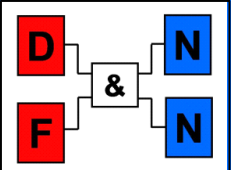


# Data Fusion & Resource Management (DF&RM) Dual Node Network (DNN) Technical Architecture

Christopher Bowman, PhD.

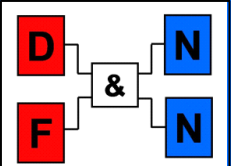
Data Fusion & Neural Networks (DF&NN)

July 2020

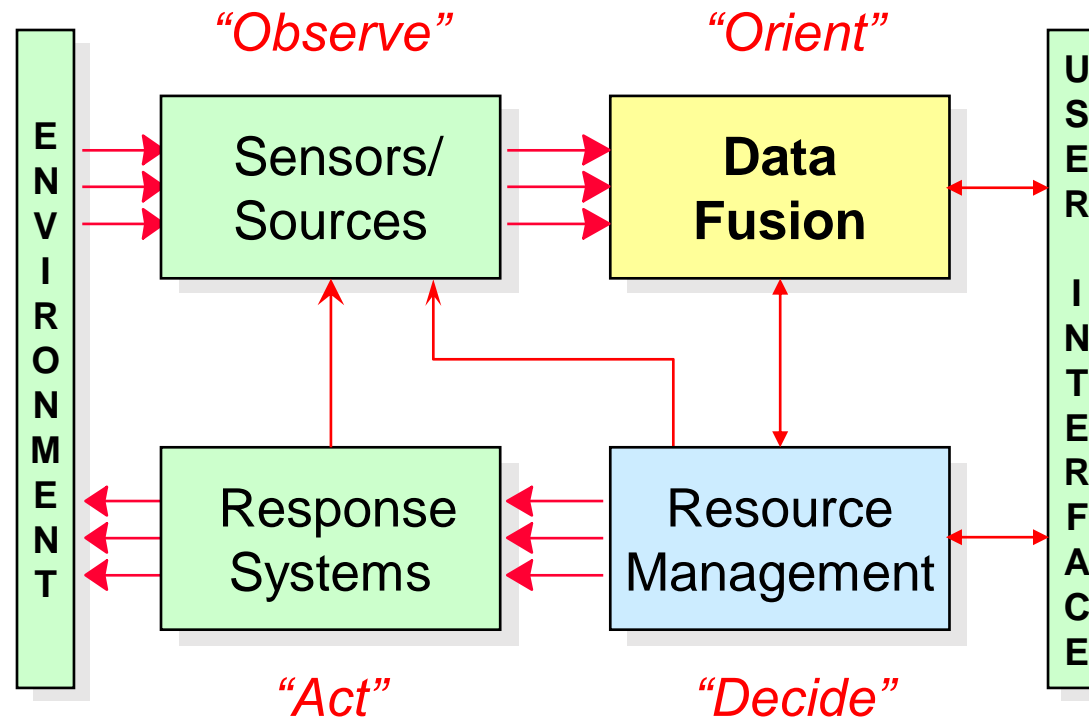


# Briefing Objectives

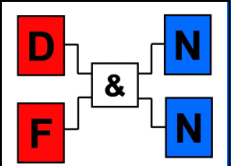
- Provide an understanding of the **roles for Data Fusion & Resource Management (DF&RM)**
- Describe how the Data Fusion heritage can be used to **“jump-start”** dual Resource Management solutions
- Describe DF&RM Dual Node Network (DNN) Technical Architecture



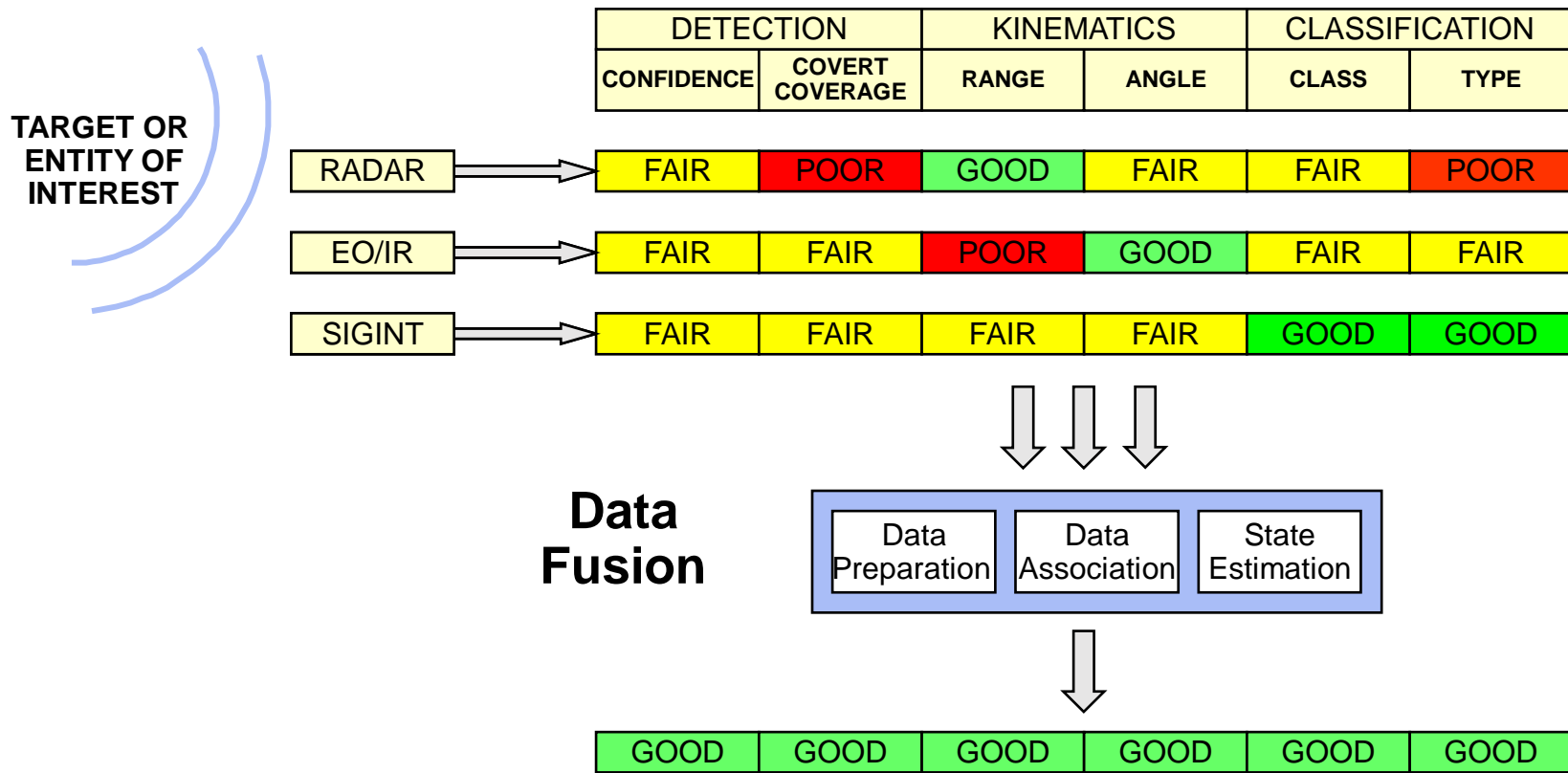
# Fusion & Management Lie in the Gap Between “Observe” and “Act”



