

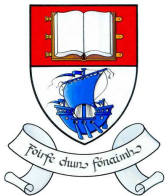
Policy Management and Autonomic Mechanisms for Seamless Mobility Networks and Applications

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MOTOROLA

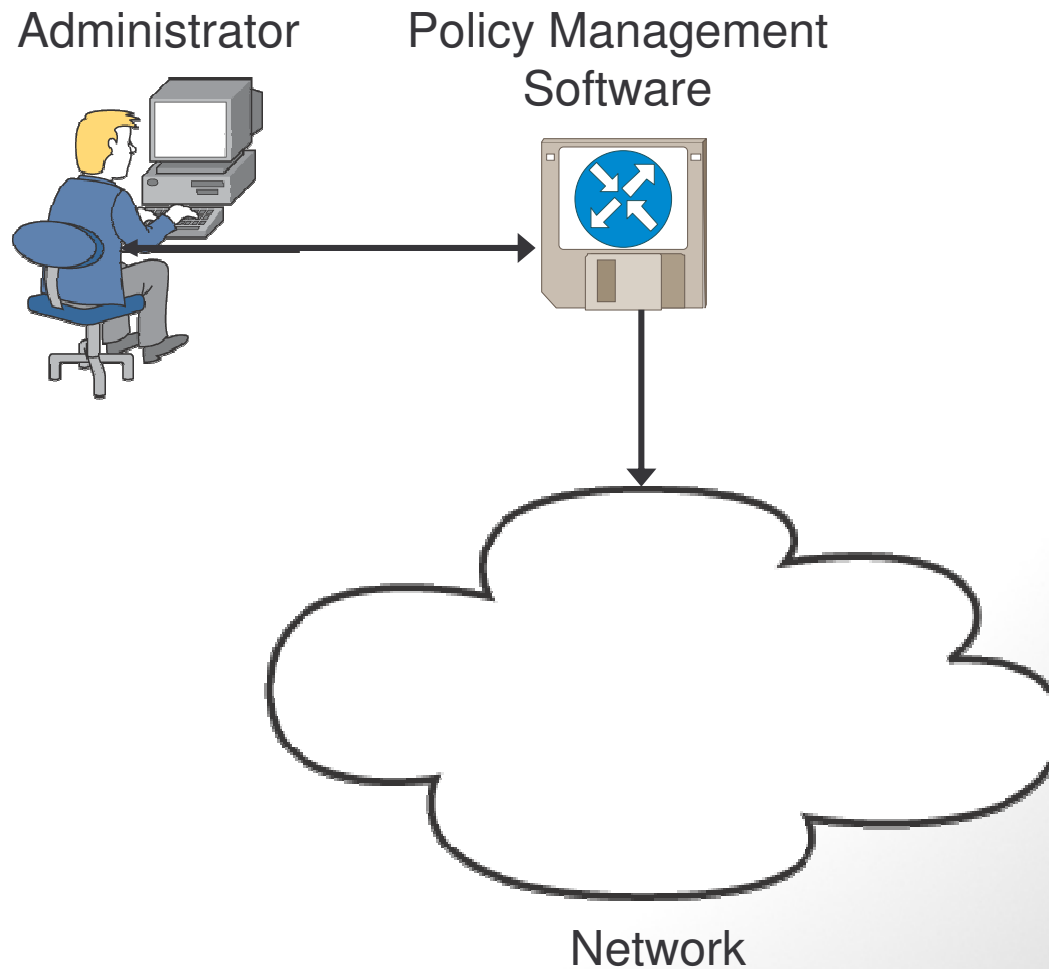
intelligence everywhere

Agenda

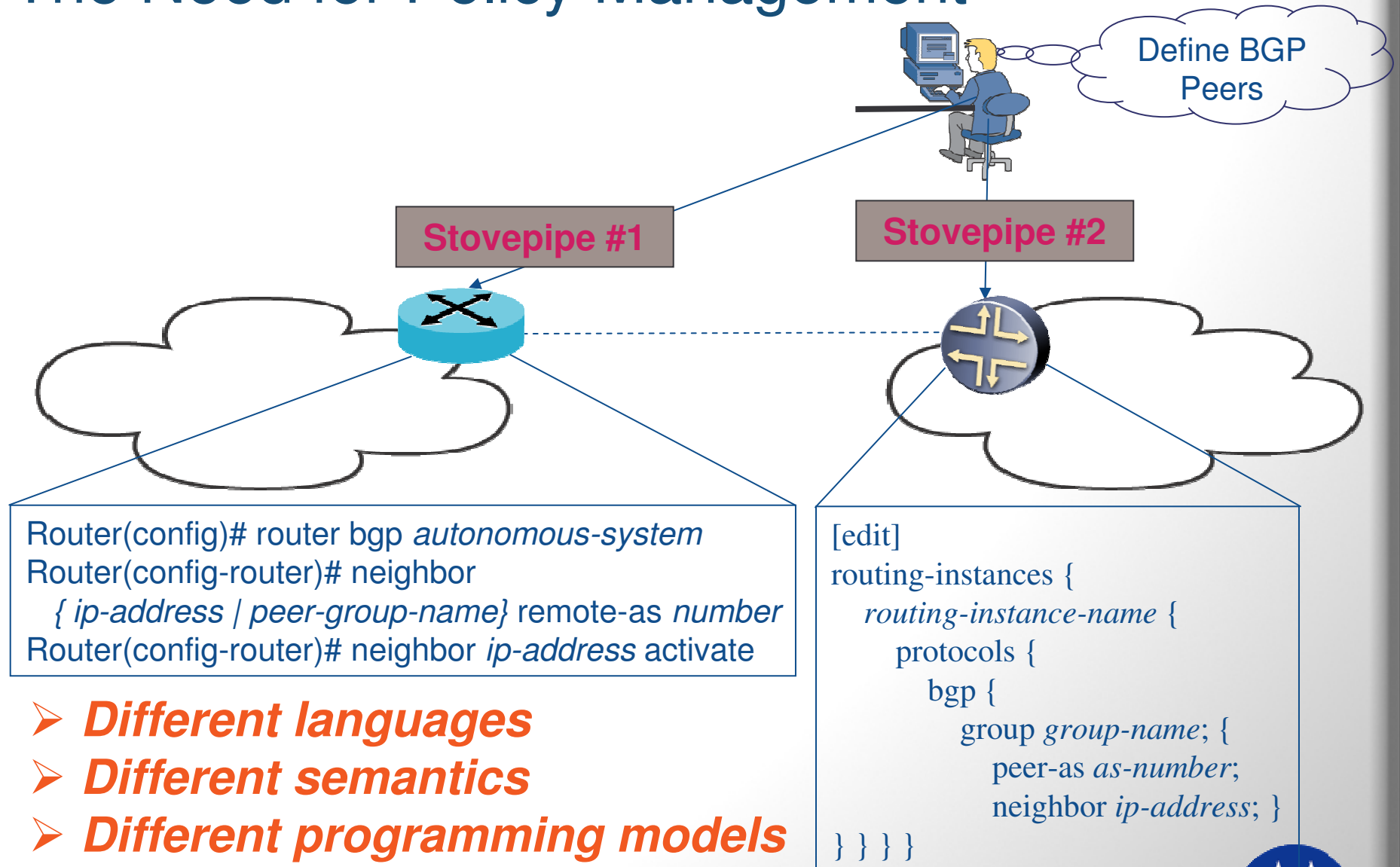
- Introduction and Motivation
- Seamless Mobility
- Autonomic *Networking*
- Policy Management
- FOCAL Architecture
- DEMO
- Conclusions



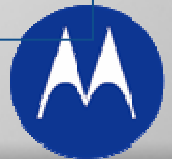
The Promise of Policy Management



The Need for Policy Management



- **Different languages**
- **Different semantics**
- **Different programming models**



The Problem – Managing *Complexity*

- **Complexity of system design and management keeps increasing**
 - Stovepipe systems: best-of-breed functionality but integration nightmares
 - Increased technology overwhelms users and administrators
 - » Different devices have different programming models and interaction models
 - » Different management tasks and integration types require different skill levels
- **The complexity of business is also increasing**
 - People are demanding a pervasive presence
 - Many types of businesses LOSE MONEY if they can't react fast enough
 - Varieties of threats, problems, and non-optimized behavior keeps increasing
- **Behavioral complexity is also increasing**
 - Everything is interconnected, requiring different policies and functions
 - Too complex to predict, needs too high a skill level, not enough people!



