

Self In-Network Resource Management

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AGENDA



Introduction: motivations and inspiration



In-Network Management



Optimization framework



Evaluation scenarios and results



Conclusions

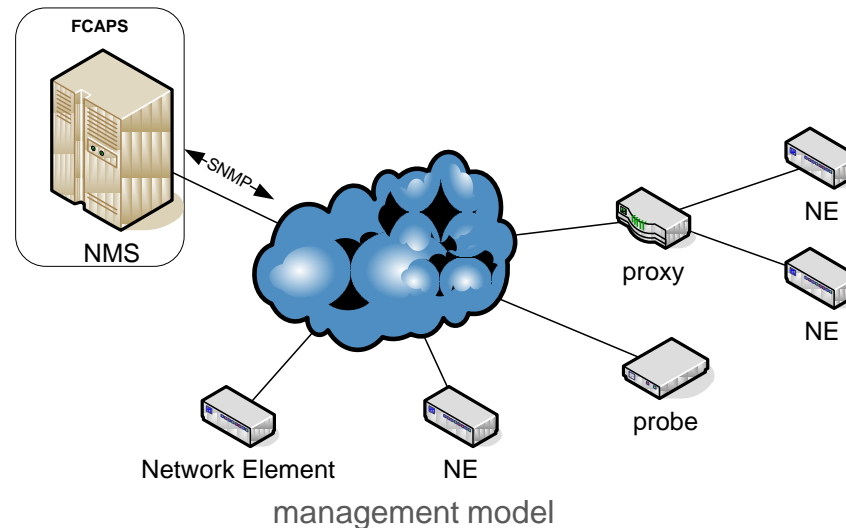


Introduction

Network Management

*The primary goal of a telecommunications network is to **convey** information between end-users.*

*A network **management** system ensures effective and efficient operation of network resources according to business **goals**.*



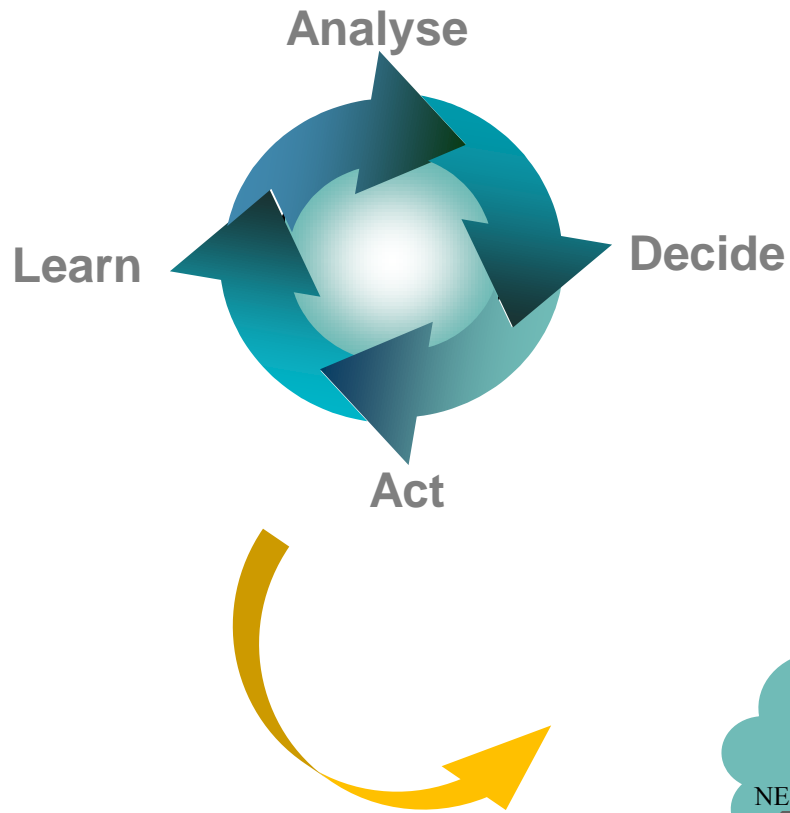
Introduction

Motivations

- Driving forces for network evolution
 - technological and socio-economical
- Increasing network complexity
- Highly dynamic environments
- Deployment time and cost (OPEX)
- Inadequacy of current management paradigms
 - not efficiently scalable
 - not fast to react (centralized)
 - too much human dependant
 - waste of resources (over-provisioning)
 - cost inefficient

