Policy Management and Autonomic Mechanisms for Seamless Mobility Networks and Applications

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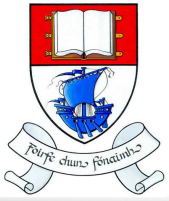
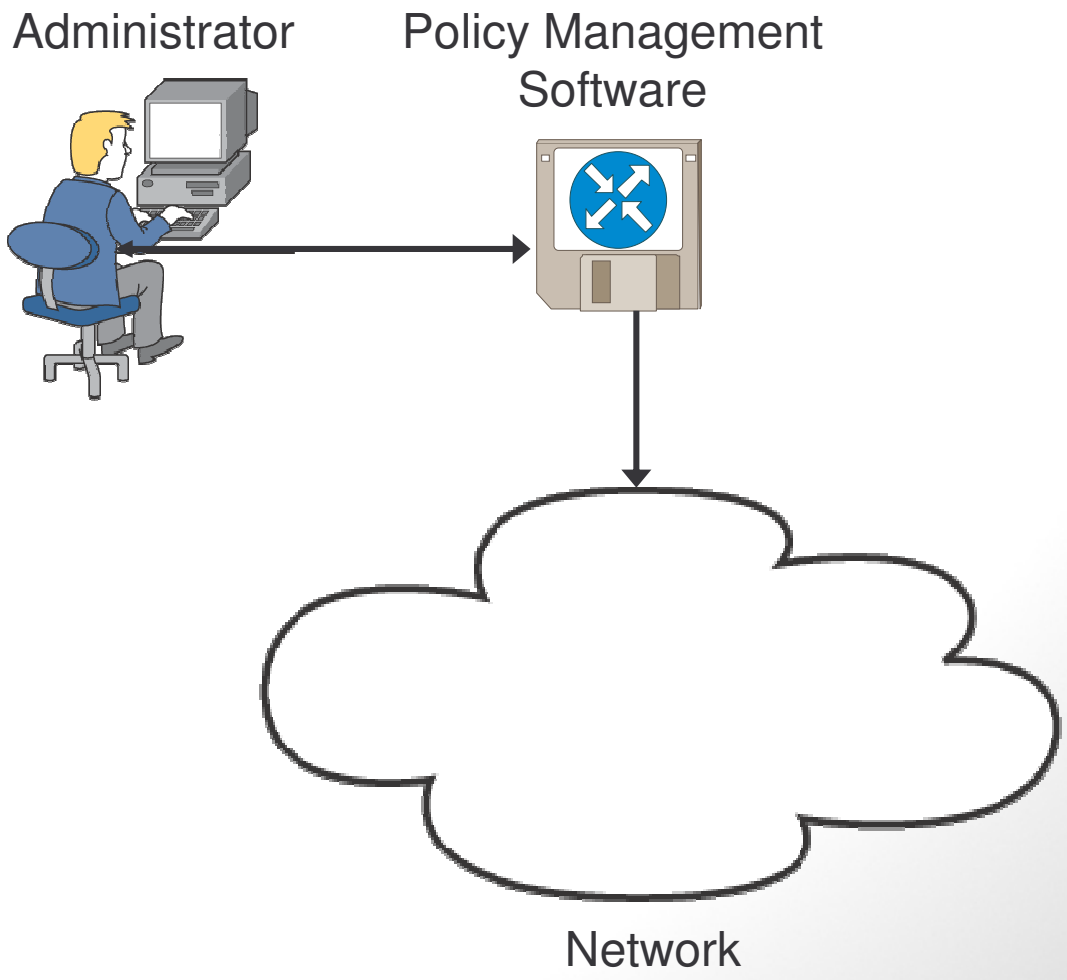


