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Policy-Based Technologies Enabling The Distributed Data Fabric

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Policy-Based Technologies Enabling The Distributed Data Fabric

Abstract

To achieve the operational vision of digital command and control concepts such as ABMS, system architects require new foundational capabilities to synchronize a large network of decentralized data platforms. Effective policy-based technologies to leverage the “data fabric” that exists with these loosely-coupled, and at times disconnected data sources, should be a core capability of a decentralized, data-centric architecture.

As operational cyber-physical systems and enterprise information systems continue to converge, IBM continues to develop distributed computing capabilities that align very well with ABMS foundational elements:

- Policy-based technologies for self-management and human supervised automation
- Generative policies that allow airborne assets to determine and generate their own policies of operation
- Data summarization capability which optimizes the amount and speed of data transfer
- Self-configuring, self-healing, self-optimizing, self-protecting infrastructure
- Edge AI infrastructure that is bandwidth optimized

Policy-based technologies establish rules governing the choices in behavior of complex systems-of-systems architectures such as ABMS. The original focus for the application of policy-based technologies was the management of Quality-of-Service within communications networks, and many of the concepts employed in the formulation and use of policies have been around for years. Policies can be used for provisioning of virtual private networks, for deployment of distributed applications, and for management of all aspects of computing systems in a pervasive computing environment. This has led to the evolution of a software paradigm denoted as policy-based computing, a core capability to support the type of data autonomy envisioned with ABMS.

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running a large number of systems at scale requires a significant bit of human interaction

operational cyber-physical systems and enterprise information systems convergence and proliferation of AI

policy-based technologies extend the data fabric that exists with these loosely-coupled systems

Policy-Based Technologies

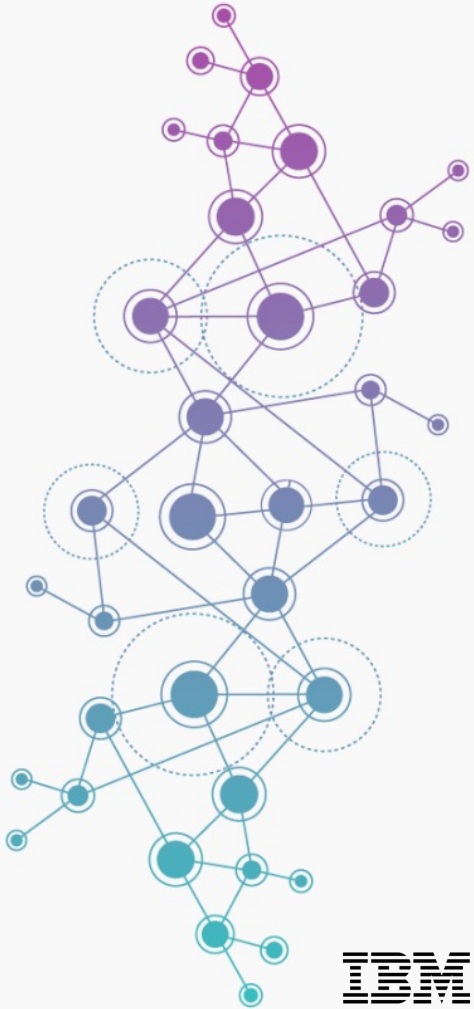
Originated in the management of Quality-of-Service within communications networks

Policy is a set of considerations designed to guide decisions on courses of actions, usually a rule in form of ....

