RESULTS OF THE
IRTF-NMRG Workshop

Challenges for Future Research on Network and Service Management

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Jointly organized by IRTF/NMRG & EMANICS

IRTF/NMRG:
• Chartered in 1999 (chair: Jürgen Schönwälder)
• 21st meeting in Utrecht, 22nd meeting tomorrow
• Foster discussion between IETF, operators and researchers

EMANICS
• European Sixth Framework Network of Excellence
• 1 January 2006 -> 31 December 2009
• Management of the Internet and Complex Services
Goals:

• Bring together researchers, operators, vendors and technology developers

• Identify promising future directions of network management research.

• Outcome should be a description of research directions that is felt worthwhile to explore in the next 5 years.

Non-goal:

• Define what management standards are needed now
Workshop Organization

• Invitation via NMRG list to submit position statements
• 20 participants:
  – Alcatel/Lucent, Avaya, Cisco, Ericsson, HP, Huawei, NEC
  – Orange France Telecom, Korea Telecom, Switch, Tiscali
  – Researchers from EMANICS, as well as from elsewhere
  – 60% from Europe
• Day 1: presentation / discussion of position statements
• Day 2: parallel vendor / operator / researcher sessions
• Day 2: plenary discussion of session results
Research challenges

- Management models
- Distributed monitoring
- Data analysis and visualization
- Economic aspects of management
- Uncertainty and probabilistic approaches
- Ontologies
- Behavior of managed systems
Management models

• We understand:
  – Manager-Agent approach (client-server)
  – Hierarchical management (DisMan, TMN)

• We do *not* understand
  – Fully distributed management (P2P, ad-hoc)
  – Self-* technologies (auto-configuration, stability of control loops)
Distributed monitoring

• Examples of what is needed:
  – track number/quality of VoIP calls
  – find best proxies / peers (P2P)

• Goal: a lightweight, distributed monitoring layer offering aggregates of local info to applications
  – Sum, average, extreme, percentile, histogram, …
  – Difficulty: bandwidth and CPU usage -> lightweight!
  – Find trade-offs
  – Tree-based versus gossip-based protocols
Data Analysis and Visualization

• We can create:
  – Topology maps for small networks
  – Static time series plots

• We have problems with:
  – Maps for large, multi-layer networks
  – Online analysis at Tbps
  – Visualization of anomalies
  – Real-time, interactive visualization techniques (zooming, filtering, correlating)
Economic Aspects

• Most researchers focus on technical solutions
• Limited research into the operational costs of such technologies:
  – IntServ/DiffServ versus overprovisioning
• Research needed on models to estimate costs
• Network management is risk management
Uncertainty and Probability

• Many researchers focus on deterministic approaches

• Scalability problems force us to rethink in terms of uncertainties and probabilistic approaches:
  – Probabilistic SLAs / statistical guarantees
  – Manager may not have a complete overview

• How to decide between probabilistic and deterministic approaches?
Ontologies

• Data modelling is believed to be understood

• Research is needed:
  – If / how ontologies can be effectively used to automate the implementation of management interfaces
  – If/how ontologies can help to check / enforce policies and behaviour
Behavior of Managed Systems

• Management models usually represent state:
  – MIBs, CIM

• Research is needed to model and manage behavior:
  – Normal versus abnormal behavior
  – Detect resource failure, intrusions, …
  – Design self-stabilizing systems
Concluding remarks

• Presentation is:
  – Summary of what was discussed at workshop
  – Represent interest of workshop attendees

• Follow-up:
  – Internet-Draft (being written)
  – Submit overview article to IEEE ComMag
  – Further discussion: tomorrow’s IRTF/NMRG meeting