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# On Policy-based Extensible Hierarchical Network Management in QoS-enabled IP Networks

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# Presentation Outline

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- ◆ **Policies in the Research Community and IETF**
- ◆ **Considerations on Policy-based Management**
  - Enterprise Networks
  - Telecommunication Networks
  - Policy-Based Management
- ◆ **Hierarchical Policies**
- ◆ **Policies in the TEQUILA functional architecture**
- ◆ **Summary and Future work**



# Policies in the Research Community

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- ◆ **Distributed models**
- ◆ **Hybrid manager-agent applications with policies representing their management intelligence**
- ◆ **Policies: objects defining the relationships between subjects (managers) and targets (managed objects)**
- ◆ **Generic Classification of Policies**
- ◆ **Specification of Policy Notations**
- ◆ **The issues of Policy refinement and conflicts**



# Policies in IETF

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- ◆ **Centralised Model**
- ◆ **PDPs enforcing policies operating on MOs within the NE**
- ◆ **Policies are seen as the means to elevate the level of control to the network level**
- ◆ **Policy is defined as an aggregation of Policy Rules**
  - **Policy Rule: if <condition> then <action>**
- ◆ **Development of O-O information model for representing policies**



# Enterprise Networks

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- ◆ **Managed with SNMP**
- ◆ **Single centralised “Network Management Centre”(NMC)**
- ◆ **NMC monitors the managed devices – infrequent re-configuration without using automated logic, according to predefined network policy**
- ◆ **No conflicts in this architecture**
- ◆ **Suitable for best-effort IP networks but not for multiservice networks**



# Telecommunication Networks

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- ◆ **Managed according to TMN model**
- ◆ **(Re-)Configuration of NE occurs through EM, orchestrated by a NM**
- ◆ **NM implements network-wide policy through automated logic**
- ◆ **Configuration Manager holds the physical and logical network topology**
- ◆ **Requests from other managers are validated but conflicting configuration requirements are possible**



# Policy-Based Management(PBM)

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- ◆ **Management logic in Policy-Based systems is expressed through declarative policies**
- ◆ **The essence of PBM: management intelligence can be modified, added and removed by manipulating policies**
- ◆ **Conflicts are the norm rather than the exception**
- ◆ **Policies must be seen as a means to “late bind” functionality to an existing management system**
- ◆ **A hierarchically distributed system is needed to meet the requirements of multiservice networks**



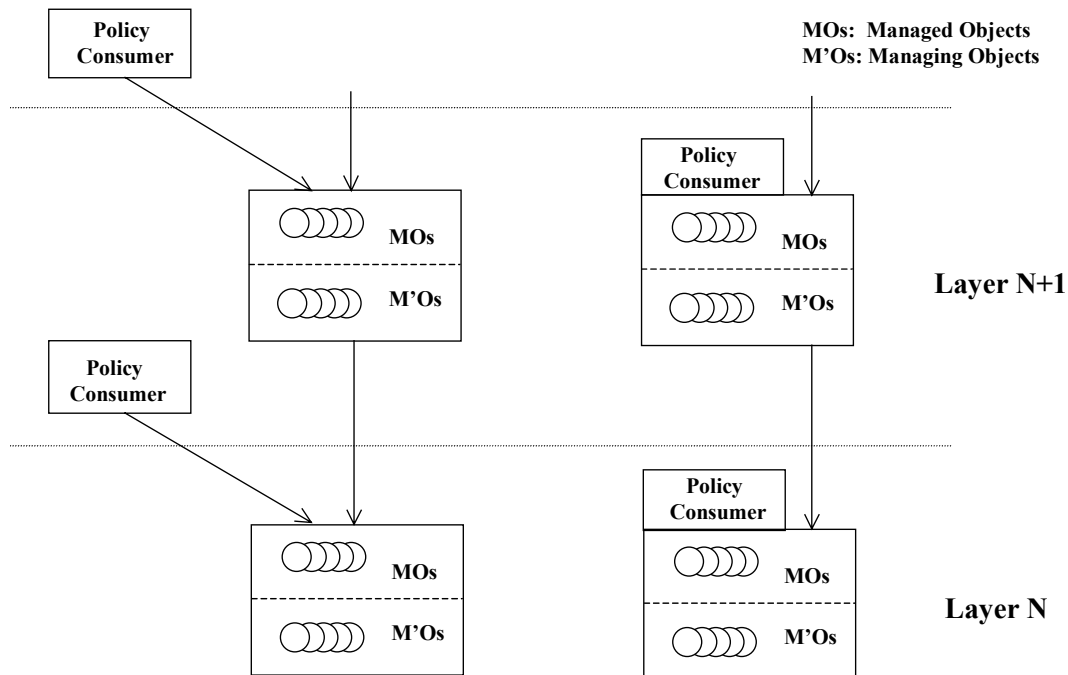
# Hierarchical Policies...