MOTOROLA
intelligence everywhere

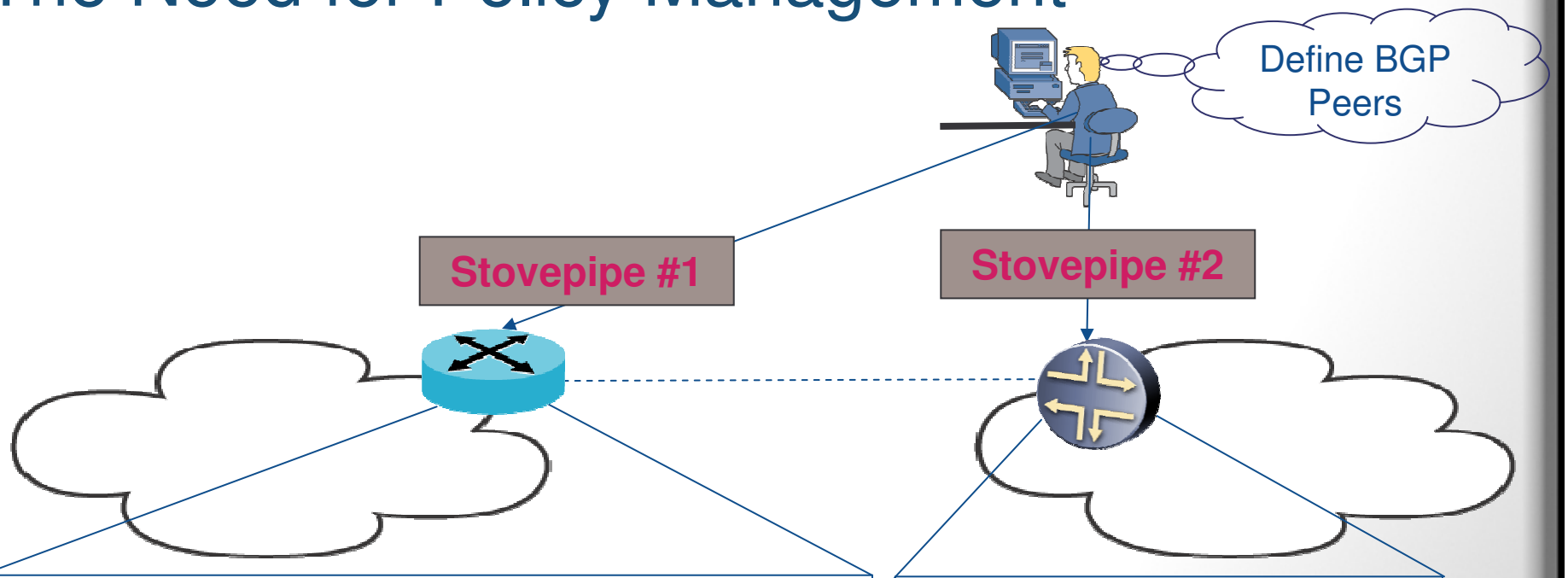
Agenda

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

The Promise of Policy Management



The Need for Policy Management



Router(config)# router bgp *autonomous-system*
Router(config-router)# neighbor
{ ip-address | peer-group-name} remote-as *number*
Router(config-router)# neighbor *ip-address* activate

```
[edit]
routing-instances {
    routing-instance-name {
        protocols {
            bgp {
                group group-name; {
                    peer-as as-number;
                    neighbor ip-address; }
} } } }
```