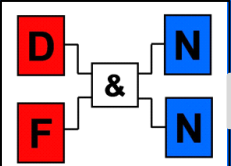
- **Data Fusion** is the process of combining data/information to estimate or predict the state of some aspect of the world.
- **Resource Management** is the process of planning/controlling response capabilities to meet mission objectives



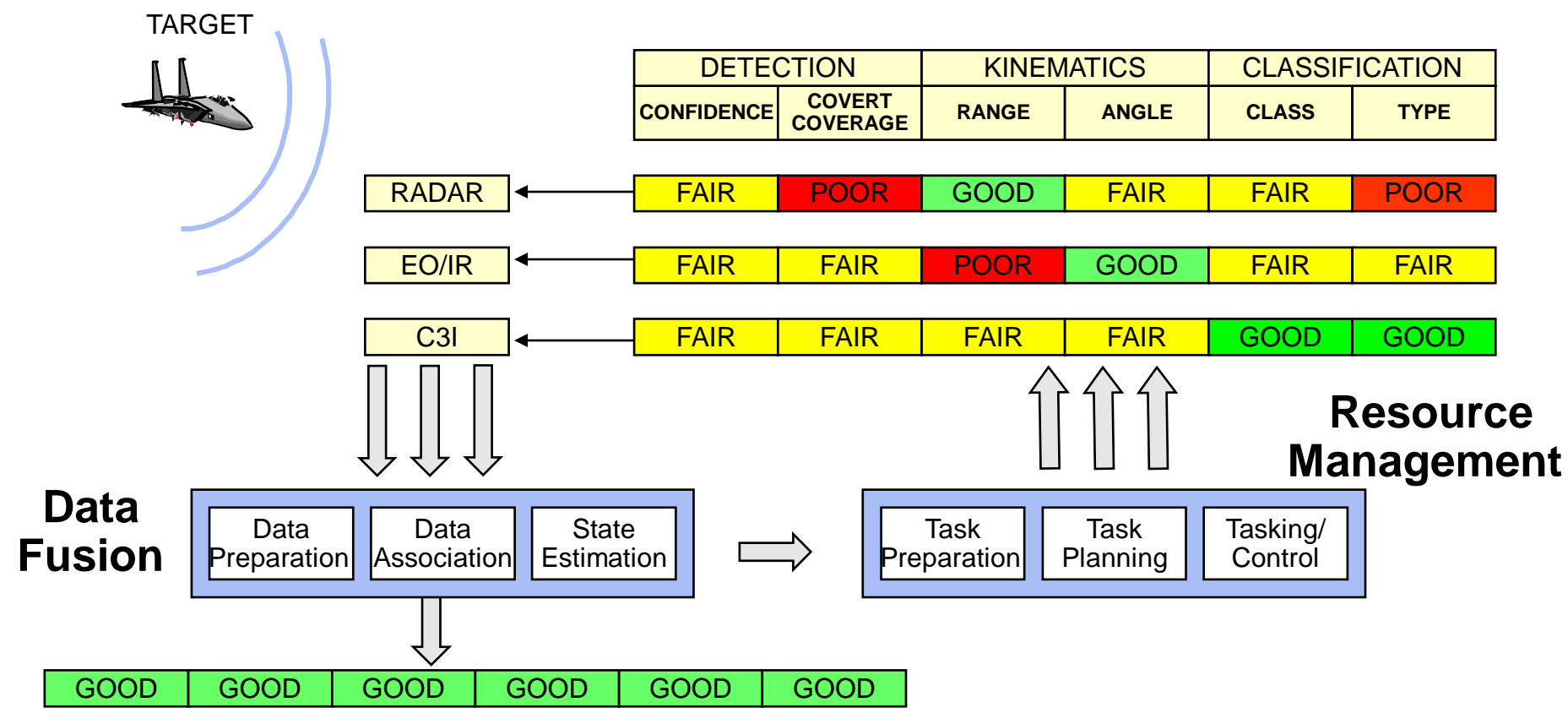
# Sensor Fusion Exploits Sensor Commonalities and Differences