More Effects – Constituency Separation

- Different constituencies have different terms, grammars, and needs
 - Service Level Agreement meaning **changes**
 - Business “speak” vs. networking commands
 - Different representations (e.g., use of UML)
- Relating network services and resources to business needs
 - Not reflected in EMS and NMS design
 - Lack of **policy** controlling allocation
 - Lack of ability to
 - » Incorporate new knowledge
 - » React in a timely manner to changes



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Enabling Seamless Visualization

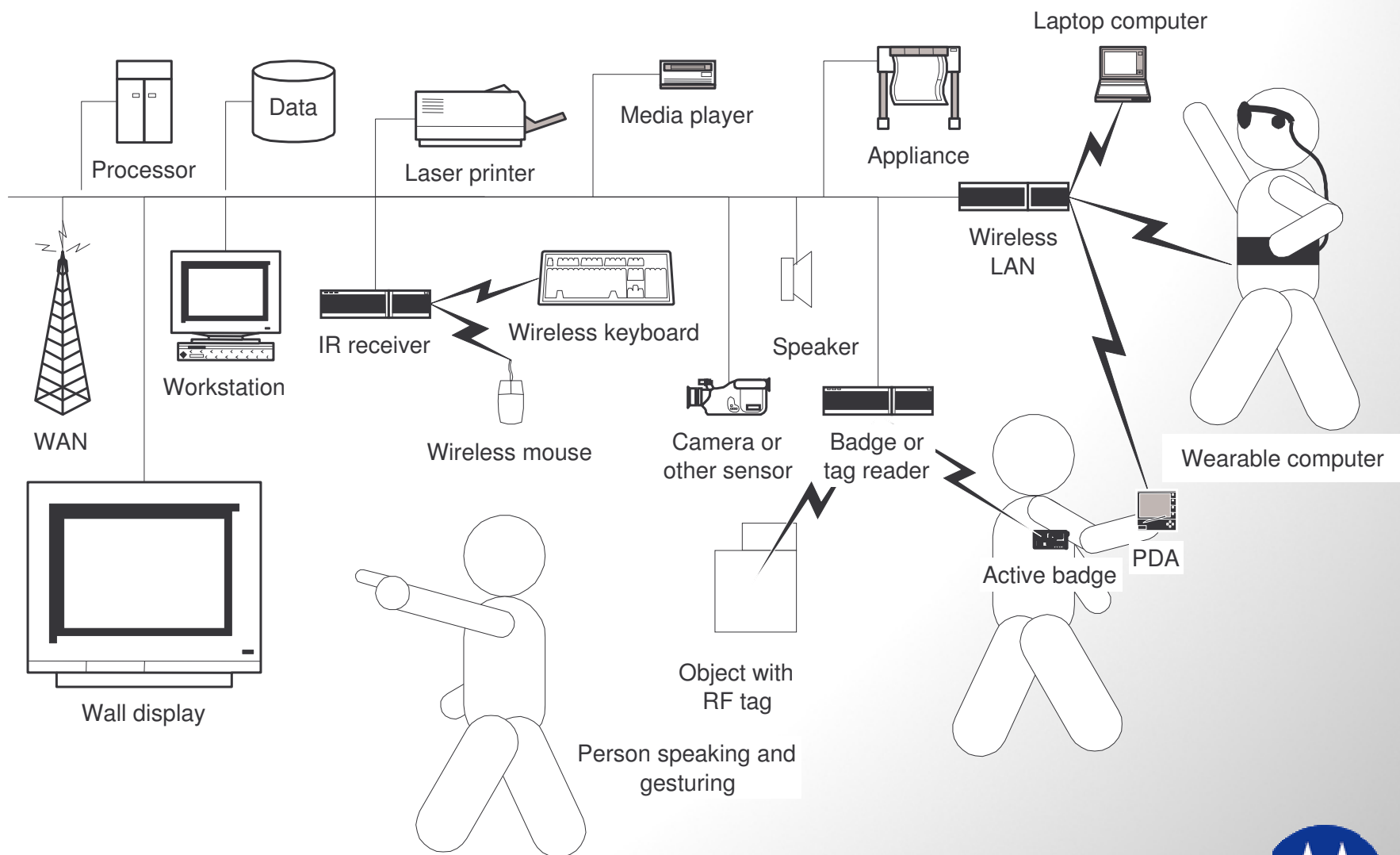


Agents and Autonomic Networking for Seamless Mobility
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Now Imagine This Environment



Seamless Mobility Vision...