if <Condition> then <Action>

Generative policy-based systems enable systems to determine their own behavior

Policy definitions infusing AI capabilities into legacy systems



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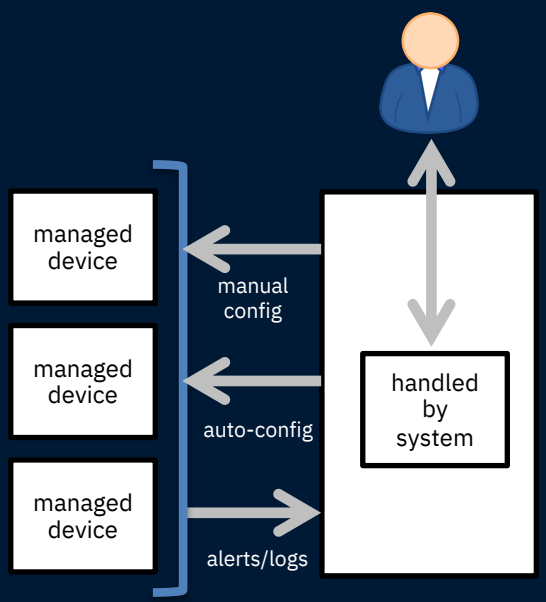
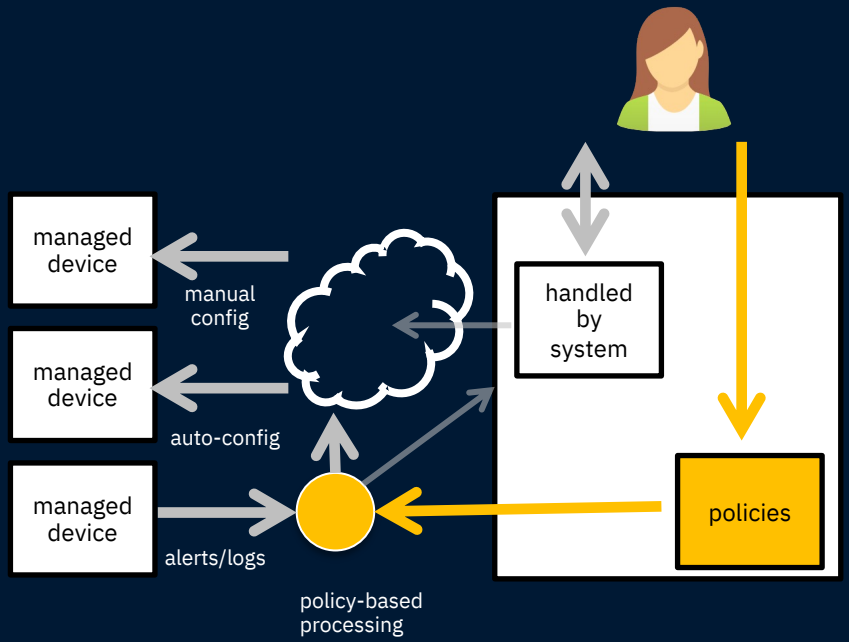
Systems Management



Traditional
(centralized management)



policy-based
(decentralized management)

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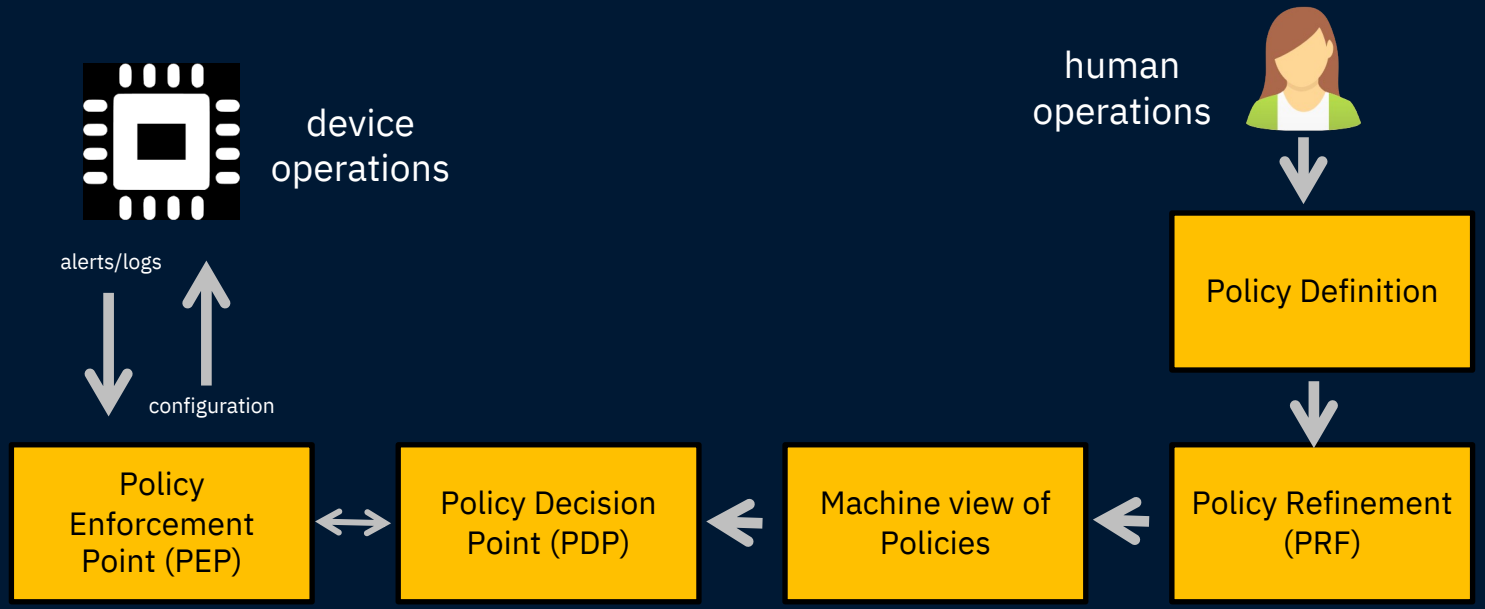
Policy-Based System Management