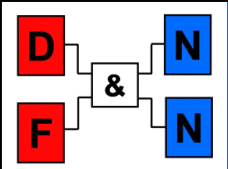
**Data Association Uses Overlapping Sensor Capabilities so that State Estimation Can Exploit their Synergies**



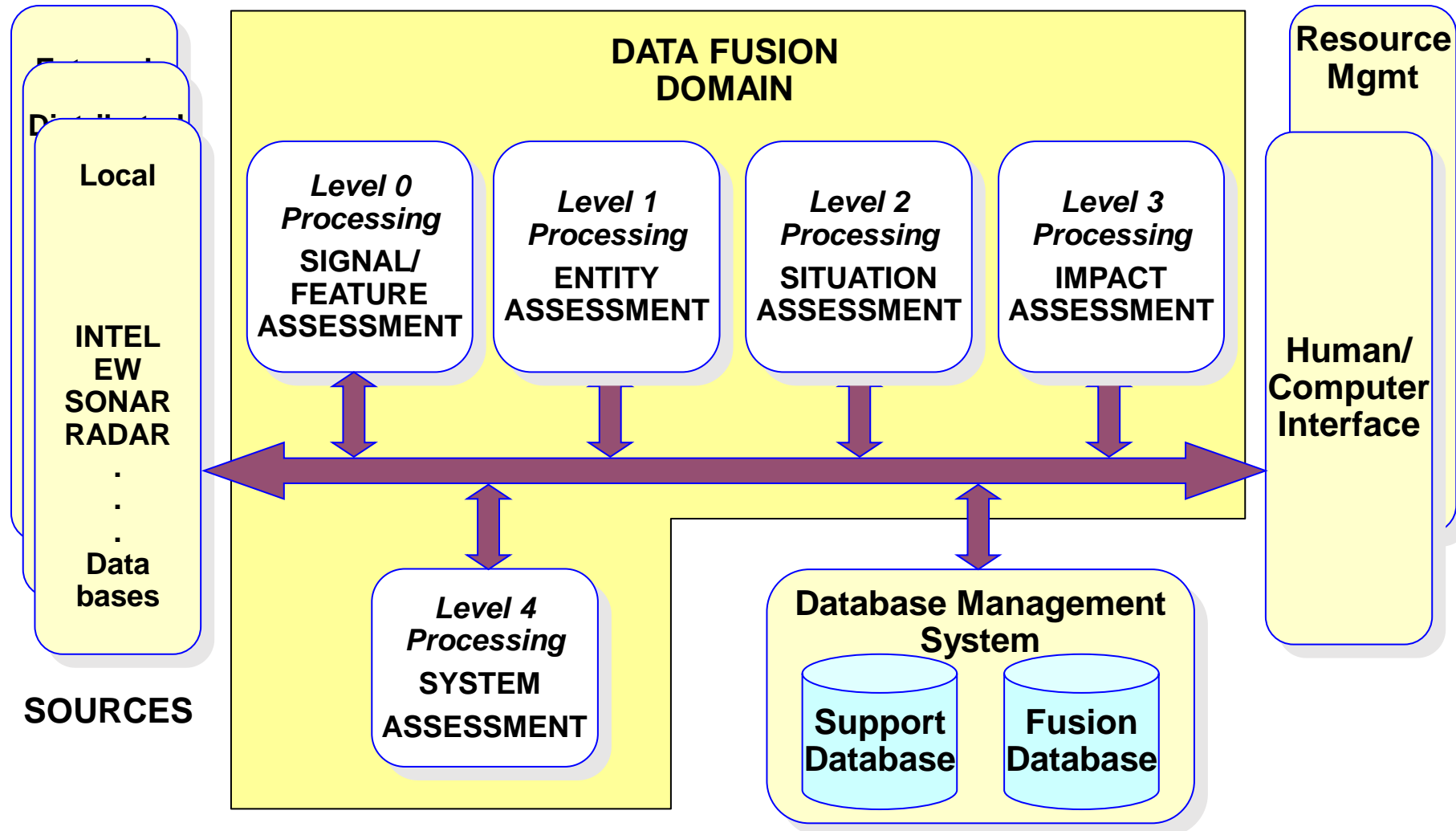
# Resource Management Exploits Sensor Commonalities & Differences

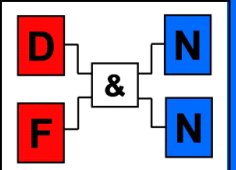


**Sensor Task Planning Uses Overlapping Sensor Capabilities so that Control Can Exploit their Synergies**



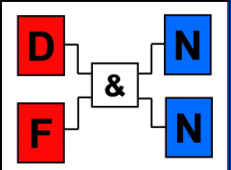
# 2004 Revision of the Joint Director's Lab Data Fusion Model