Easy, un-interrupted access to information, entertainment, communication, monitoring and control

➤ *Seamless Mobility 101*

- Set of solutions to give the user the experience of being connected anywhere, anytime, to anything, with any service
- “Seamless” emphasizes continuity of experience across multiple spatial domains, devices, network protocols and access modes
- “Mobility” is the next phase of the internet revolution that allows users to communicate and manipulate information regardless of location

Seamless mobility is a framework architecture that enables devices and networks to interoperate using compatible, reusable software



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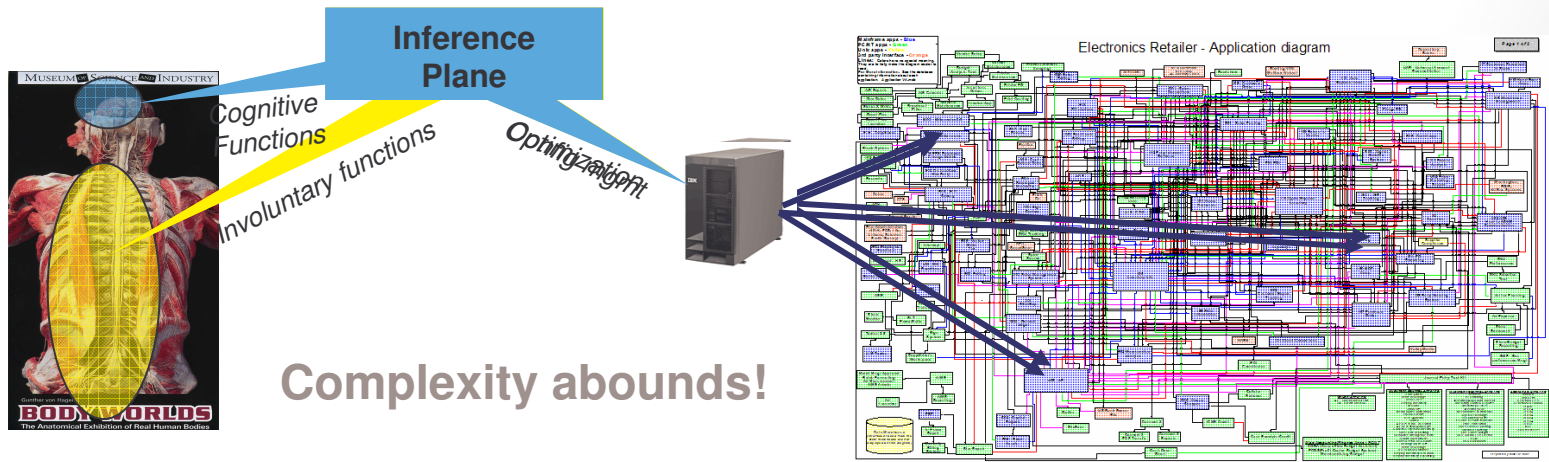
Autonomic Networking Definition

- An autonomic system is a self-governing system
 - governance model is expressed using policies
 - policies are bound to business goals
- Self-governance is accomplished through the use of self-knowledge
 - model the capabilities of the system, as a function of context
 - model the constraints placed on the system, as a function of context
- Closed control loop enables the system to
 - sense changes in itself and its environment
 - analyzes changes to ensure that business goals are still being met
 - plan changes to be made if business goals and objectives are threatened
 - execute those changes, and observes the result
- Control loop augmented by self-learning and reasoning processes



Autonomic Networking

Biology, Sociology, and Economics can Inspire Better Networks!



- *Technical* complexity: human body ⇔ technology, devices
- *Business* complexity: macro-economics ⇔ e- and m-Commerce
- *Behavioral* complexity: social interaction ⇔ service composition
- *Operational* complexity: healing ⇔ anti-virus, configuration management



Autonomic Computing and People

A Partnership

- People *express* at a high level what they want the system to achieve
 - System will optimize according to its capabilities and constraints
- The system strives to manage its own behavior to optimally satisfy these multiple criteria, given appropriate constraints
 - **Resource constraints:** Hardware, software, people
 - **Business constraints:** Cost, revenue, customer retention/loyalty, ...
 - **Application constraints:** How to ensure that different applications having different resource constraints *peacefully coexist*
- People and self-managing systems will work together iteratively, in partnership with one another
 - Let people will do what they're best at, remove management burden
 - Systems will gradually assume more management burden
 - » As they become more competent to do so (machine learning and reasoning)
 - » *As people become more comfortable with this*

