An Architecture for Network Management

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What we mean by "architecture"

- ◆ Objectives

- ◆ Requirements

- ◆ Organizing principles

- ◆ Core design features

- ◆ Not detailed design

- ◆ Not implementation

Examples

◆ Traveling employee (enterprise support)

◆ Distributed applications (peering)

◆ Zero-day low-volume worms (local/ collaborative aggregation)

Network management: the desired functionality

◆ Analysis of network behavior

◆ Diagnosis of network misbehavior

◆ Prediction of behavior

◆ Analysis and prediction of use

◆ Mitigation/repair of misbehavior

◆ Improvement of behavior

Enhancing the network architecture

Data Plane

Management (Knowledge) Plane

Control Plane
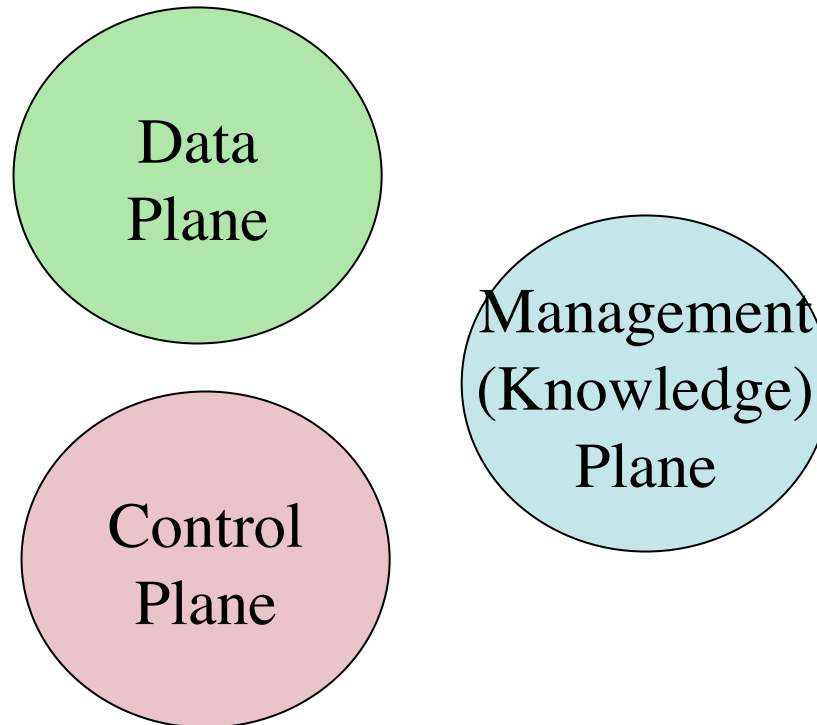
The context of network management

◆ Network management administrative domains: scope of control and responsibility is local

◆ Clientele are mobile and removed from network managers

◆ Services provided to clientele are a composite, with individual network management

Objectives

◆ Provide the service the customers' want, i.e. maintain and improve transport service for:

➤ Users

➤ Distributed applications

➤ Other networks

◆ Operate local network effectively

Requirements

◆ Recognize that local managers only have local control

◆ Local boundaries also reflect policy boundaries

◆ Problems faced by "customers" reach beyond local boundaries

◆ Minimize impact
  ➤ Performance
  ➤ Duplication of effort
  ➤ Security

Organizing principles

◆ Divide-and-conquer
- ➤ Partition and subdivide, but not necessarily strictly hierarchically

◆ As much as possible explicit rather than implicit definitions, relations, controls, etc.
- ➤ Support time and location independence

◆ Distinct layering
- ➤ Computation and reasoning
- ➤ Information

Information challenge

- ◆Storage

- ◆Discovery

- ◆Finding information

- ◆Sharing information

- ◆Reasoning over information

- ◆Extensibility of lifetime

- ◆Policy formation/composition

Computation and reasoning challenges

◆ Dealing with the nature of the information

◆ Efficiency and performance

◆ Decomposition

◆ Composition

◆ Extensibility

◆ Organizing framework

Core proposed architectural design components

◆Information Plane

◆Knowledge Plane

The Information Plane

- Collection
- Storage
- Location
- Definitions: Ontology
- Metadata
- Identity
- Policies

- Announcements or publish
- Requests or subscriptions
- Rendezvous
- Delivery
- Regionalization

The Knowledge Plane

◆ Ontology for knowledge

◆ Regionalization

◆ Function library and definitions

◆ Probabilistic programming

◆ Agent system

◆ Reasoning organization framework

Several hard research challenges

◆ Understanding organizational constraints

◆ Evaluating the impact on the network

◆ Managing information:

◆ Exposing and supporting tussles: who has incentives for what and whether compromise is possible

◆ Statistical machine learning in pervasively distributed scaled environment of Internet

◆ Pervasive efficient delivery

Value of common architecture: framework for common design

◆ Shared cost of measurement and monitoring

◆ Complementary capabilities

◆ Ability to understand, evaluate and control amount and types of cooperation and sharing to meet local constraints

◆ Framework to manage performance and evolution of network management functions

Questions?