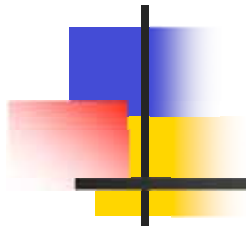


Research Report

Dependable TCP/IP Networking



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Outline

- Why work on TCP/IP dependability?
- An Overview of Dependable Network Management
- Current work: WAN Monitoring
 - DNR: Distributed Network Reachability
- GigaMan P2P: A Management Framework for the Brazilian Gigabit Backbone
 - Fault-Tolerant Routing
- Monitoring Dynamic Networks
- Distributed Integrity Checking
- Other Projects



We All Know That...

- The estimated number of Internet users has grown to 800 million persons worldwide
- Applications are increasingly critical for individuals & organizations
- How can one *monitor* such connected sets of heterogenous networks?
- What about re-configuration & control?



Integrated Network Management

- Monitoring & Control (Configuration)
- Independent of Operating System
- The 5 original management functions include:
 - Security Management
 - Performance Management
 - Configuration Management
 - Accounting Management
 - and.....



Fault Management

- Perhaps the most important function
 - At the very least you want to know what is working and what has crashed...
 - FAULT MANAGEMENT MUST BE FAULT-TOLERANT
- Several approaches have been proposed:
 - Use of Management Proxies for reaching managed objects
 - Management by Replication: replicating objects so that they are available post-mortem (IETF Draft)
 - The application of Distributed System-Level Diagnosis for LAN Management



Testing Is An Issue

- Several heterogeneous units are monitored
- For each unit, a test procedure must be defined
 - e.g. check whether the toner is too low, which virtually represents a faulty printer



We Are Currently Working on WAN Monitoring

- DNR: a Distributed algorithm for computing Network Reachability
- An algorithm to determine which portions of the network are reachable & unreachable
- The network may get partitioned & heal later
- Implementation: SNMP-based, allowing a reliable map to be drawn
- Reliable in the sense that even if part of the system is faulty, fault-free nodes are able to get reachability information



GigaMAN-P2P: Managing the Brazilian Gigabit Backbone

- The Brazilian RNP (Academic-Research Network) is currently upgrading links
- There are several challenges for managing high-speed networks
- Nodes are Autonomous Systems, in the sense that they are administered independently
- A Peer-To-Peer (P2P) Management System is being proposed
- Specific research project: Fault-Tolerant Routing



Monitoring Dynamic Networks

- It is difficult to model and map dynamic decentralized networks
- Information might be stale
- We have been working on an intelligent approach based on swarm intelligence
- Agents migrate throughout the network collecting topology information



Distributed Integrity Checking

- Consider a choice of peers from which you can download a program
- Can you trust all of them?
- Remember: this is the Internet!
- How can a set of peers build a web of trust?



Comparison-Based Diagnosis

- Nodes run comparisons and report comparison results
- A Generalized Model of Distributed Diagnosis has been proposed
- After receiving a file/an output:
 - The tester compares files/outputs
 - If the comparison results in a match, nodes are classified in the same set
 - If a mismatch results, nodes are classified in different sets, according to the result



The New Model

- Allows nodes to be trusted according to the set they belong to
- A large number of comparisons may be executed in a distributed fashion



Other Projects

- An Architecture for IP Packet Tracing
- HyperGrid: a Dependable Grid Infrastructure
- SLA Contract Checking Based on MultiDimensional Search
- JXTA SNMP Peer