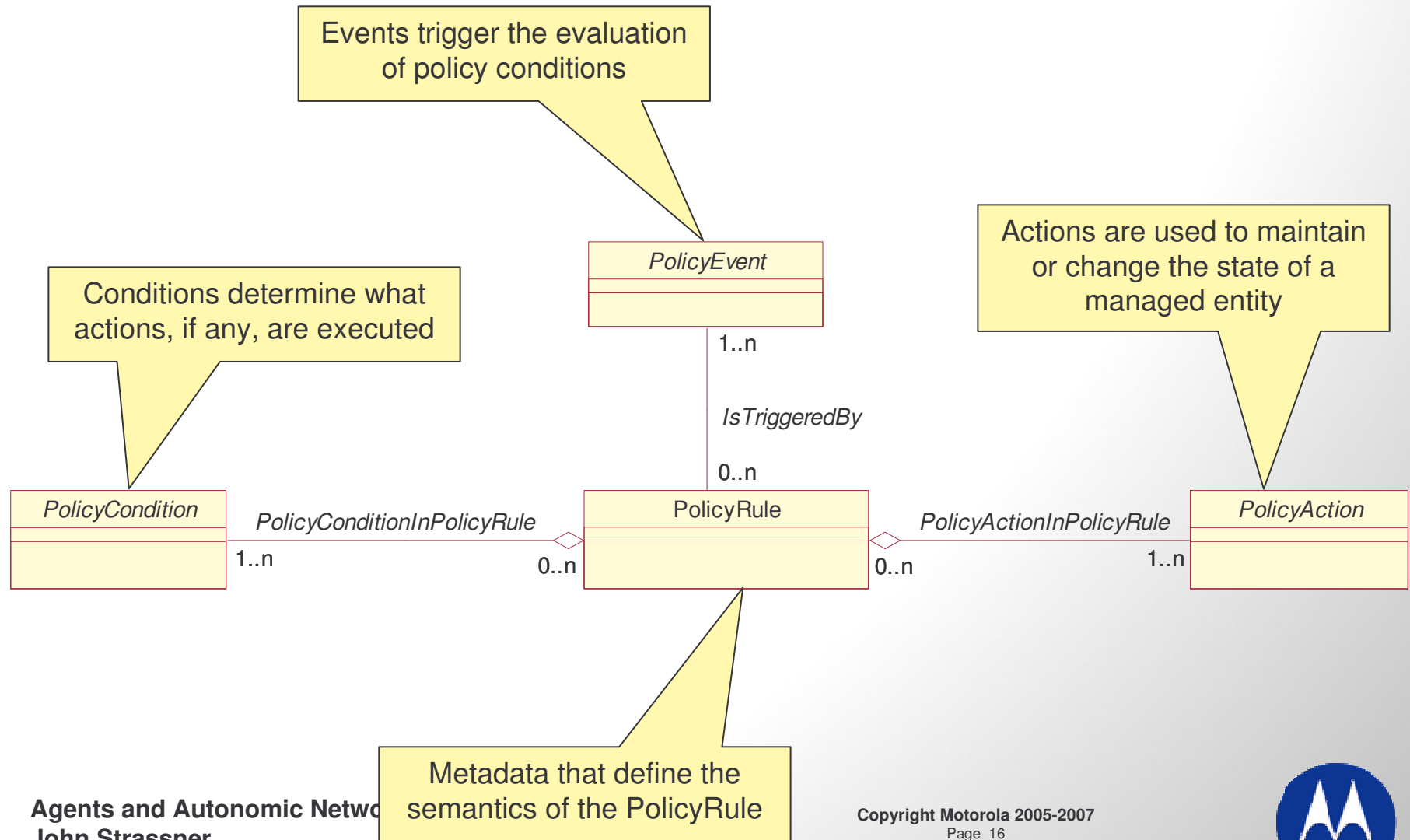


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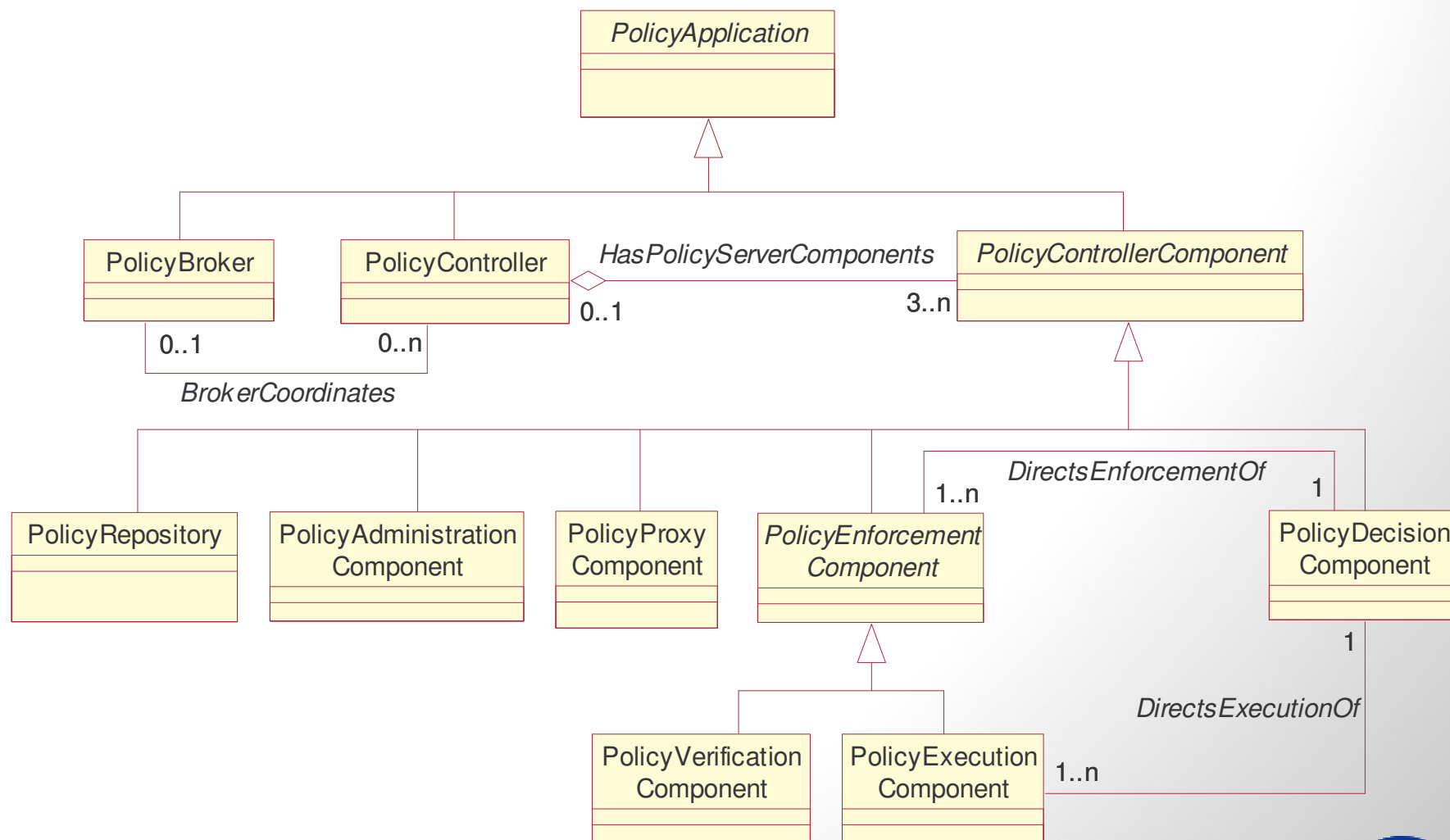