- ***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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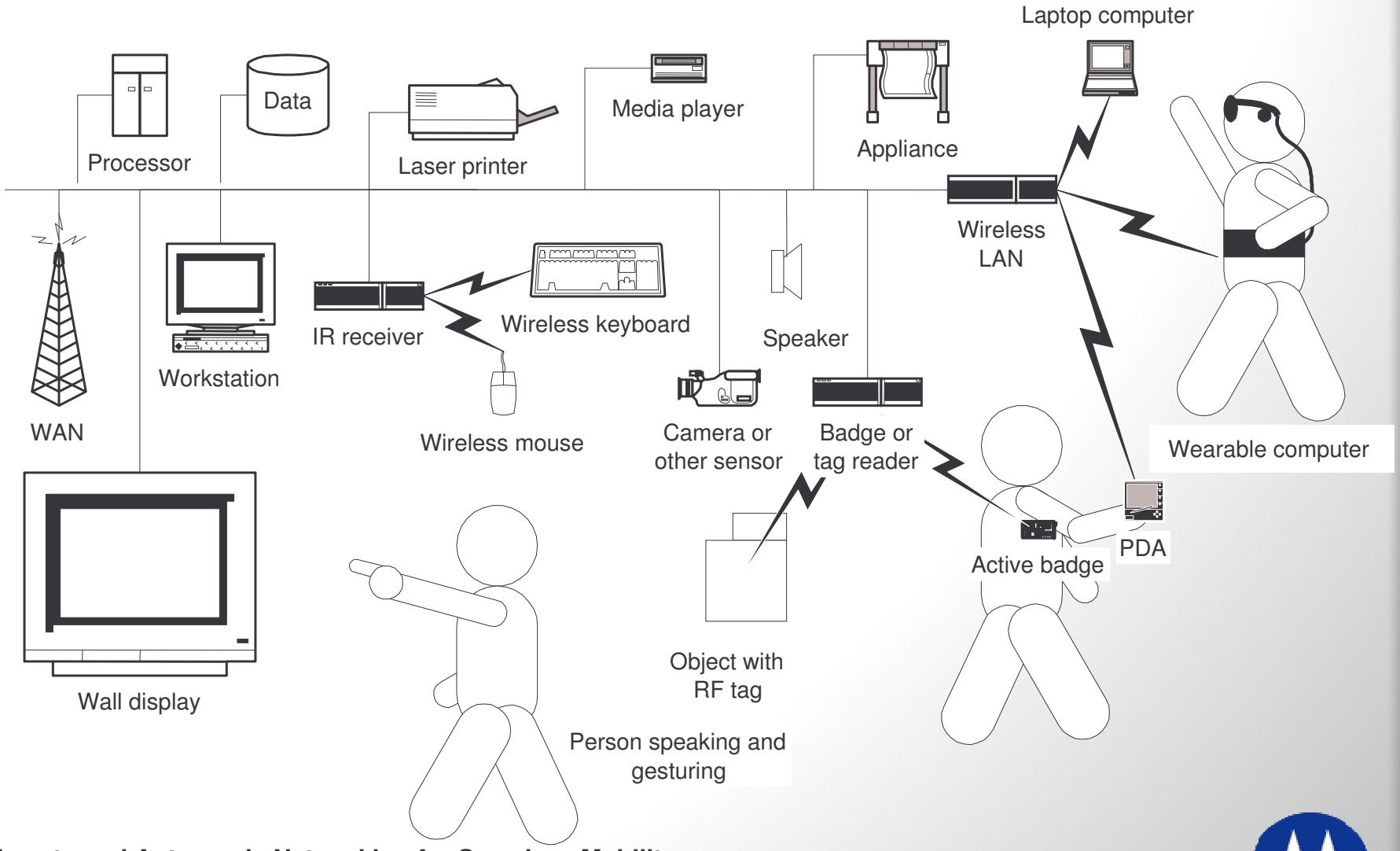
Enabling Seamless Visualization

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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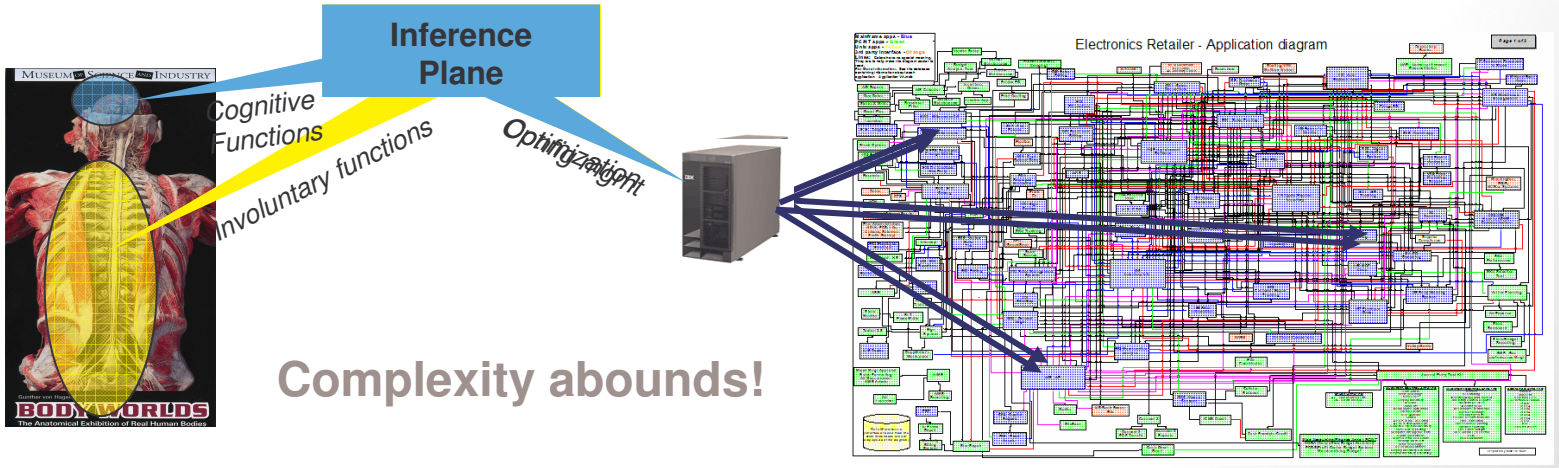
Autonomic Networking Definition