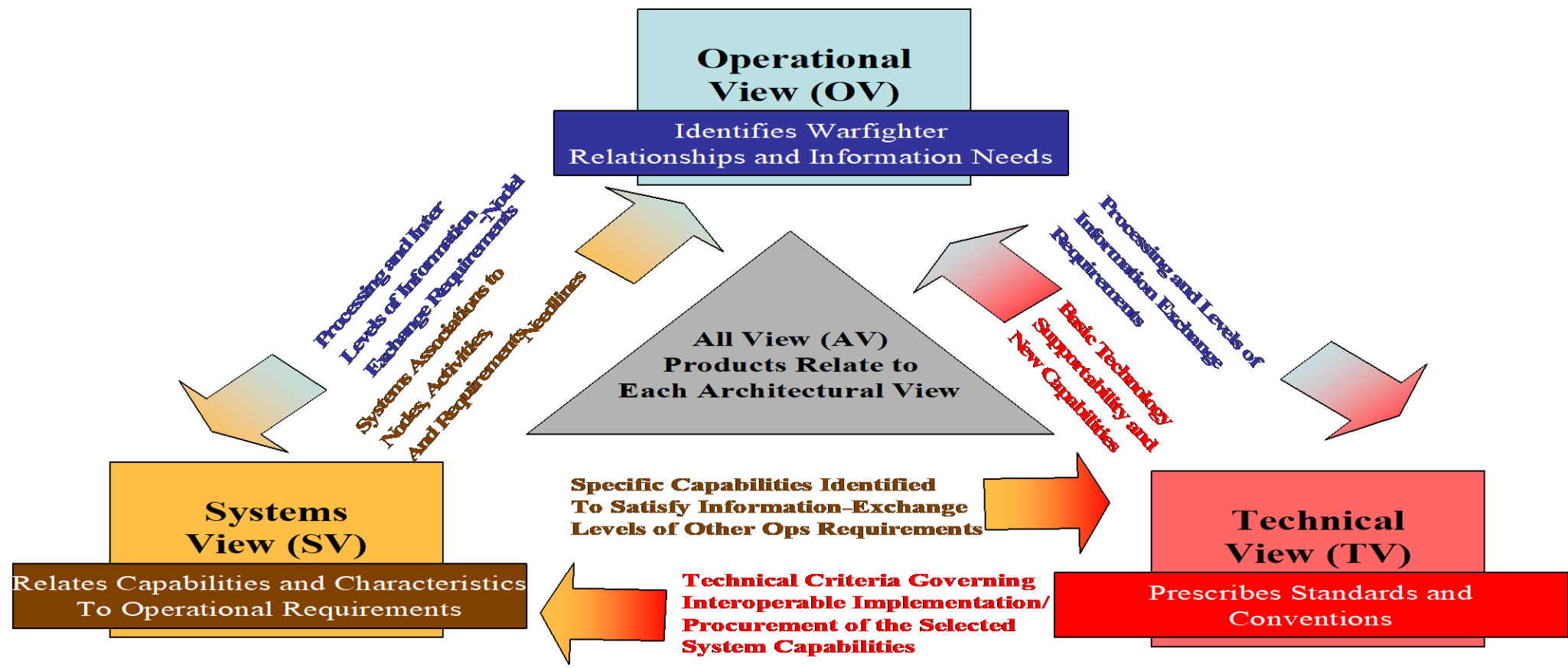


# Using a Fusion & Management Architecture Will Stop One-of-a-Kind Software Developments

- Architectures are frequently used mechanisms to address a broad range of common requirements to achieve interoperability and affordability objectives
- An architecture (IEEE definition) is a structure of components, their relationships, and the principles and guidelines governing their design and evolution over time
- An architecture should:
  - Identify a focused purpose with sufficient breadth to achieve affordability objectives
  - Facilitate user understanding/communication
  - Permit comparison, integration, and interoperability
  - Promote expandability, modularity, and reusability
  - Achieve most useful results with least cost of development