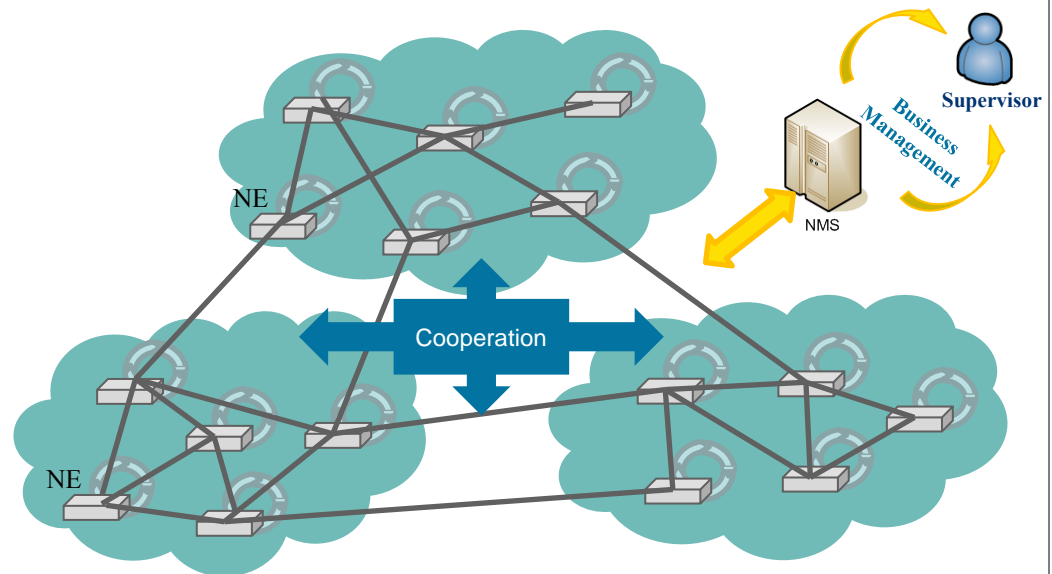
Introduction

In Network Management: the new paradigm



Self-* behaviour

- Increased automation
- Cooperative decisions



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In-Network Management

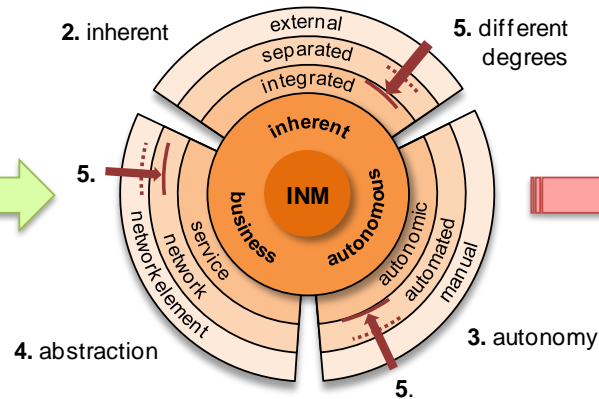
4WARD Project (FP7)



Vision

1. Embedding paradigm

Principles



Major Impacts

- 1: Clean-slate methodology
- 2: Distributed architecture
- 3: Self-management
- 4: Complexity hiding
- 5: Marketability

Research Team



In-Network Management

Research goals

- Design and develop distributed mechanism for network management
 - Evaluate feasibility of those mechanism
 - Evaluate and compare results
- Address resource efficiency and optimization algorithms
 - Local optimization vs. Network optimization
 - Stability and convergence
- Consider Self-adaptation
 - adaptation to changes (malfunction, new services)
 - support new features
- Support a probabilistic model for information uncertainty
 - incomplete information, prediction, trust