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- ◆ **Hierarchical Management Systems consist of hybrid agent-manager applications**
- ◆ **Agent-manager application at layer N comprises:**
  - **MOs presenting the capabilities to layer N+1**
  - **M'O's or management logic accessing MOs of the layer N-1**
- ◆ **Simplest form of introducing Policies to a Hierarchical Management System:**
  - **Centralised Policy Consumer point accessing MOs at all the layers of the hierarchy**
- ◆ **Proposed approach: hierarchical structure of Policies**

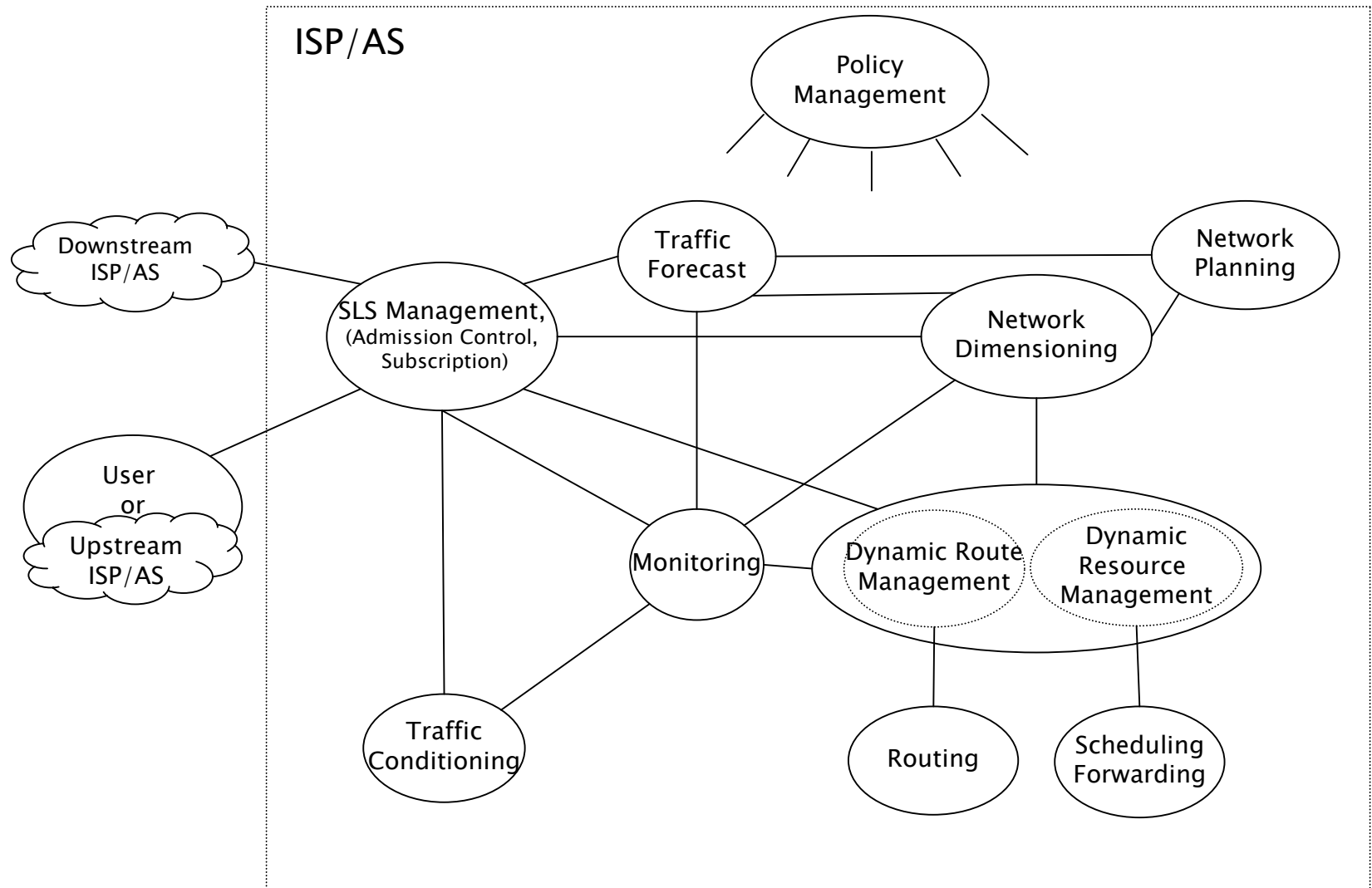
# ...Hierarchical Policies...