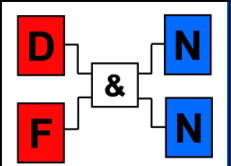


# Role for DF&RM DNN Technical Architecture Within the “DoD Architecture Framework”

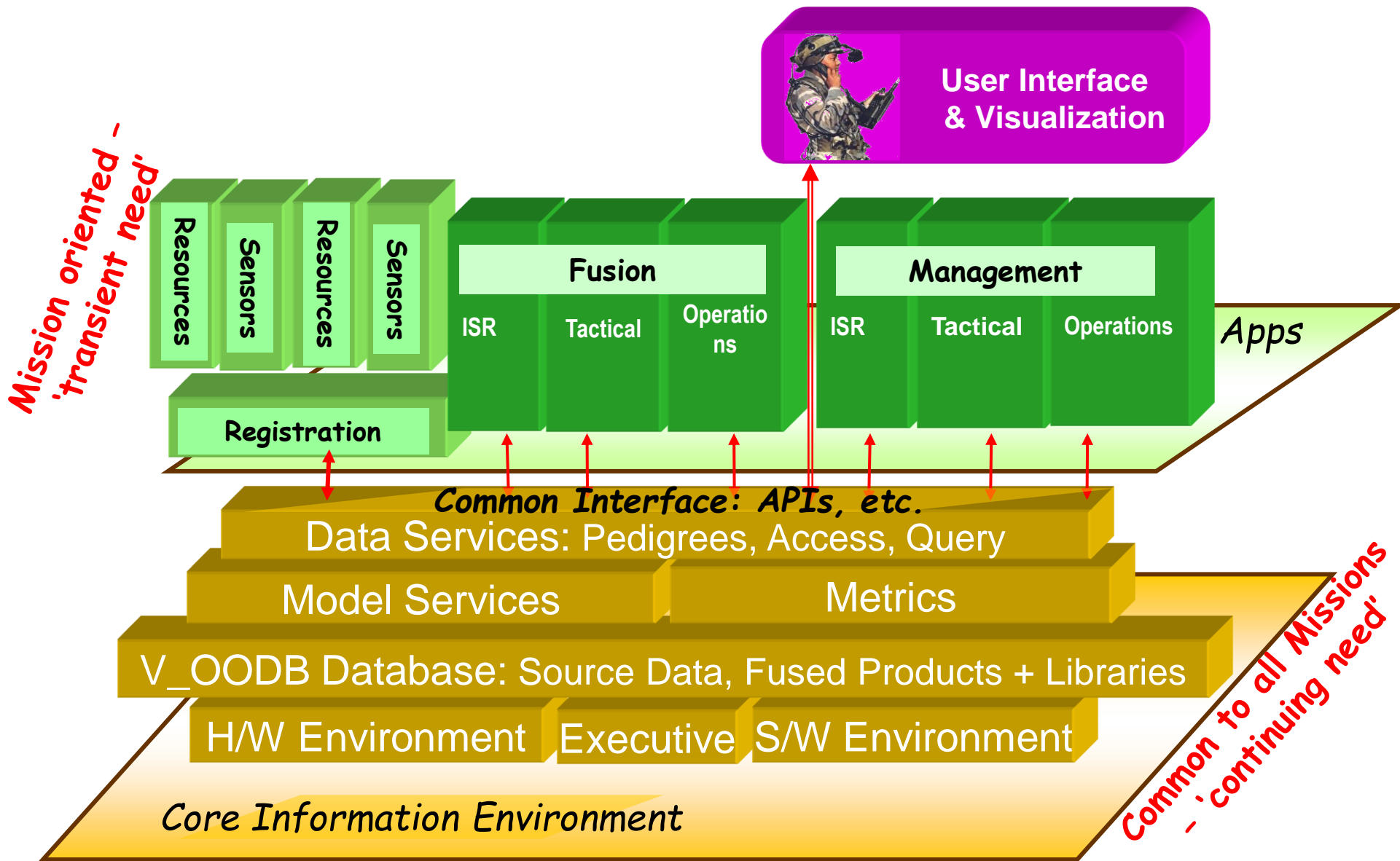


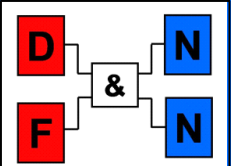
- The operational architecture provides the “what and who” operational needs
- The technical architecture provides “problem-to-solution space” guidance
- The systems architecture defines the “how” to build the operational system