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Optimization framework



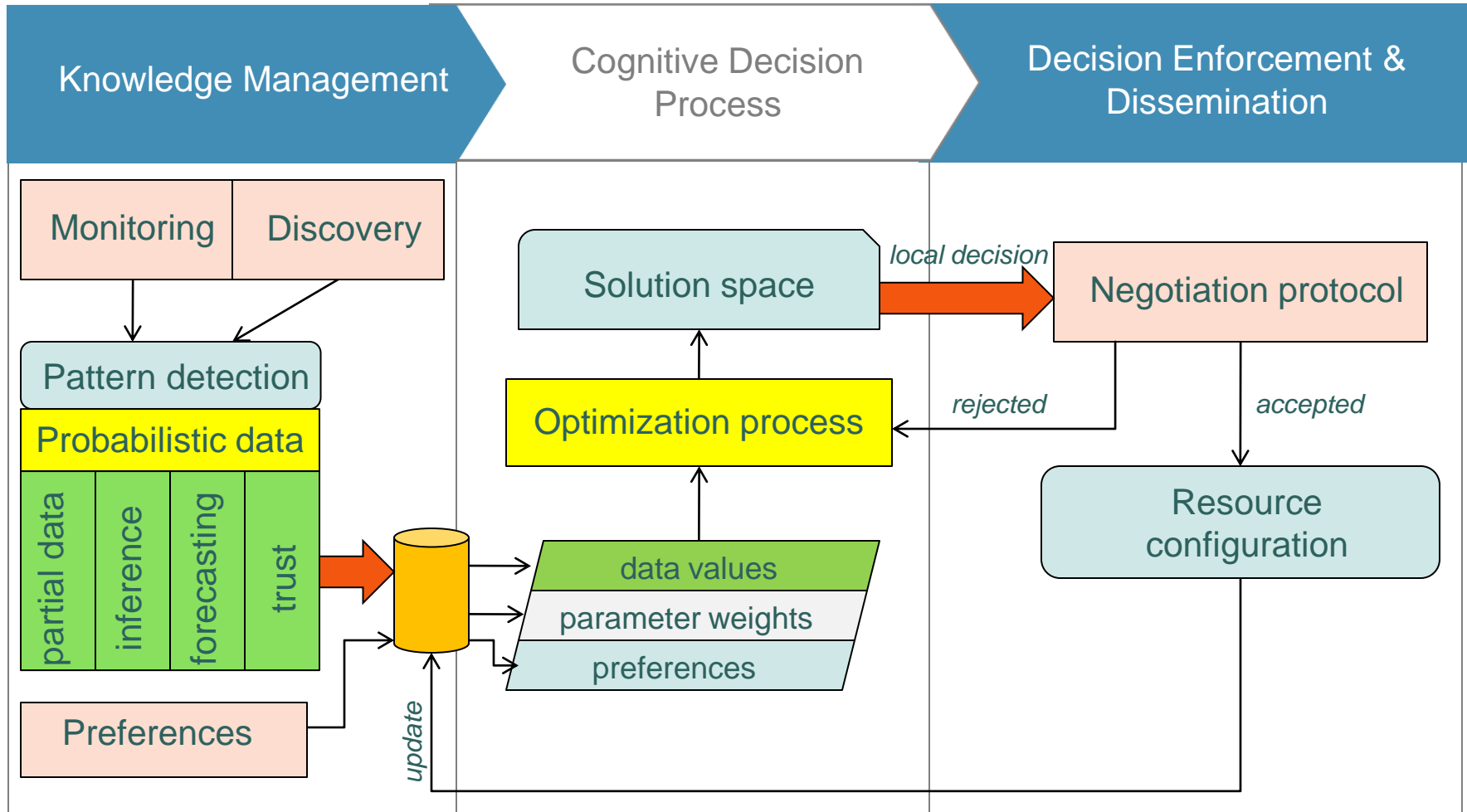
Evaluation scenarios and results



Conclusions



Optimization framework



Optimization framework

Knowledge Management

Context awareness

Probabilistic Information

Outer Behaviour

- The what, how and when of sending data to other parties
- Polling mechanisms, information expiration, refreshing or dropping
- On-demand requests: relevant or mandatory parameters
- External notifications

Inner Properties

- Classification: *completeness, ownership, reliability, universality, stability, accuracy, relevance*
- Structures and Tags: *meta-information*
- Storage and retrieving
- Computation: *learning, training, inference, prediction*