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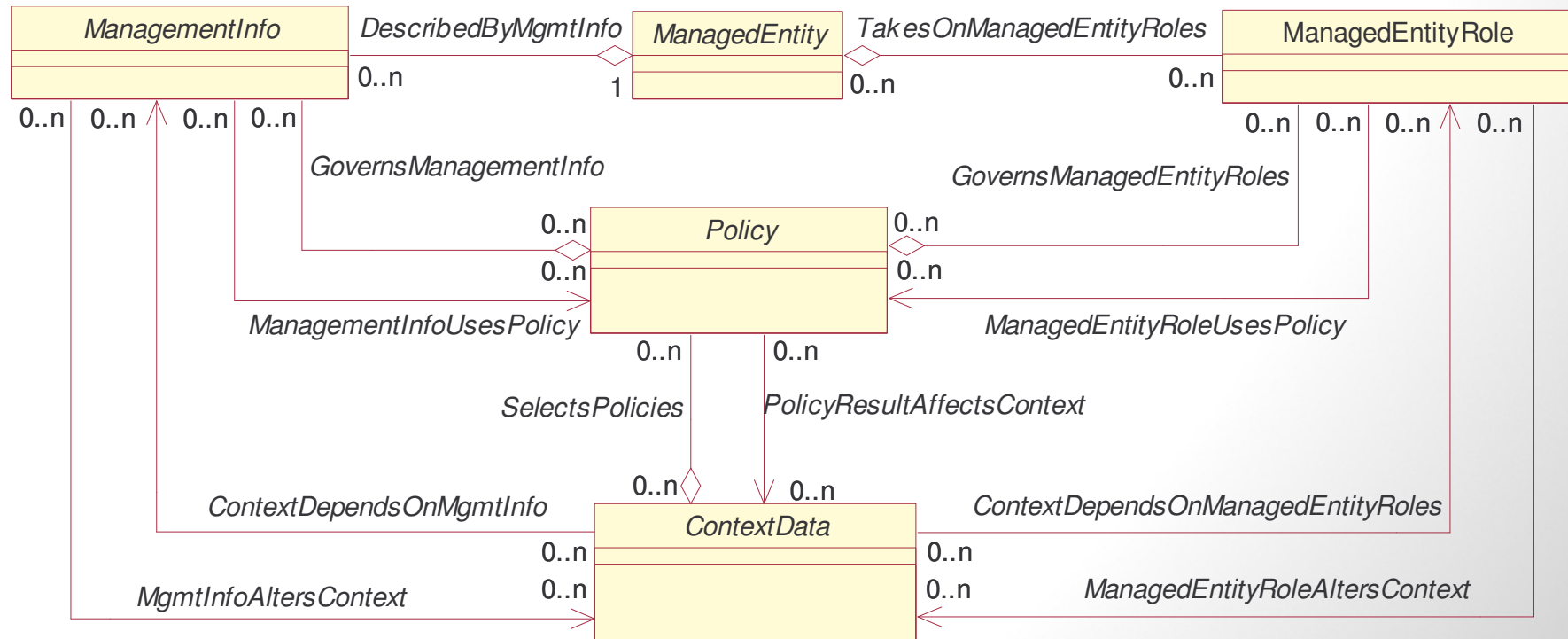
DEN-ng SIMPLIFIED Policy Model