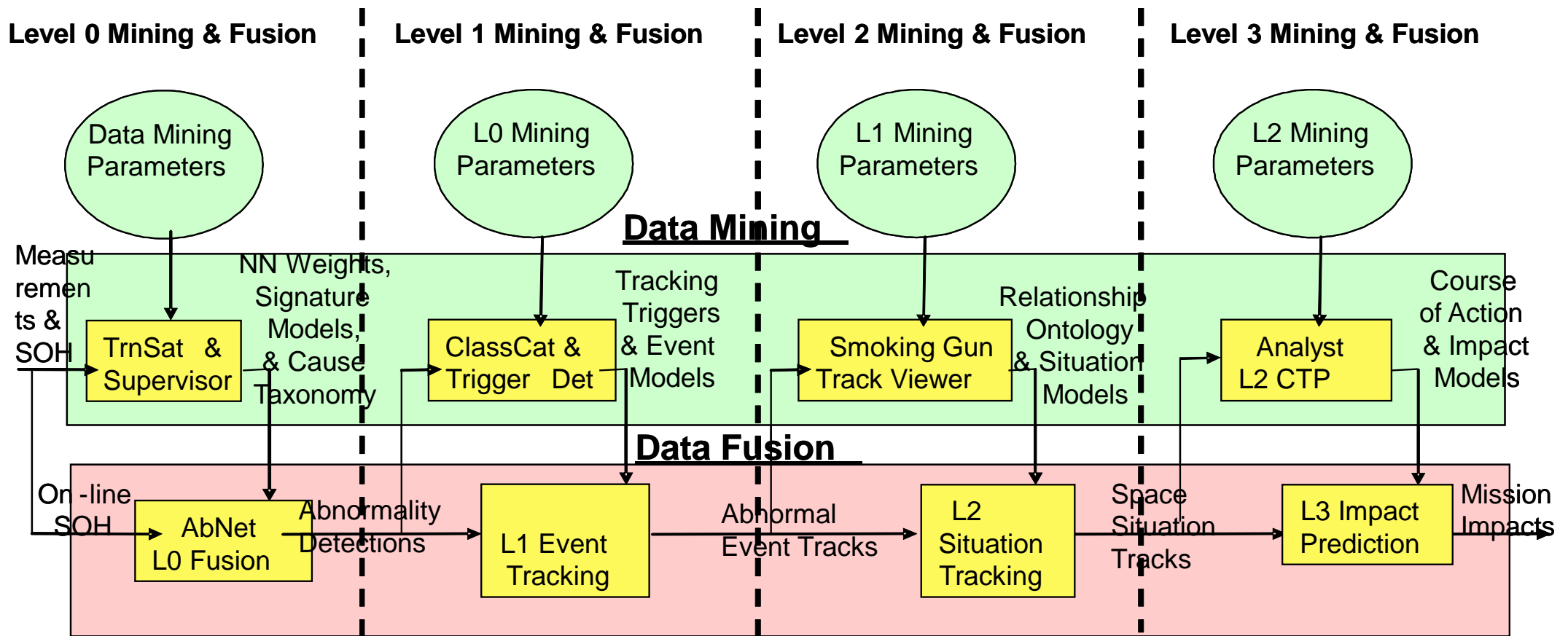


# Layered Information Environment Functional View

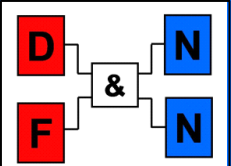




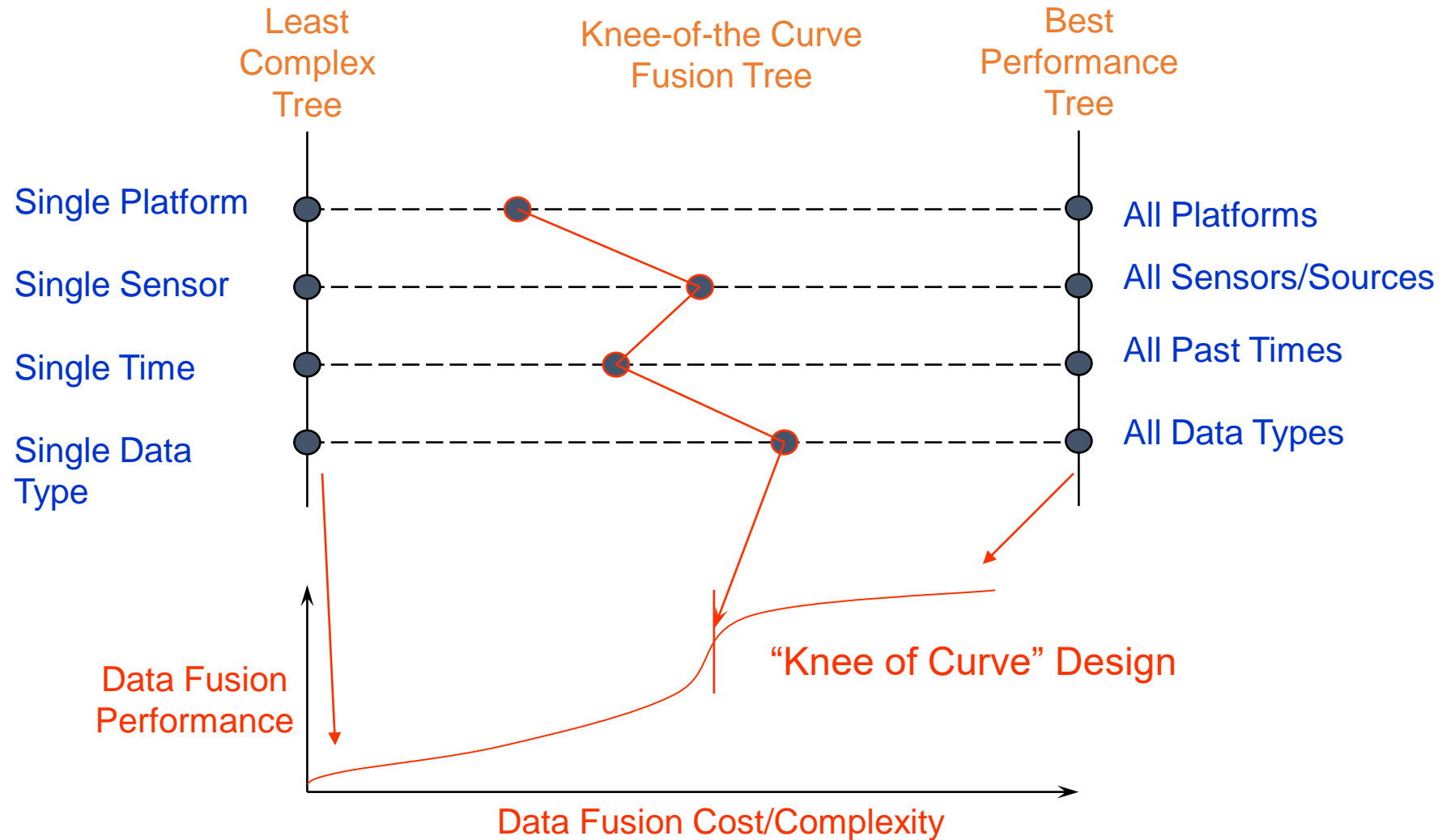
# Data Mining Learning of Fusion Models

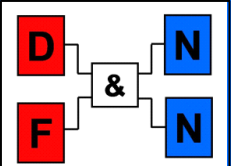


- Data Mining discovers and models some aspect of data input to each fusion level
- Data Fusion combines data to estimate/predict the desired state at each fusion level