Optimization framework

Cognitive Decision Process

Input data for the Intelligent Local Decision

- Locally acquired and measured information on the network, neighborhood information -> *knowledge management component*
- Local preferences (user preferences, operator preferences, service provider preferences)
- Running services and their service parameters (used resources)

Triggers

- Upon a new service request
- Upon change of context of preferences
- Upon a change on network conditions
- Continuously updating (polling)

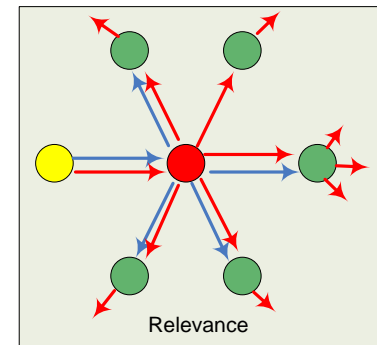
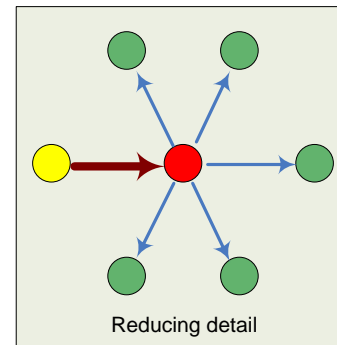
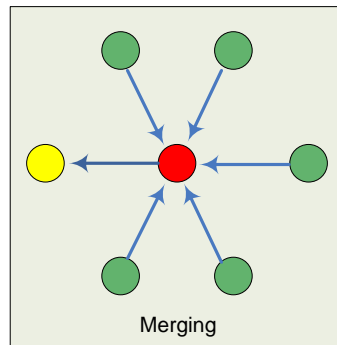
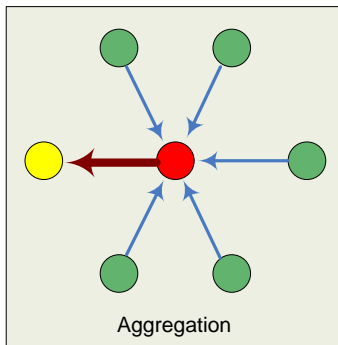
Standard multi-dimension optimization problem

- Weights are shaped by the current Knowledge
- Define a solution space (for negotiation)

Optimization framework

Decision Enforcement & Dissemination

- Final decisions depend on agreement between parties
- Tussle space
 - Different entities/actors will have **competitive** goals
 - **Cooperation** between entities in a Win-Win strategy
- Dissemination models
 - distance vs. detail, data composition



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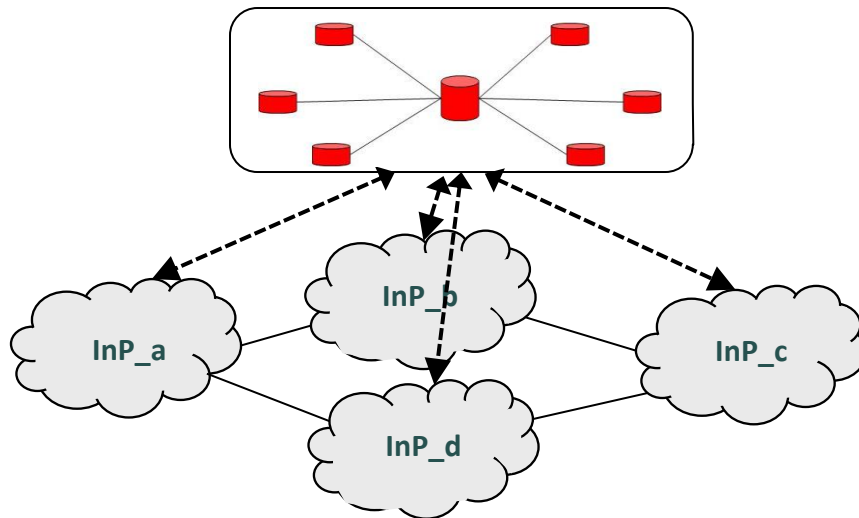
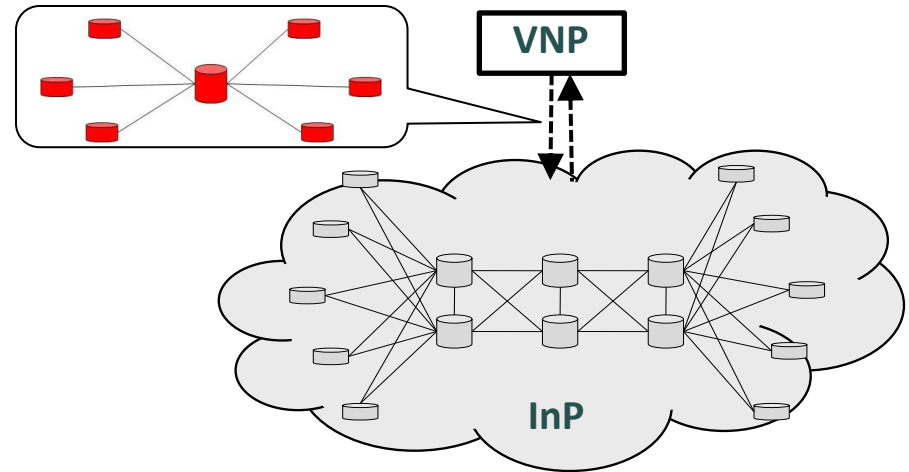