Enhanced Policy Architecture



Simplified DEN-ng Context Model



Motonomics Business Policy Language

autonomics-policy - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Address file:///C:/tibco_3_1_0/gi/shell.html?jsxapppath=JSXAPPS/autonomics-policy

Google

Motonomics Policy System

- Policy Rule Library
 - Drill Down Decision
 - Event List
 - Voice Call Event
 - Condition List
 - Voice Quality KQI Violation
 - Action List
 - Perform Drill Down Action
 - Do not Perform Drill Down Action
 - Log Alarm Events
 - Log Normal Events
 - Policy 1
 - Event List
 - Event 1
 - Event 2
 - Condition List
 - Condition 1
 - Condition 2
 - Action List
 - Action 1
 - Action 2
 - Action 3
 - Action 4
- Policy Event Library
- Policy Condition Library
 - Condition 1
 - Condition 2
- Policy Action Library

Policy Event | Policy Condition | Policy Action | Policy Rule

Policy Rule Name:

☒ Include Comment

This policy is used to determine when to initiate a drill down for more specific analysis based on data that is related to specific KQIs and their associated KPIs. The drill down analysis will be used to determine which optimization should be applied to improve the performance of the CDMA system back to nominal levels.

Policy Rule Options:

Policy Rule is:
☒ ENABLED
☐ NOT ENABLED
☐ IN TEST

Policy Rule has Priority:

Policy Rule Body

Policy Rule Event Name: **Voice Call Event**
Policy Rule Condition Name: **Voice Quality KQI Violation**

If condition is TRUE execute following actions:
Drag and Drop Actions to the List Below

Action Name
Perform Drill Down Action
Log Alarm Events
Log Alarm Events

If condition is FALSE execute following actions:
Drag and Drop Actions to the List Below

Action Name
Log Normal Events

Save Restore

Policy Text

```
CREATE POLICY RULE NAMED "Drill Down Decision"
BEGIN COMMENT
  "This policy is used to determine when to initiate a drill down for more specific analysis based on data that is related to specific KQIs and their associated KPIs. The drill down analysis will be used to determine which optimization should be applied to improve the performance of the CDMA system back to nominal levels."
END COMMENT
BEGIN RULE OPTIONS
  THIS POLICY RULE IS "Enabled"
  THIS POLICY RULE HAS PRIORITY "100"
END RULE OPTIONS
BEGIN BODY
  ON OCCURANCE OF EVENT NAMED "Voice Call Event"
  IF THE CONDITION "Voice Quality KQI Violation" IS SATISFIED THEN
```