- 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!



Complexity abounds!

- *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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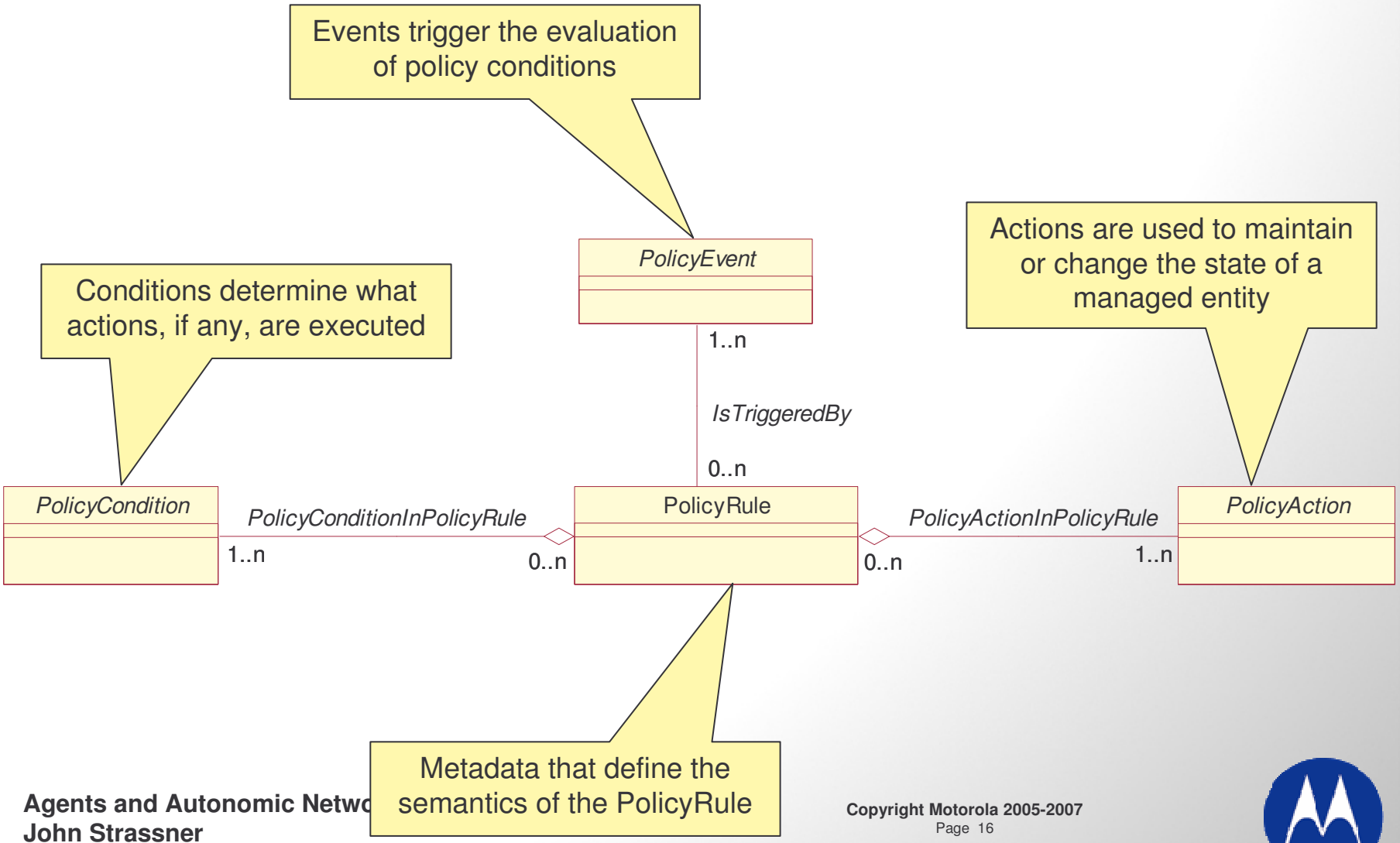