Evaluation scenarios and results

Network Virtualization

Network provisioning

- Vnet mapping
- Vnet recovery
- Cooperation



Inter-operability

- Cross-providers Vnet
- Cooperation
- Competition

Evaluation scenarios and results

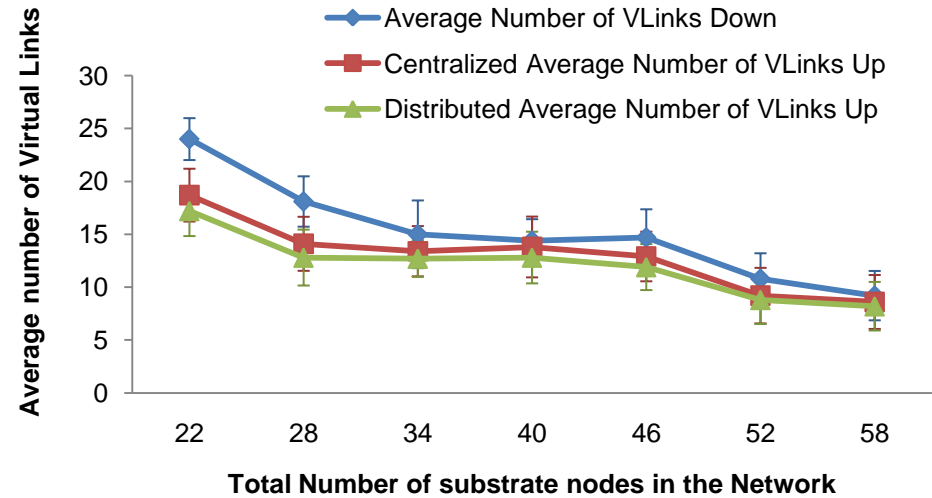
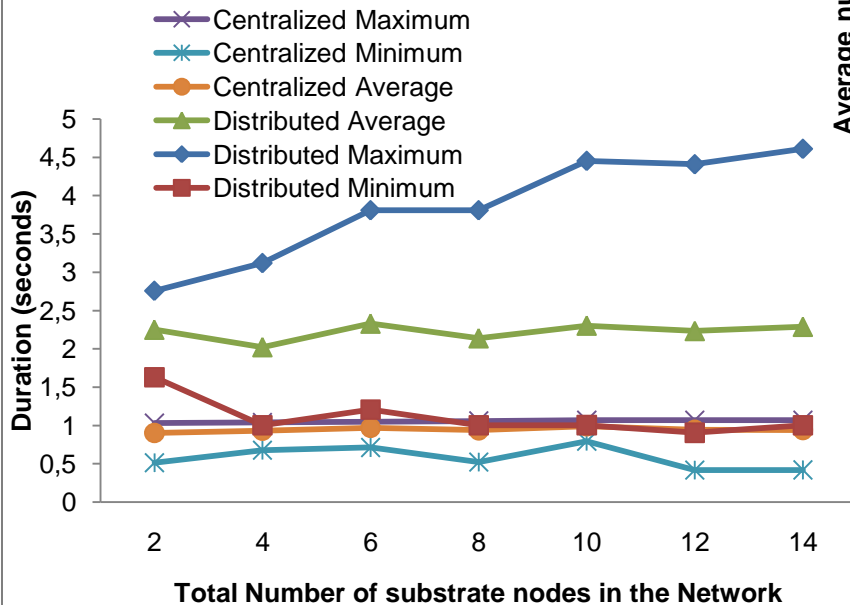
Network Virtualization