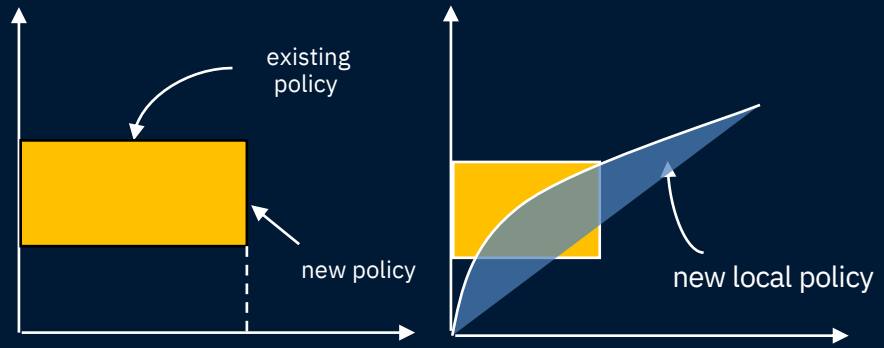


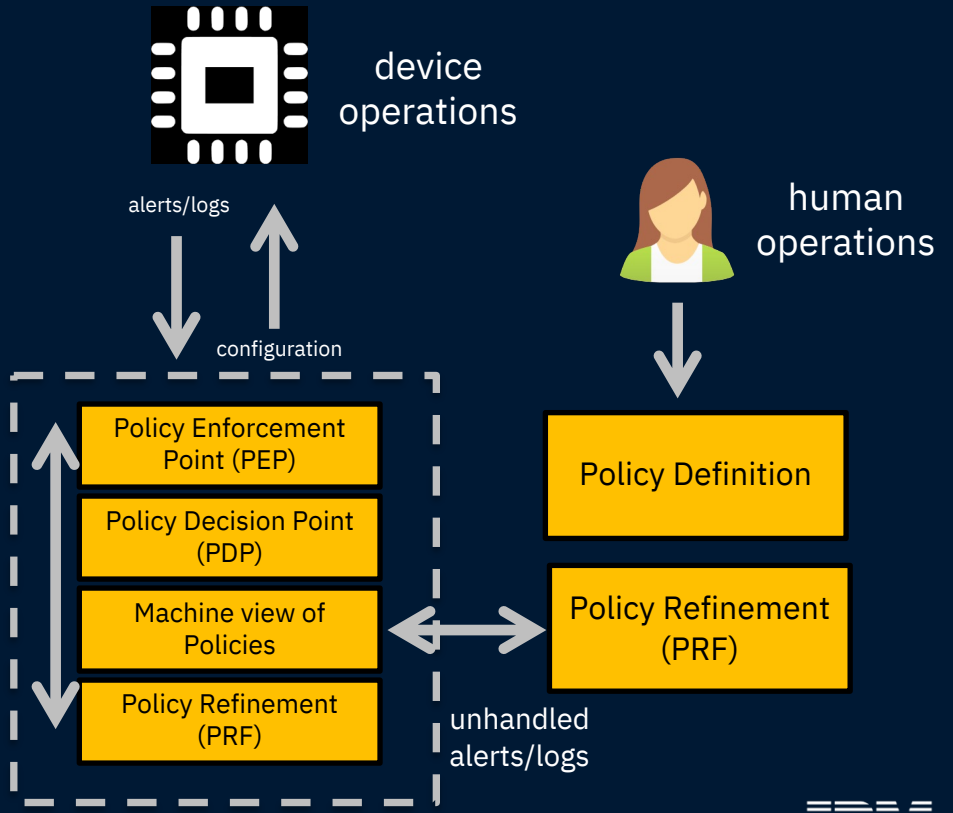
Generative Policies

Defining policy rules is tedious, even with refinement

Allow devices to generate their own policies

but constrain the amount of independence



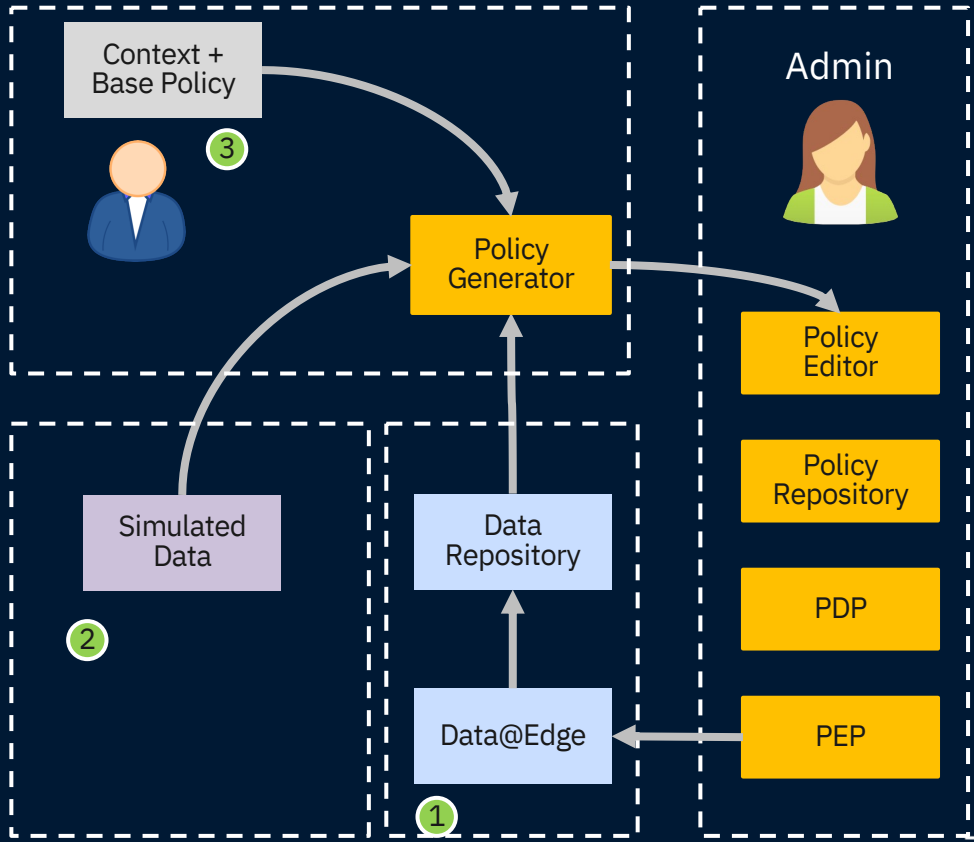


Learning of Policies

If real data is available, system can mine that information to generate policies to be used using AI/ML based techniques

AI/ML models can also be trained using simulated data, e.g. from a digital twin environment.

Policy generation can also be done using predefined contexts and customizations to policies from one context to another.