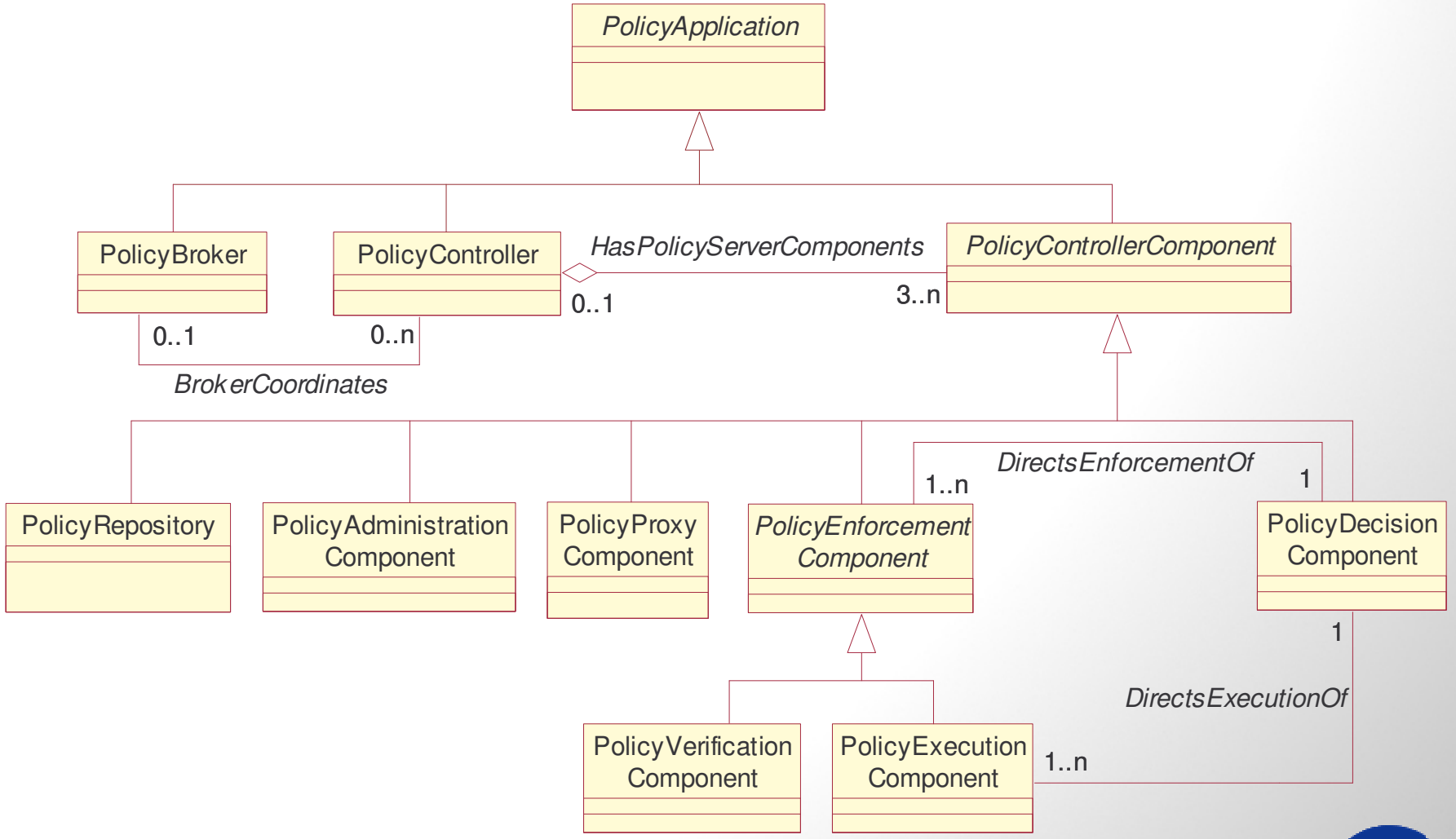
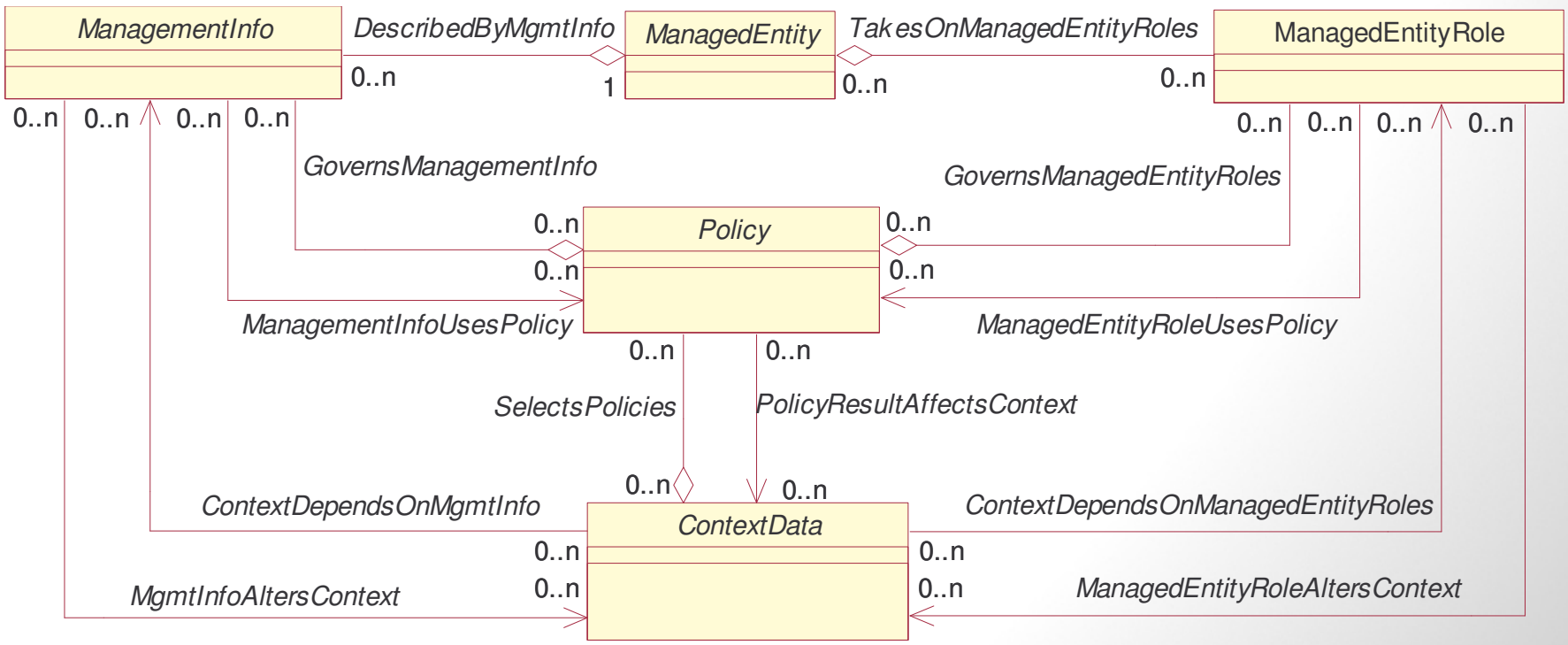
DEN-ng SIMPLIFIED Policy Model