NS2 simulator

Number of messages

Recovery time

Recovered virtual links

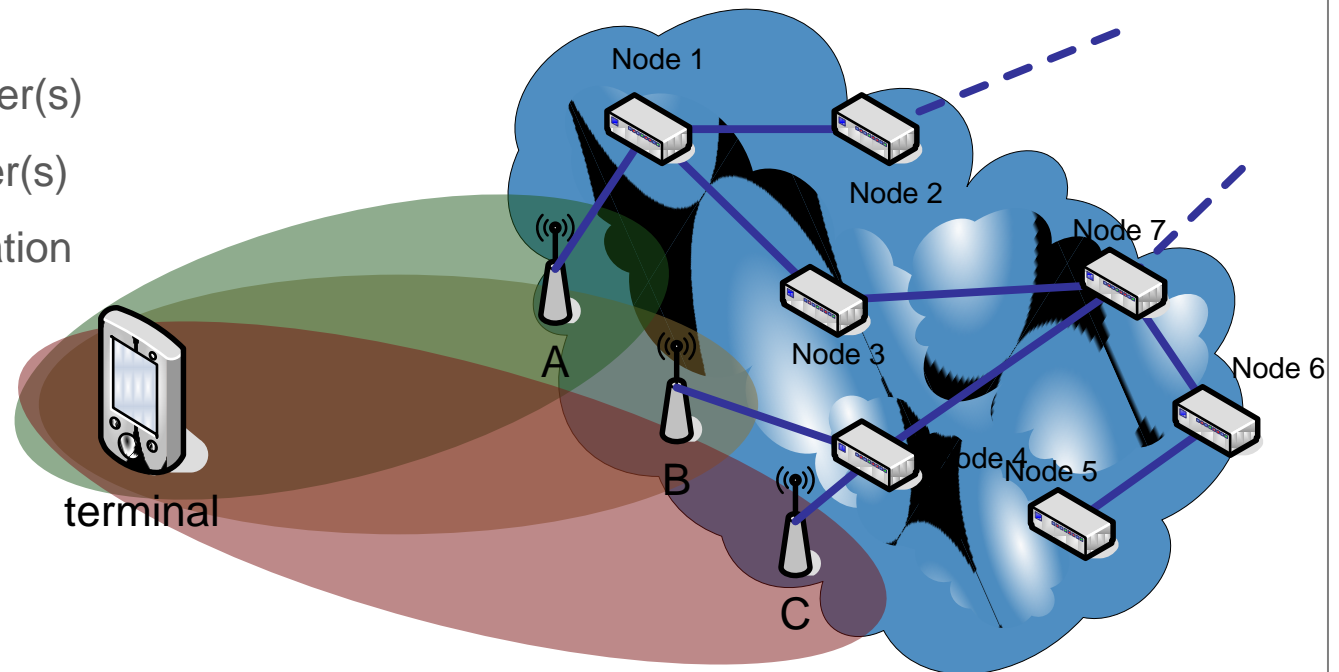


- Algorithm requires optimizations
- learning and inference
- recovery results close to centralized
- Termination criteria