- ◆ Policies may be considered as part of the managing intelligence of layer N+1 and could execute at layer N+1 (left)
- ◆ Policies could execute at the agent-manager having local access to MOs (right)

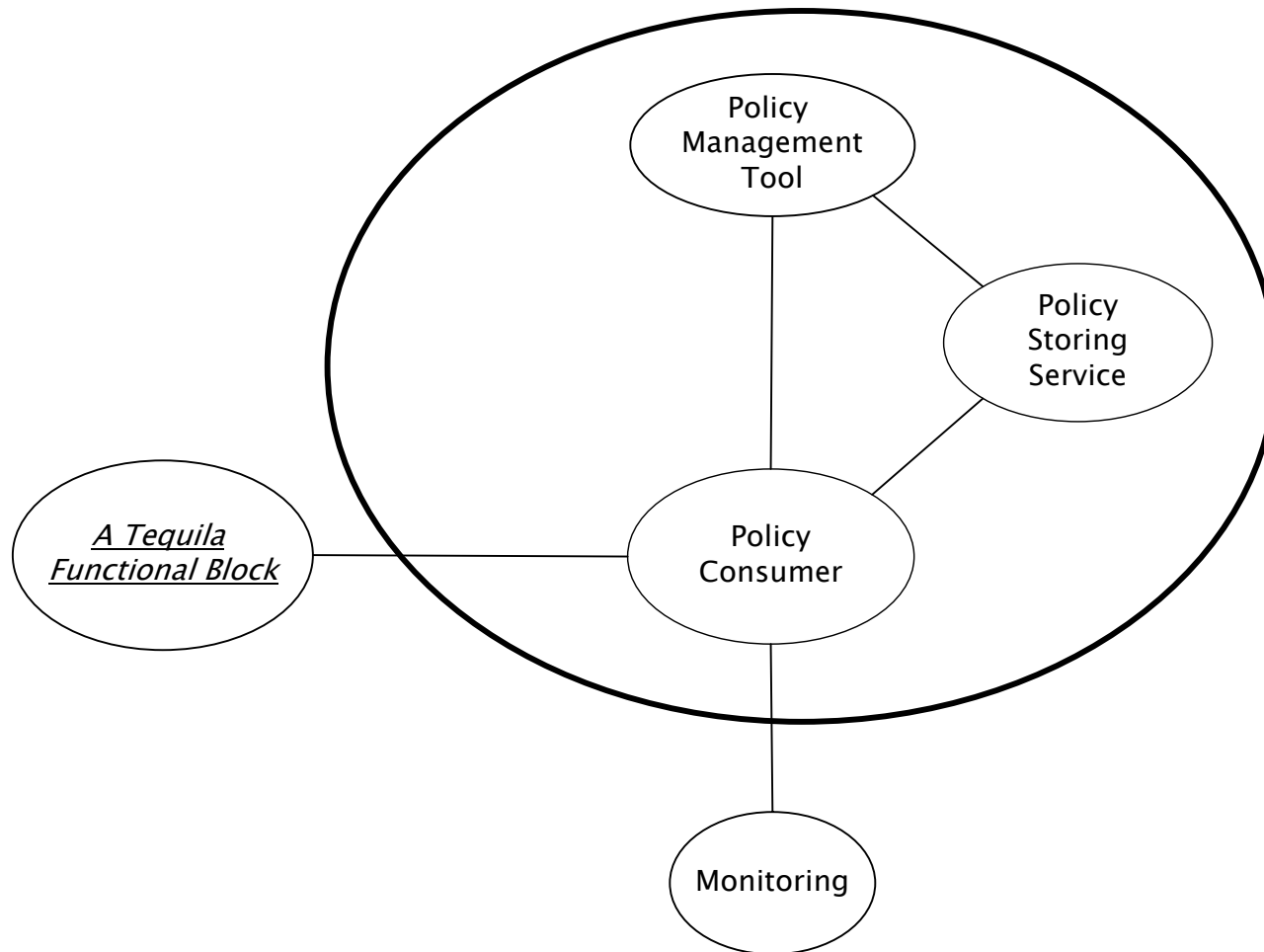


- ◆ **Policies complement the static management system intelligence**
  - How much intelligence should be realised in a static fashion?
  