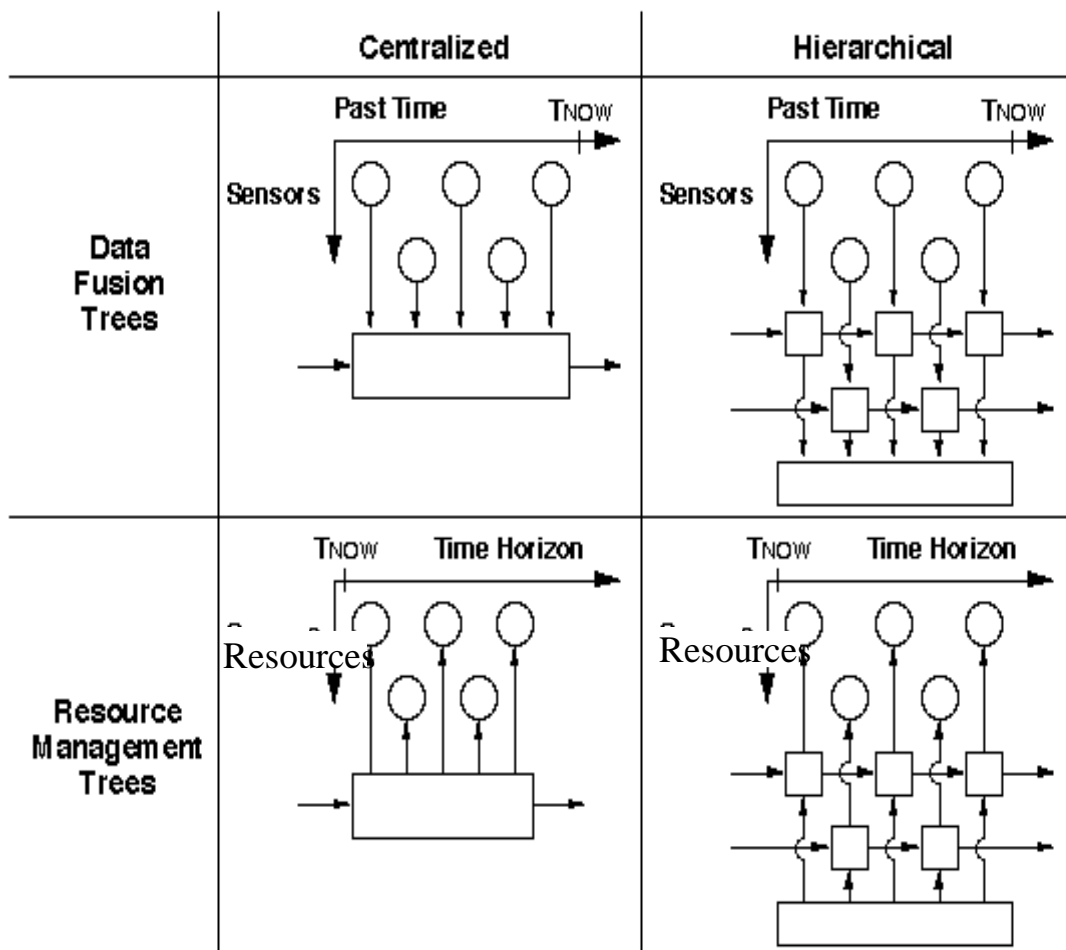


# Fusion Network Selected to Balance Performance & Complexity





# DF&RM Trees Divide & Conquer the Problem



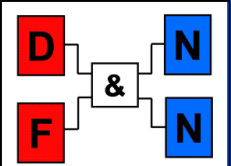
- Fusion tree defines batching of data by
  - Sensor/source
  - Past time
  - Data type

- Management tree defines batching of commands by
  - Resource (sensor or response)
  - Time horizon
  - Command type

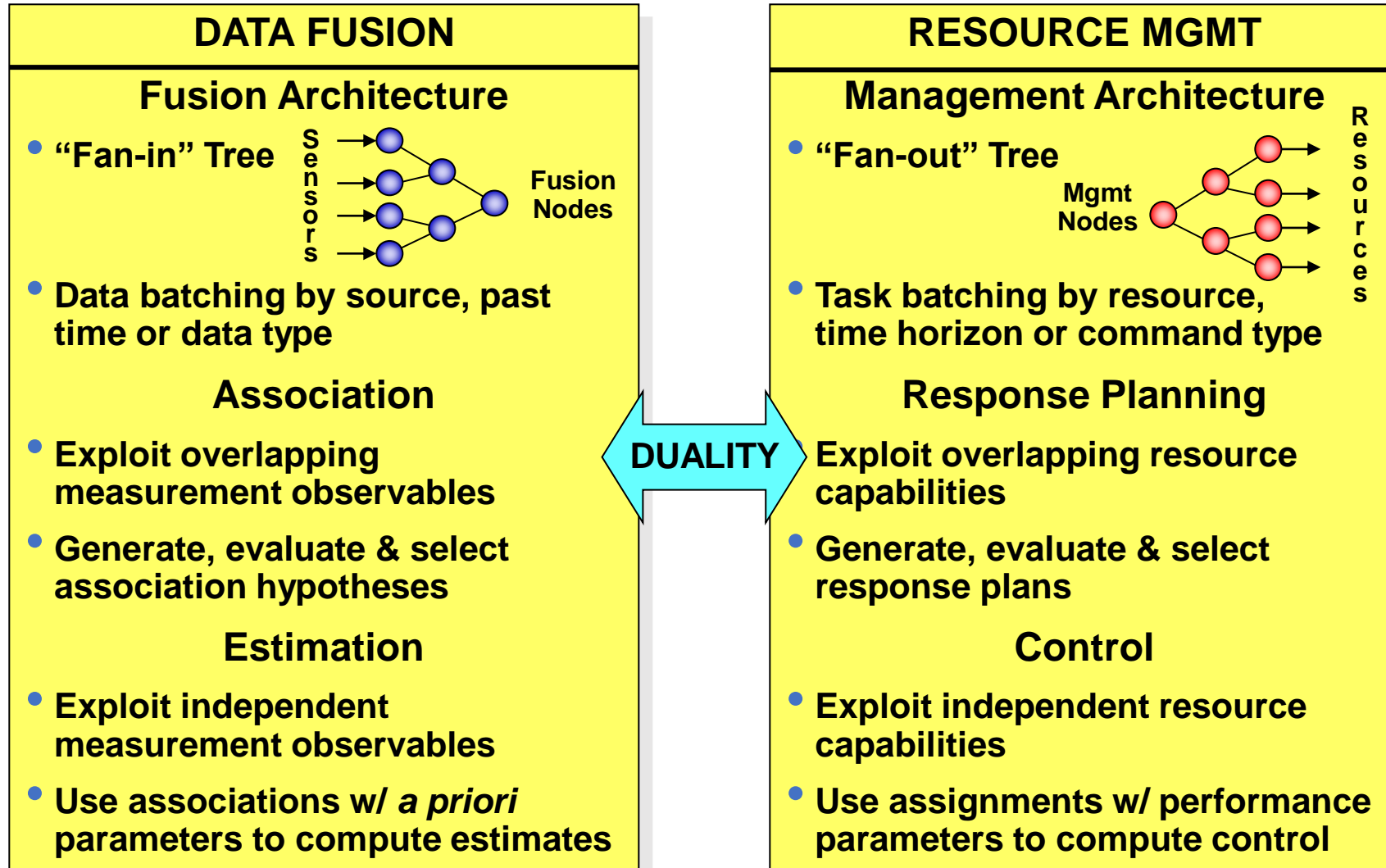
- High performance
- High complexity/cost