TIBCO Software® - Professional Edition

Done

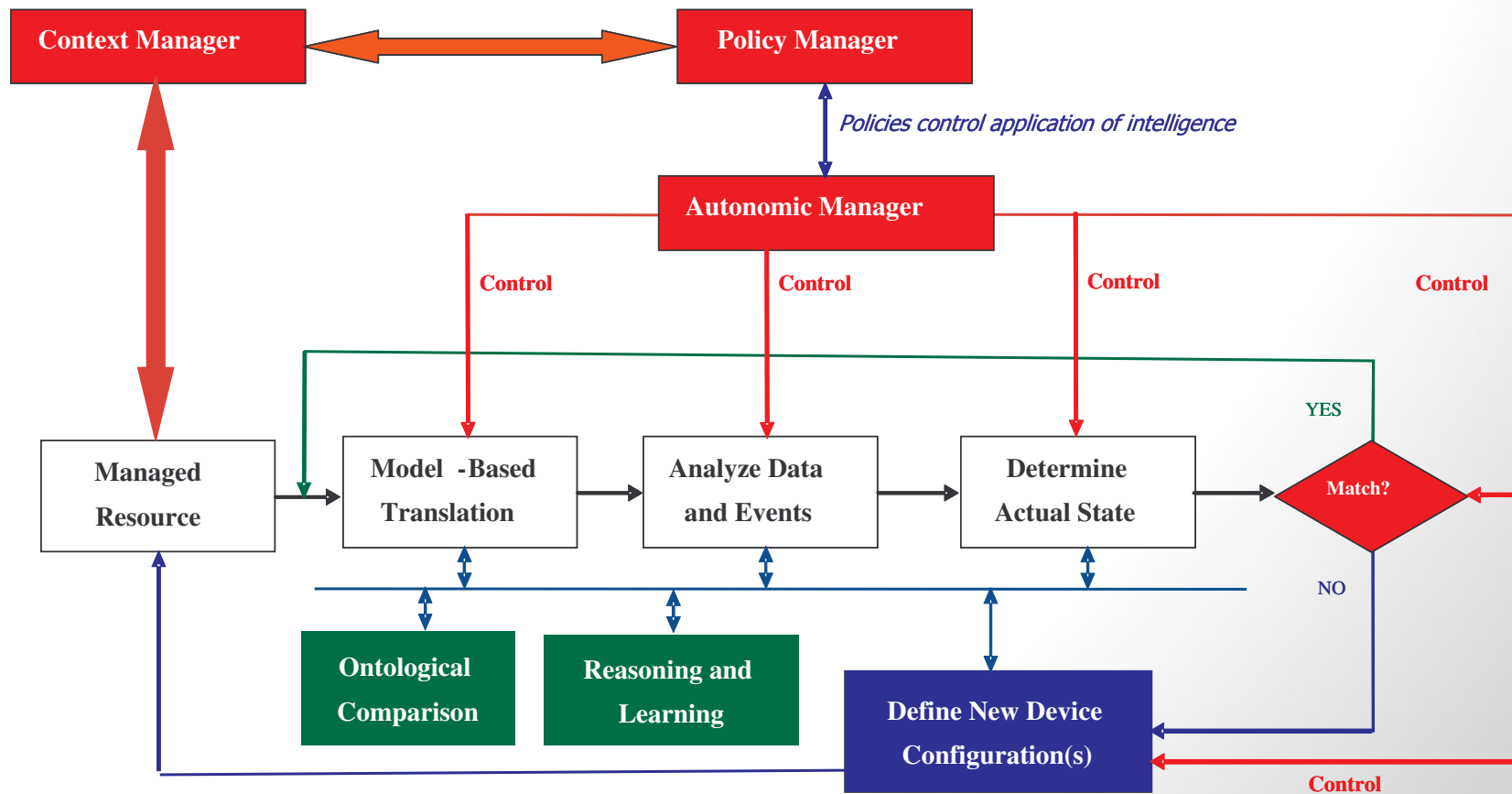
My Computer

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Simplified Version of FOCALE



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Conclusions

- Goal is to manage complexity of wireless systems
- Defined a context-aware, policy-based autonomic architecture, whose novelty includes
 - uses multiple controls loops
 - can vary the functionality of each control loop according to context
 - context changes select a new set of policies, which select a new set of roles, which adapts functionality to new context
 - uses model-based transformation to harmonize different sensor data
- SLAs mapped into programmable KQIs and KPIs
 - drill down using DROOLS to determine the root cause
 - remedy the problem using causal analysis via supervised classification
- Future work
 - Add ontologies to ***reason*** about the system's ***formal correctness***
 - Conduct experiments using the **FOCALE** architecture



Questions?



“Create like a god. Command like a king. Work like a slave”
- Constantin Brancusi