- ◆ **Policy transformation and refinement**
  - High-level Policies may result in the introduction of related policies at lower layers
  - Guidelines may be devised and followed in the context of a specific nature hierarchical system that will assist and automate the process of refinement

# The TEQUILA functional architecture

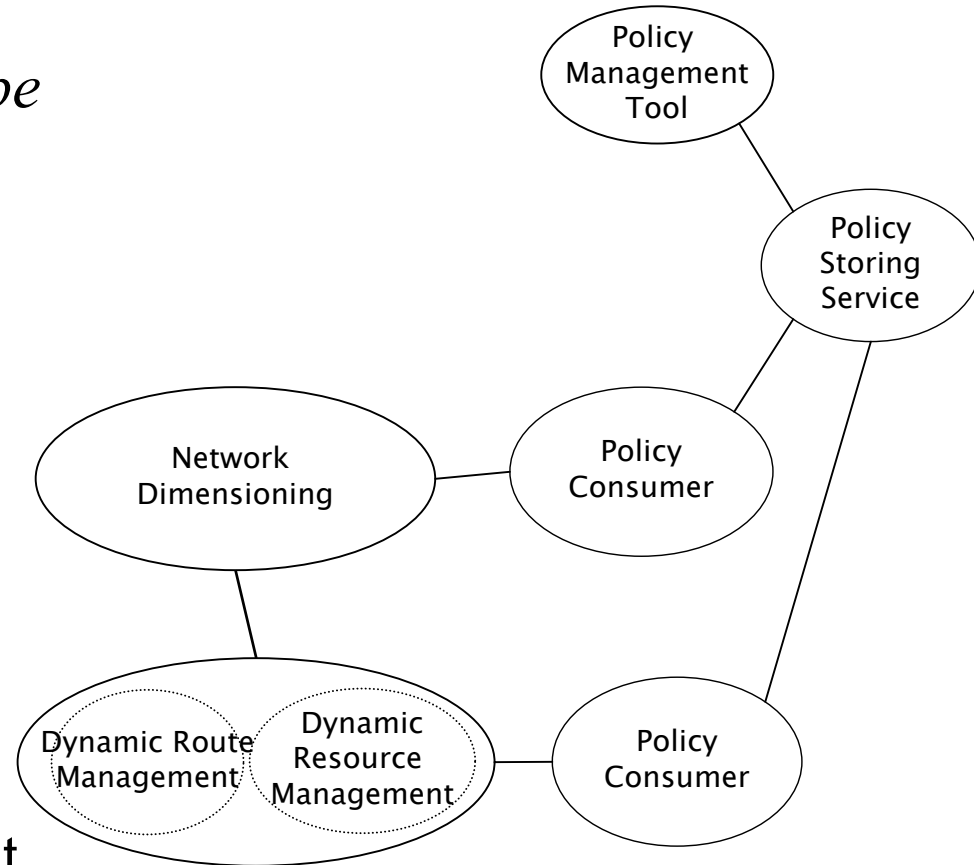


## Policy Management



# An Example of Hierarchical Policy

- ◆ *“At least 10% of Network Resources should always be available for EF traffic”*
- ◆ Template of the generic policy class:  
*<bound><percentage> of Network Resources <period> available for <traffic type>*
- ◆ Decomposed into:
  - a dimensioning policy
  - a dynamic resource mgmt policy





# Summary and Future Work

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- ◆ **Description of the characteristics of policy-based management and their coexistence with hierarchical management systems**
- ◆ **Fundamental target is a management system able to sustain requirement changes and evolve through policies without changing its initial “hard-wired” logic**
- ◆ **Future work:**
  - **Definition of O-O Information model representing the capabilities of each layer of the TEQUILA architecture**
  - **Specification of dimensioning and dynamic resource & route management policy classes**
  - **Explore the concept of decomposition and refinement**