Evaluation scenarios and results

Multi-homing access network

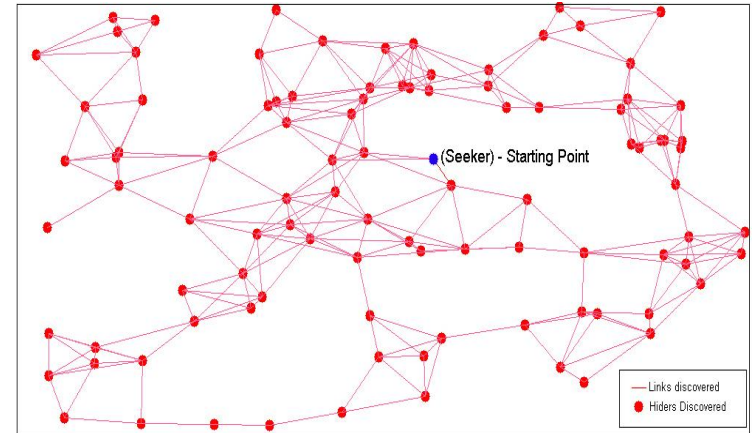
- ABC concept
- QoS, QoE
- Preferences
 - user(s)
 - network provider(s)
 - service provider(s)
- Network reconfiguration



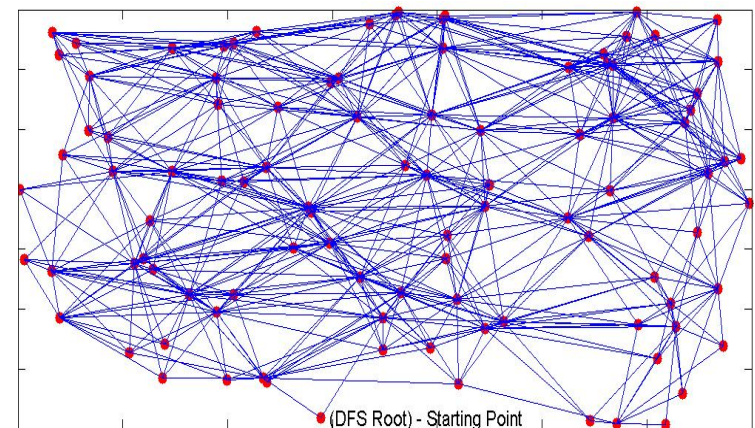
Evaluation scenarios and results

Network bootstrapping and discovery

- Network warm-up
 - discovering neighbours and their capabilities
 - acquiring (sharing) global or common knowledge (e.g. Policies)
- Continuous process
 - network is dynamic
 - information expires
- Distributed vs. Centralized (omniscient)
- Incomplete information models



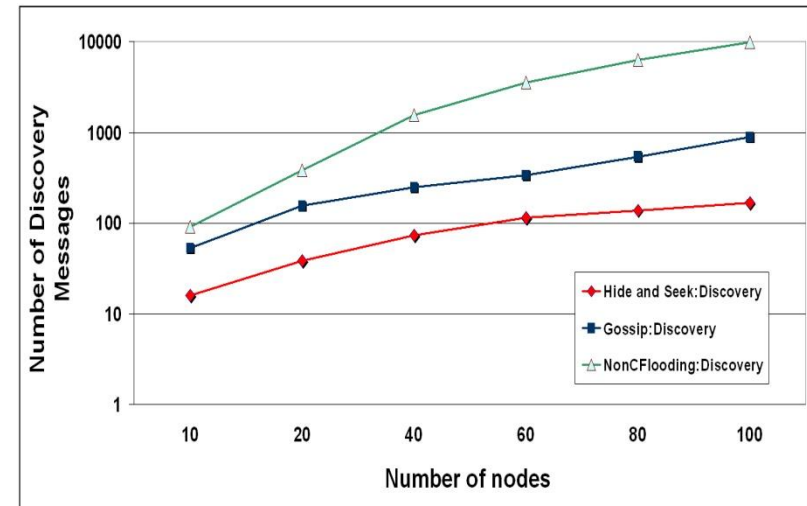
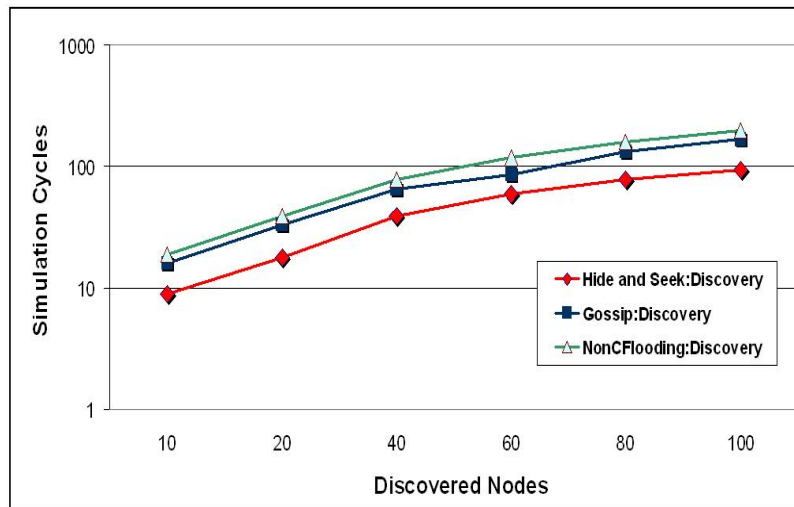
Hide & Seek



