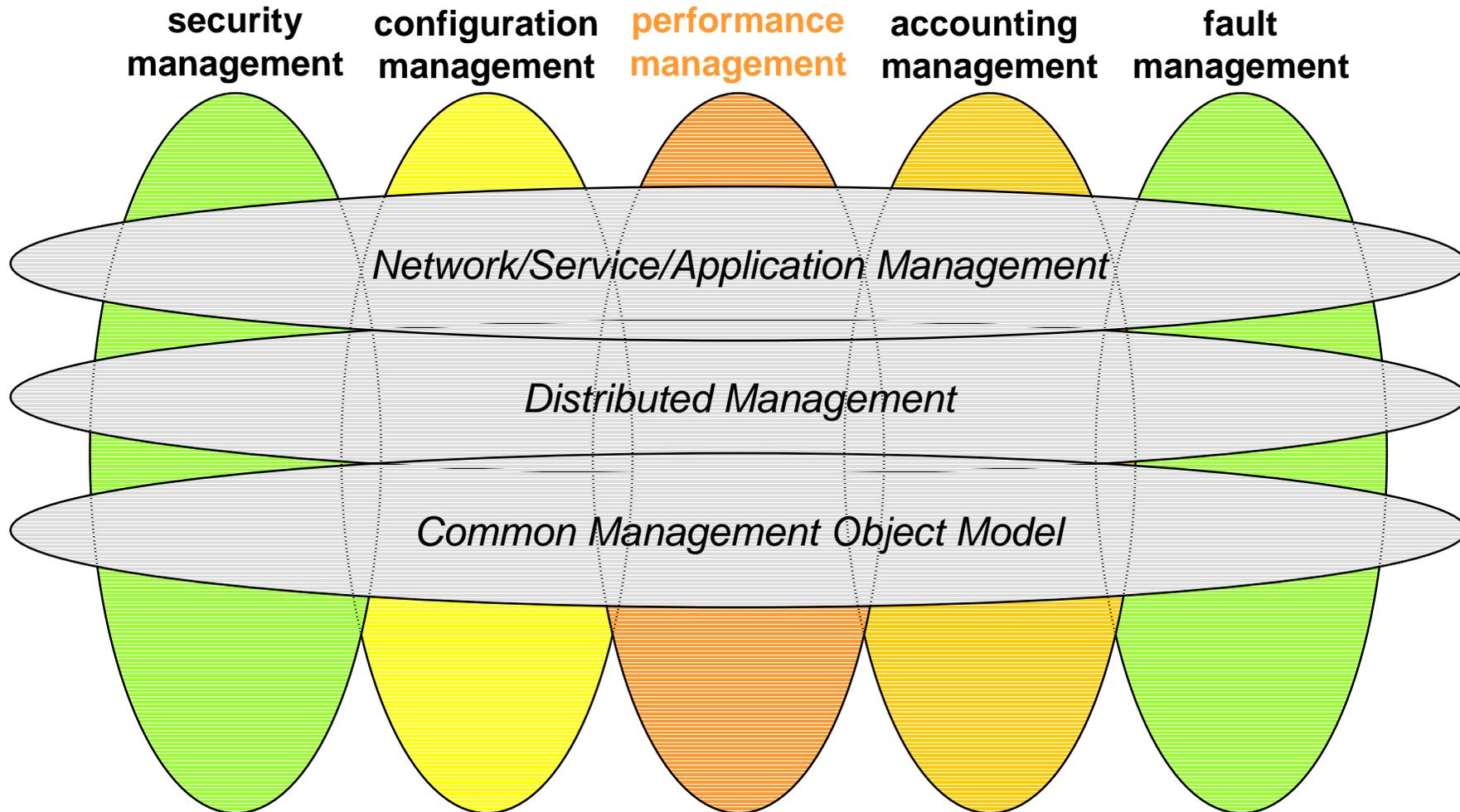- methods to design, implement, and deploy an IP-based communication network

▷ **IP Network management (NM):**

- methods to operate and evolve an IP-based communication network and maintaining its service quality

- *IP Traffic/Performance engineering*:

  - aspect of Internet network engineering that deals with the issue of performance evaluation and performance optimization of operational IP networks

Taxonomy of Management Actions

security management
configuration management
performance management
accounting management
fault management

Network/Service/Application Management

Distributed Management

Common Management Object Model

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IP Performance Metrics I

▷ IETF Working Group "IP Performance Metrics" (IPPM)

▷ main goal:

- specification of standard, unbiased, quantitative metrics that can be applied to the quality, performance, and reliability of Internet data delivery services

▷ family of five RFCs and four drafts

- RFC 2330: "Framework for IP Performance Metrics"
- RFC 2678-81: metric documents

IP Performance Metrics II

▷ metric notion suggested by RFC 2330:

- *analytical metric:* metric evolved from an analytical view of the network, e.g .:
  - propagation time of a link, bandwidth of a link for packet of size k bytes, route, and hop count of a route

- *empirical metrics*: performance and reliability metrics that do not fall under analytical, e.g.:
  - "the best flow capacity achievable along a path using RFC-2001-compliant TCP"

- sampling distinction:
  - *singleton metrics*: atomic metrics
  - *sample metrics*: derived from singleton metrics
  - *statistical metrics*: derived from sample metrics

IP Performance Metrics IV

▷ metrics:

- connectivity (RFC2678):
    - uni/bidirectional-connectivity (instantaneous/time interval)
- one-way delay (RFC 2679):
    - single observation/sequence of singleton delays within an interval taken time instances from a Poisson process
    - percentile, median, minimum, inverse-percentile
- one-way packet loss (RFC 2680):
    - single observation of packet transmission and/or loss measured at times taken from a Poisson process
    - loss average
- round-trip delay (RFC 2681):
    - same as for one-way delay

IP Performance Metrics IV

▷ drafts (as of July 2000):

- packet delay variation metric

- empirical bulk transfer capacity

- one-way loss pattern

- network performance measurement for periodic streams

▷ evaluation:

simple approach, easy to implement

practical relevant

flow performance

? application to on-line traffic engineering

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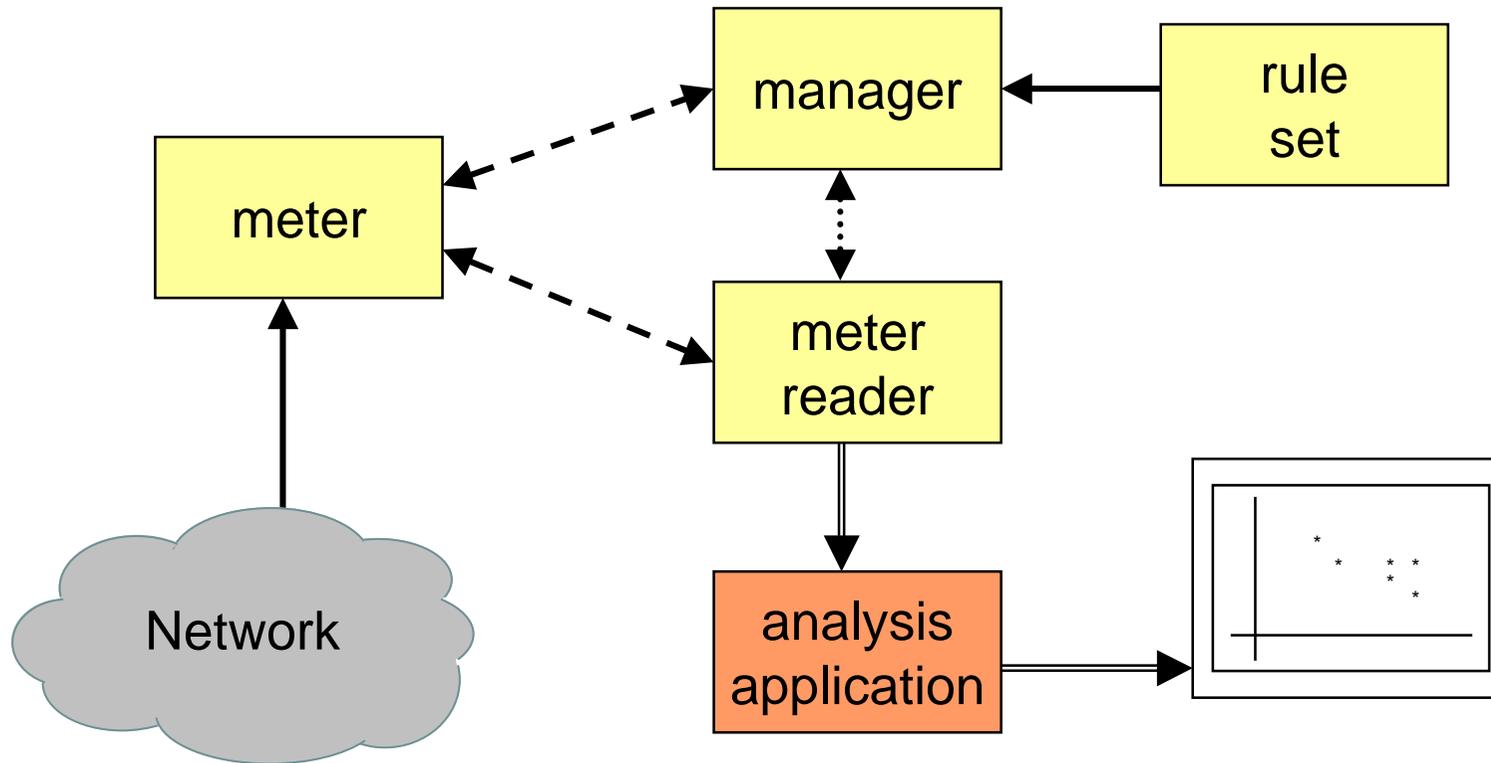# Traffic Flow Measurement I