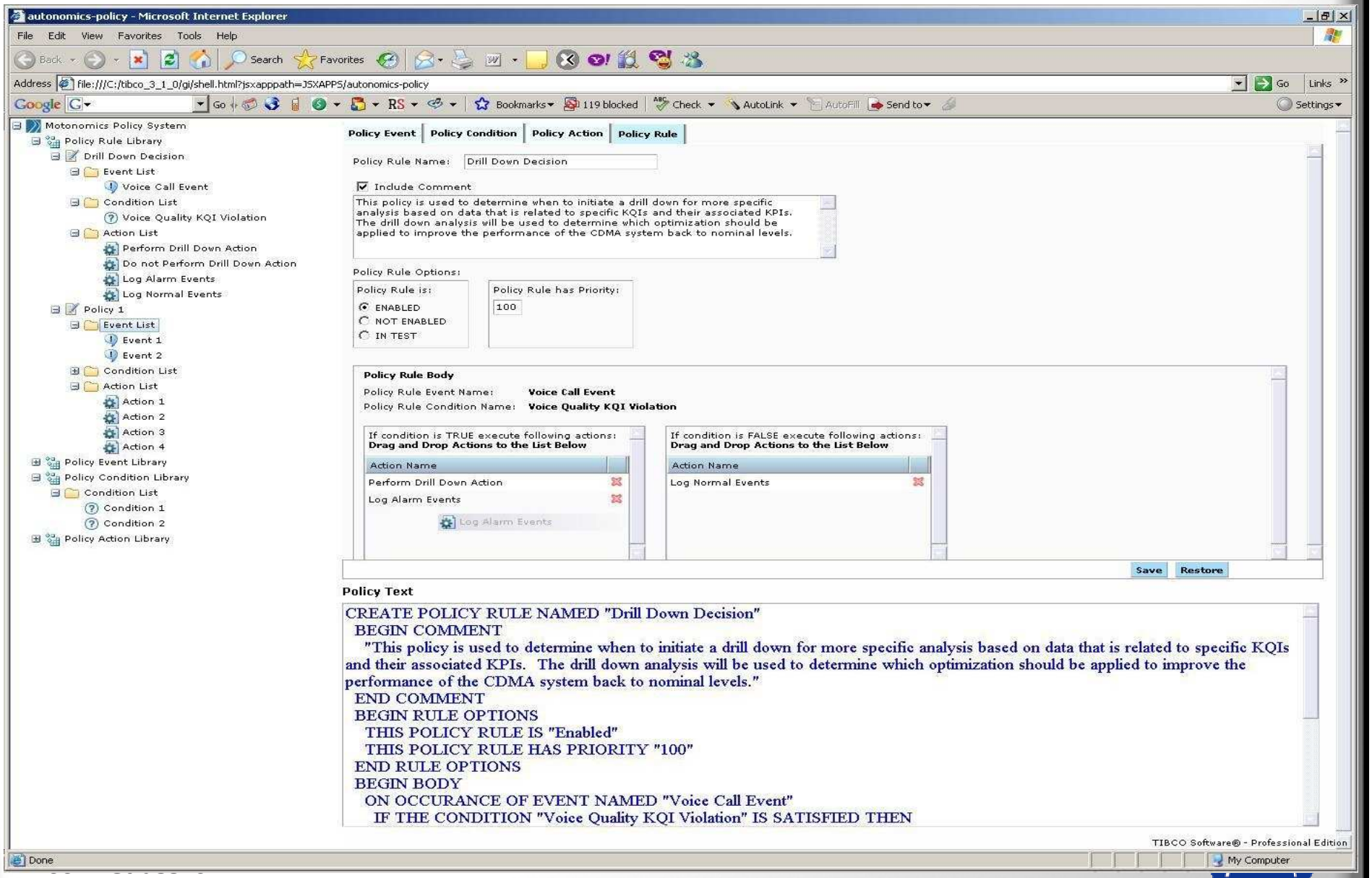
Enhanced Policy Architecture



Simplified DEN-ng Context Model



Motonomics Business Policy Language



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