Gossip

Evaluation scenarios and results

Network bootstrapping and discovery



Non controlled flooding was used instead of centralized

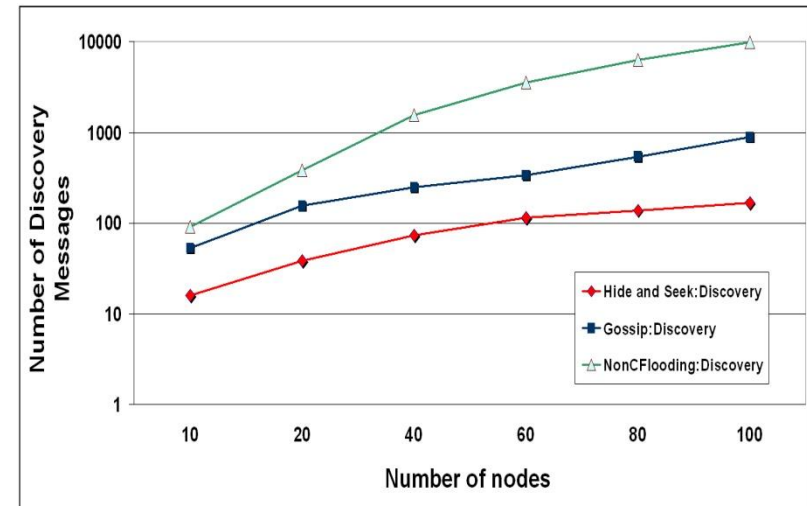
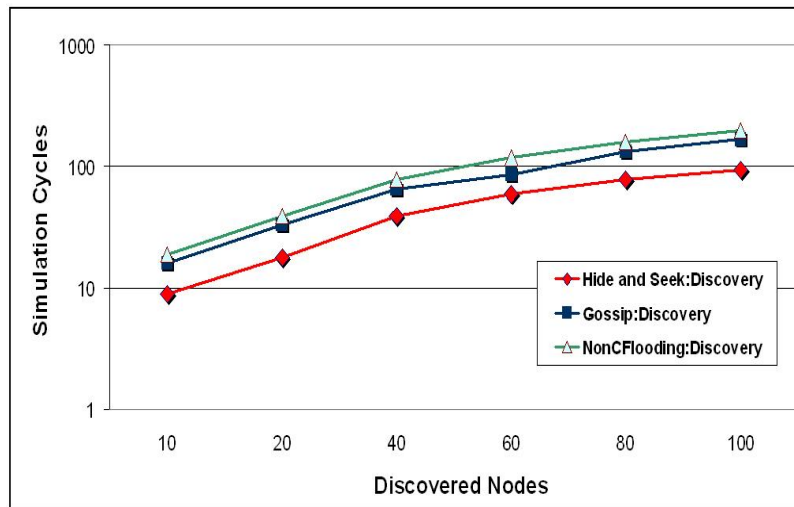
H&S requires less messages

H&S requires less simulation cycles

Simulator: matlab

Evaluation scenarios and results

Network bootstrapping and discovery



Non controlled flooding was used instead of centralized

H&S requires less messages

H&S requires less simulation cycles

Simulator: matlab

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Optimization framework



Evaluation scenarios and results



Conclusions



Conclusions



Future Work

- Conclude the evaluation scenarios
 - Optimize algorithms
 - Multi-homing scenario
 - incomplete information
- Feedback the results to the framework
- Integrate the different framework components
- Disseminate the results

Risk Factors

- Time
- Scope

Thank You

By:

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