▷ overview:

- extended in 1999 by five RFCs (RFC 2720-24), main document: RFC 2720: "Traffic Flow Measurement: Meter MIB"
    - RFC 2722: "Traffic Flow Measurement: Architecture"

▷ characteristics:

- traffic flow model applicable to any protocol/multiple protocol stacks
- users may specify flow measurement by "rule sets", allowing the collecting of certain data
- data reduction placed as near as possible to the measurement point

Traffic Flow Measurement II

Traffic Flow Measurement III

▷ flow identification

- portion of a traffic, delimited by a start and stop time

- assignment of data streams into flows records by user specified rules

- flow records comprise a set of attributes and an associated set of values

  – attributes examples: addresses (src/dest), first/last time when packets seen for this flow, counts for forward/backward components (bytes/packets)

▷ flow lifetime

- cannot directly be measured by the meter

  – meter reader collects data of flows active since last collection

  – analysis application has to determine when each flow stopped

- flow information deleted on meter after "InactivityTimeOut" or when data has been read by all meter readers

Traffic Flow Measurement V

▷ evaluation:

    simple approach, easy to implement

    ⚡ limited flow information

    ⚡ complex flow lifetime identification

    ? application to accounting questionable

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Policy Framework I

▷ two IETF Working Groups responsible

- WG "Policy Framework" (Policy)

- WG "Resource Allocation Protocol" (RAP)

▷ WG "Policy Framework" goal:

- guidance in defining a policy framework, information model, and schemata to store, retrieve, distribute and process policies.

▷ overview:

- only drafts proposed, main documents:

- "Policy Core Information Model - Version 1 Specification" (B. Moore et. al.)

  - specification of core policy classes, i.e.: `PolicyRule`, `PolicyCondition, PolicyAction, PolicyGroup, PolicyRepositoy,` etc...

Policy Framework II

- – "Policy Framework QoS Information Model" (Y. Snir et. al.)
  - information model for DiffServ/IntServ QoS enforcement via policy control on RSVP admission
  - e.g.: definition of policy action objects as specified by the DiffServ architecture: meters, markers, shapers, and droppers

▷ evaluation

comprehensive information model

↗ isolated model solely concerned with policing

↗ additional network management aspects not covered

Network Information Model under consideration (BOF at 48th IETF Meeting – Pittsburg 30 July - 4 August 2000).

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COPS I

▷ WG "Resource Allocation Protocol" goal:

 ▪ establishing a scalable policy control model for RSVP

▷ overview:

 ▪ specified in 2000 by family of four RFCs (RFCs 2748/49/50753), main document:

  – RFC 2748: "The COPS (Common Open Policy Service) Protocol"

▷ COPS objectives:

 ▪ simple client/server (C/S) model for supporting policy control over QoS signaling protocols