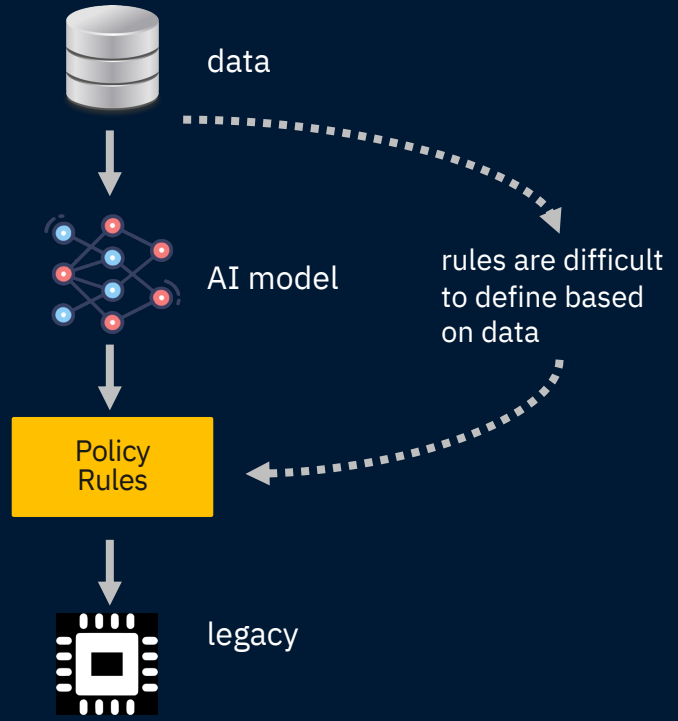


Policy rules defined by AI/ML and neural network models to apply to legacy systems

As AI technologies scale within defense systems, providers must provide contextual information about how AI systems operate

Policies can create Explainable AI to allow people to understand how decisions are made and can identify errors more easily

Evolve and define new distributed policy models that develop on localized operations across domains



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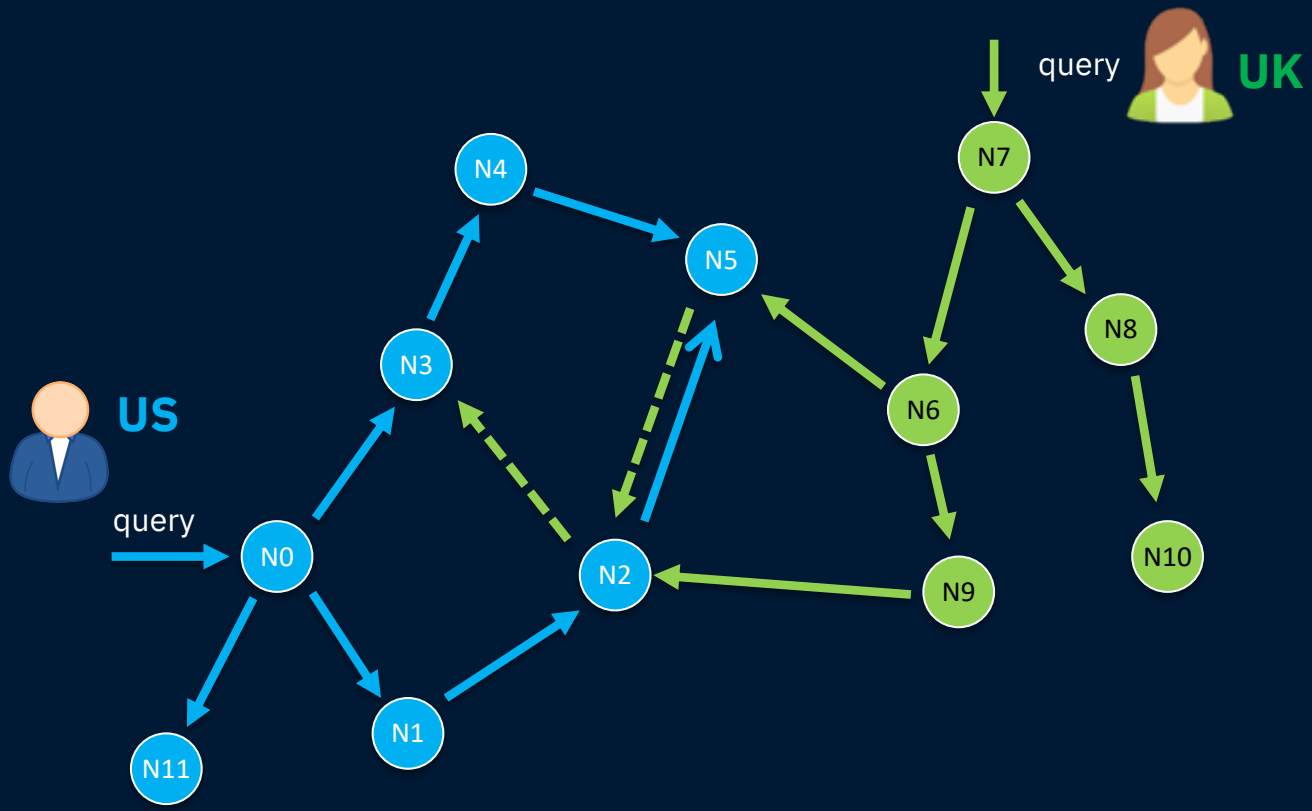
Use Case: Data Access And Flow Control