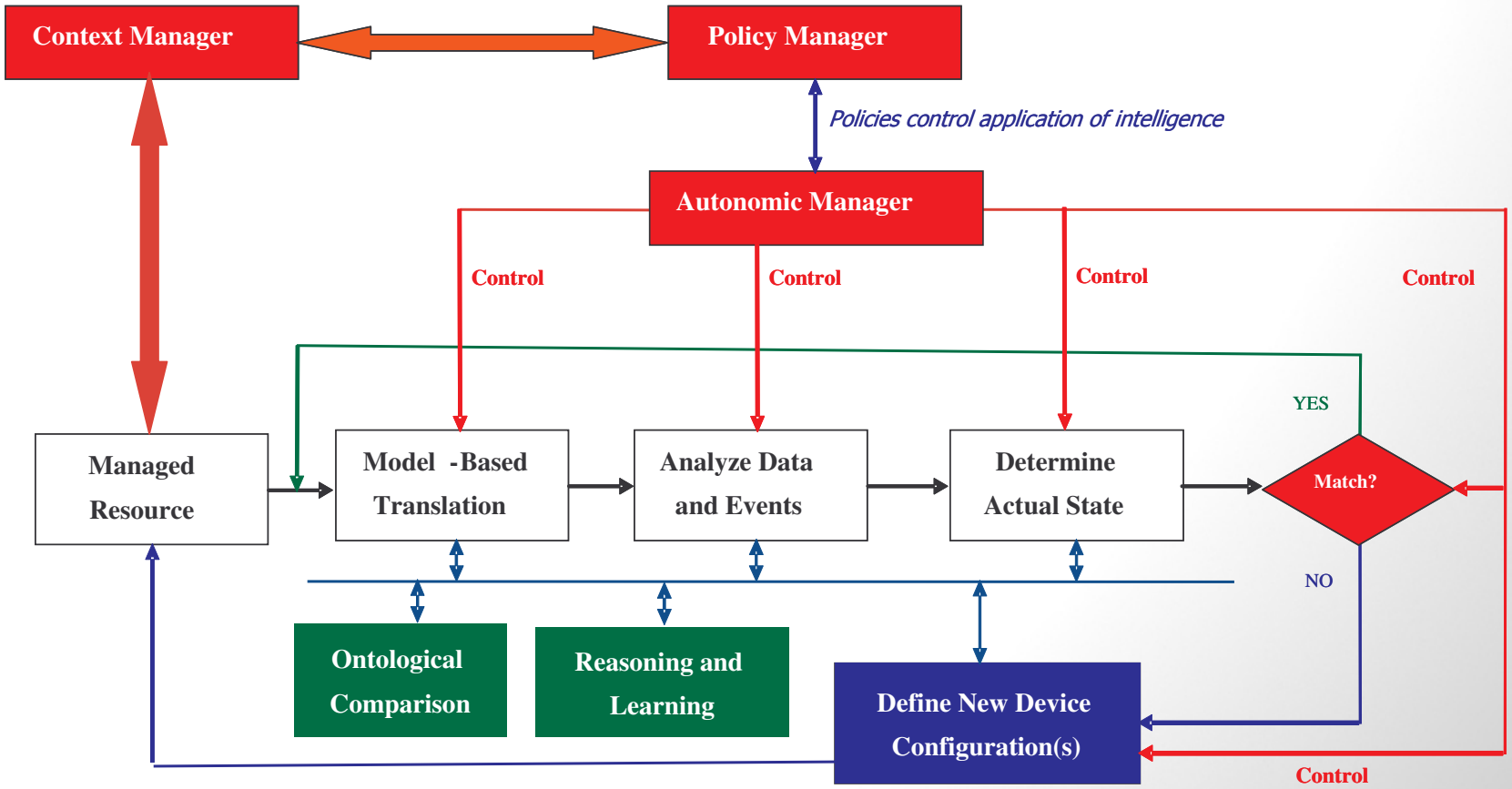
Simplified Version of FOCALE



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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