RESULTS OF THE

IRTF-NMRG Workshop

Challenges for Future Research on Network and Service Management

Jointly organized with EMANICS

October 2006 – SURFnet – Utrecht – the Netherlands

Aiko Pras

University of Twente

a.pras@utwente.nl

Information Society Technologies

EMANICS

Structure

- What is EMANICS
- Goals of the workshop
- Organization of the workshop
- Future research challenges
- Conclusions

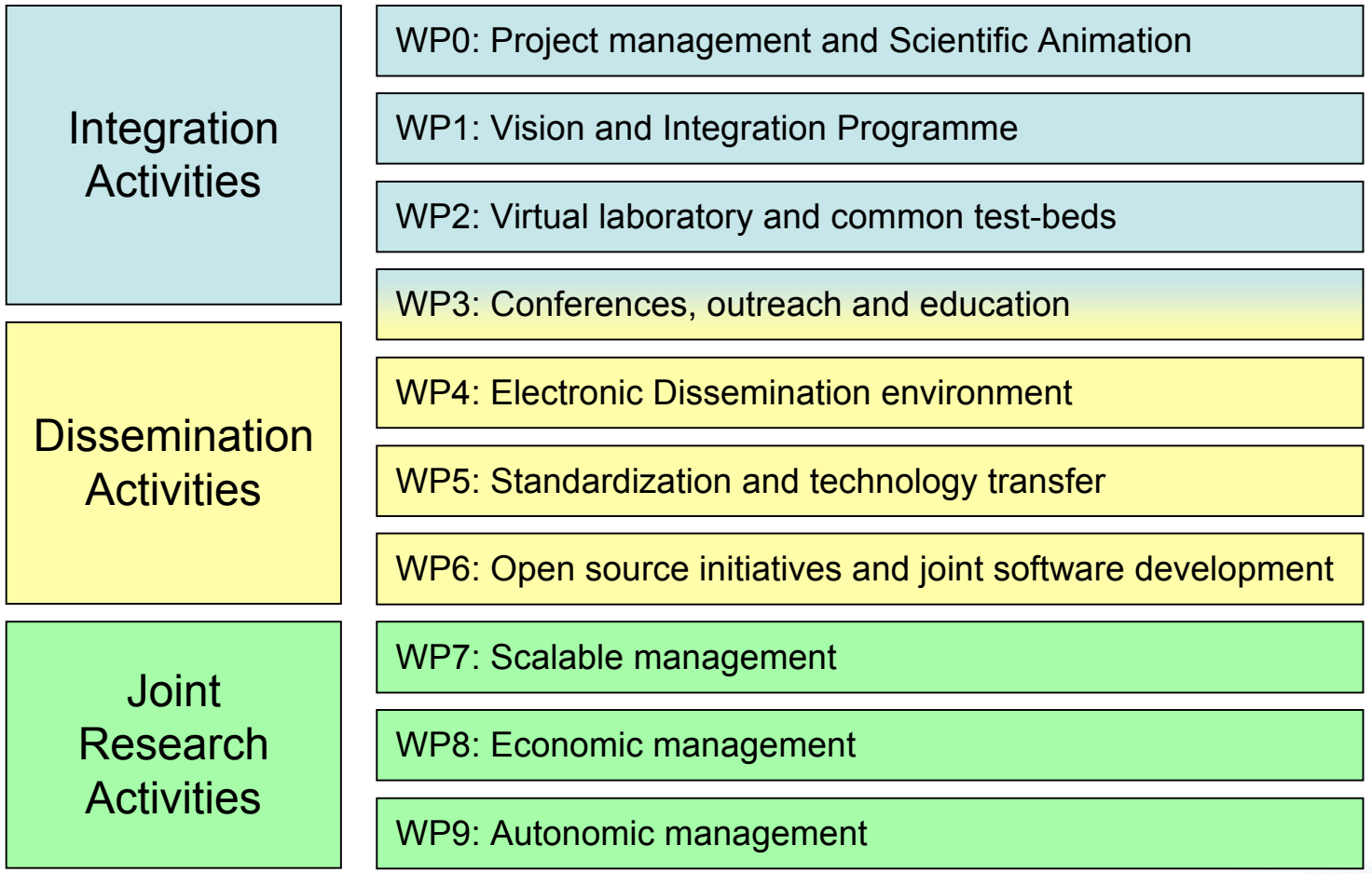
What is EMANICS

- European Sixth Framework Network of Excellence
- FP6-2004-IST-026854-NoE
- 1 January 2006 -> 31 December 2009
- ***Management of the Internet and Complex Services***
- EMANICS themes:
  - Management Principles
  - Management Technologies
  - Management Applications

EMANICS Members

- Caisse des Dépôts et Consignations (France)
- Institut National de Recherche en Informatique et Automatique (France)
- University of Twente (The Netherlands)
- Imperial College (United Kingdom)
- International University Bremen (Germany)
- KTH, Royal Institute of Technology (Sweden)
- Oslo University College (Norway)
- Universitat Politecnica de Catalunya (Spain)
- University of Federal Armed Forces Munich (Germany)
- Poznań Supercomputing and Networking Centre (Poland)
- University of Zürich (Switzerland)
- Ludwig-Maximilian University Munich (Germany)
- University of Surrey (United Kingdom)
- University of Pitesti (Romania)

EMANICS Structure



Workshop Goals

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
  - http://www.ibr.cs.tu-bs.de/projects/nmrg/
- Follow-up:
  - Internet-Draft (being written)
  - Submit overview article to IEEE ComMag
  - Further discussion: tomorrow's IRTF/NMRG meeting

Questions??

Information Society Technologies

EMANICS