- Distributed formal policy based techniques are used to control access to data and the flow of data through the network
- Each node implements policies that can be stored at any other node(s) in the network

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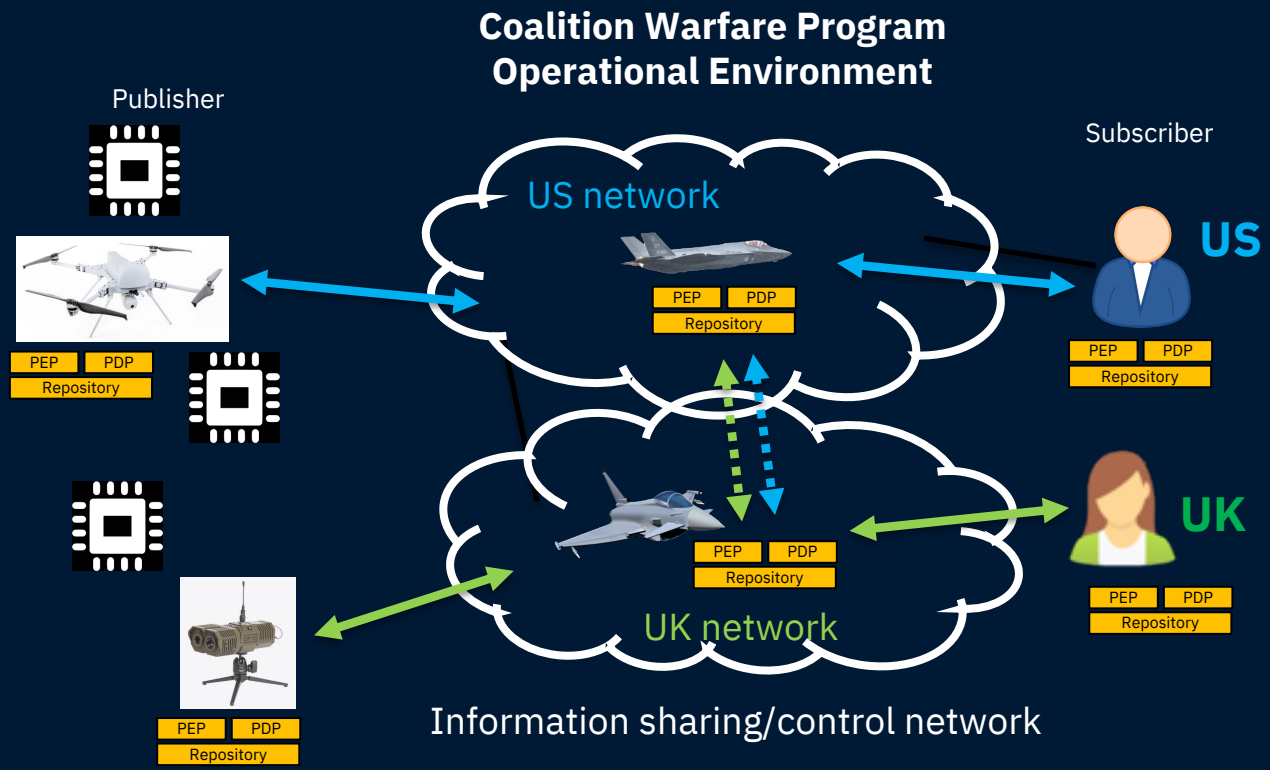
Use Case: Sensor Network Topology, Data Sharing and Filtering



- Self-organizing inter-domain network infrastructure
- Flexibility, adaptability, resilience and small platforms
- Support for arbitrary network infrastructure
- Publish/subscribe information sharing
- Policy-enabled authorization and data filtering
- Minimal human intervention and error

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Generative Policy Technology

- Policy-based technologies support lightweight, distributed computing capabilities for Edge AI applications
- Establish self-configuring, self-healing, self-optimizing, self-protecting infrastructure
- Capabilities to extend human supervised automation to legacy platforms and support AI Explainability

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