 ▪ no assumptions about policy methods

 ▪ server is returning decisions to policy requests

 ▪ extensible to support future policy clients

COPS II

▷ architecture:
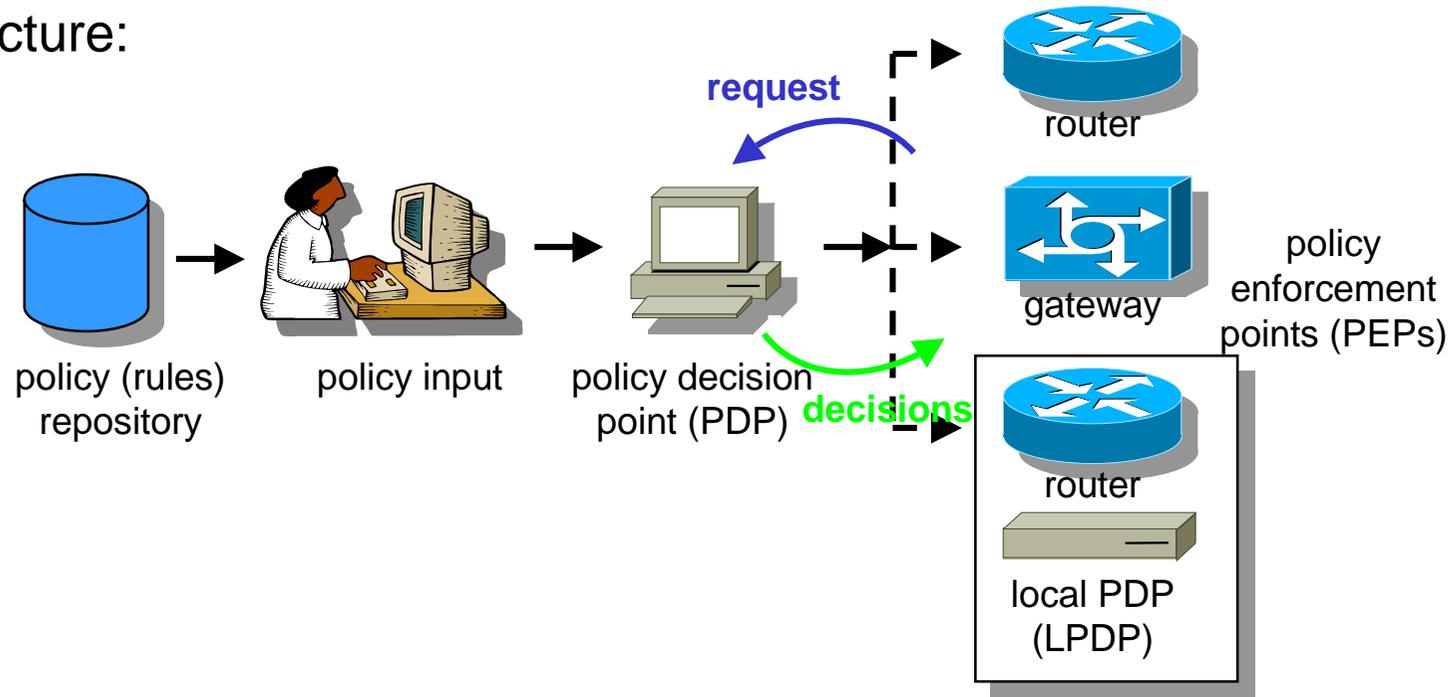
▷ communication:
- PEP sends requests, updates, and deletes to the remote PDP
- PDP returns decision back to PEP

COPS III

▷ RFC 2753: "A Framework for Policy-Based Admission Control"

- ■ outlines how the COPS architecture supports policy-based admission control

- ■ specifies additional functions required at the PDP
  - ‐ questioning the PEP on policy related error messages

- ■ provides guidelines where to place policy elements in the network

- ■ gives example policies and scenarios for:
  - ‐ admission control based on Time-of-Day, User Identity, etc…
  - ‐ agreement enforcement between service providers
  - ‐ pre-paid calling cards

- ■ specifies further extensions to COPS communication protocol

  provides feasible approach for admission control in QoS-enabled IP network

  ⚡ incomplete framework

  ⚡ extensions to COPS protocol not yet specified

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Traffic Engineering

▷ Draft: "Traffic Engineering of Load Distribution" (S. Wright et. al.)

- Best Common Practice (BCP) document
- identifies mechanisms that affect load distribution and enables policy-based traffic engineering, e.g.:
  - traffic load definition and measurement
  - load distribution controls
  - traffic classification in multipath routing configurations
- provides guidelines for the control of load distribution mechanisms for centralized IP network administration
- mapping of load distribution controls to the COPS framework

identification of main components to control load distribution

✗ no engineering guidelines for the of use load distribution controls

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Conclusion

▷ IP performance management gained increased importance

▷ some of the mechanisms/models/methods have to be re-evaluated and require enhancement

- on-line TE

- flow lifetime

- flow characteristics (loss per flow)

- future accounting mechanisms

▷ efficient policy control mechanisms available

▷ improved engineering guidelines necessary