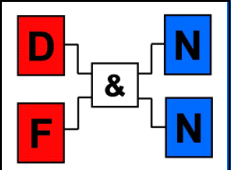
- Sufficient performance
- Reduced complexity/cost

Each node in each tree generates, evaluates, and selects solutions for knee-of-the-curve performance vs. cost

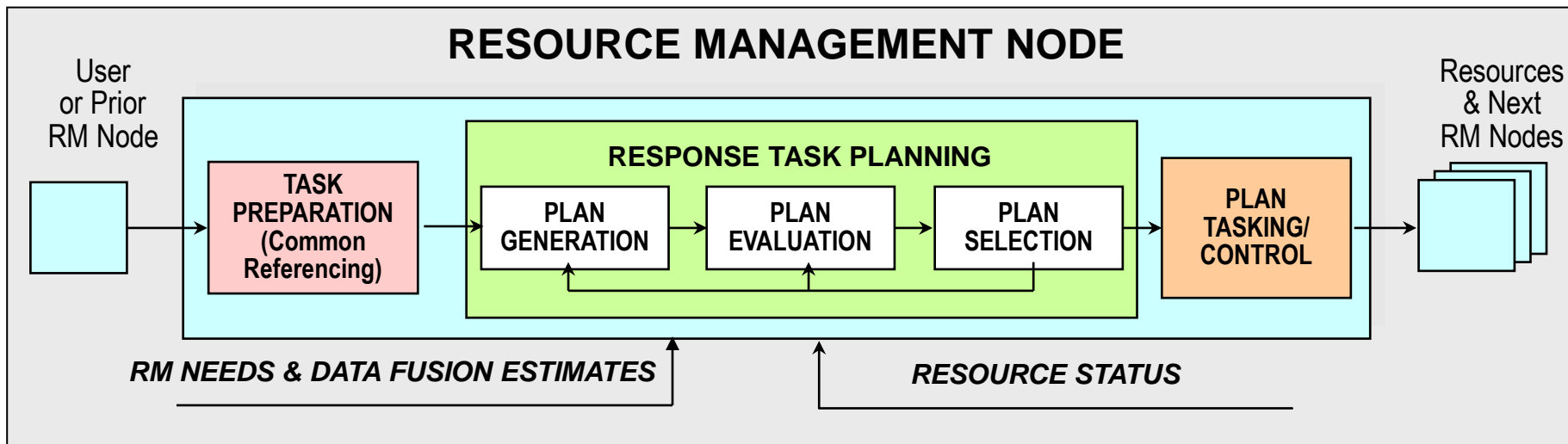
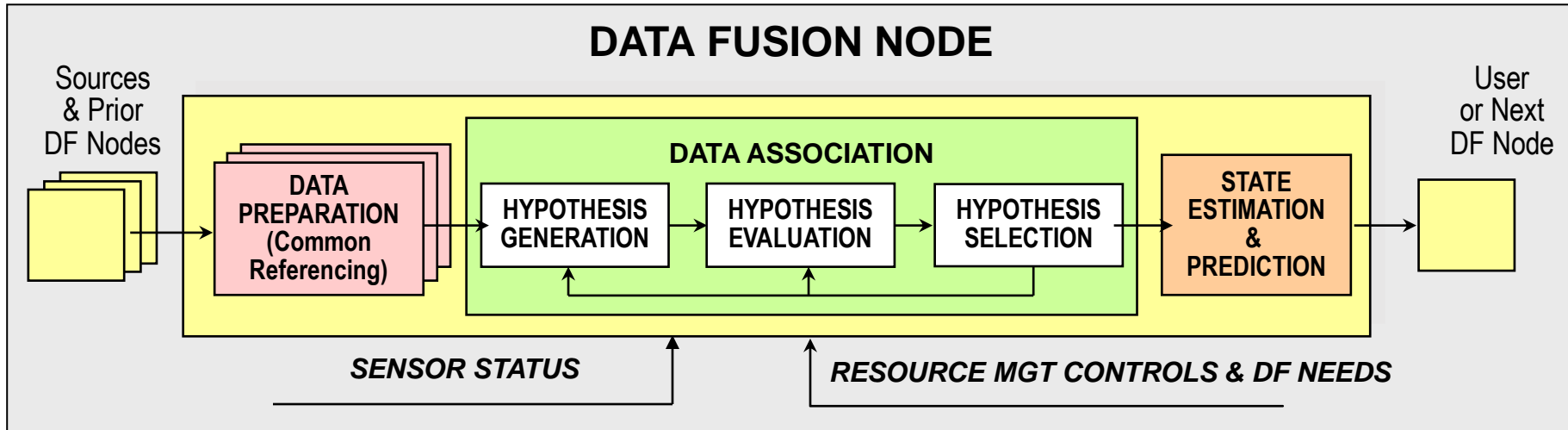


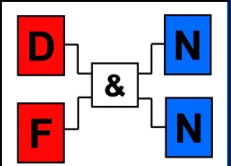
# DF/RM Duality Allows Similar Approaches & Consistent Operation





# DF & RM Node Duality Facilitates Understanding of Alternatives & Reuse





# Sample Interlaced Network of DF&RM Dual Level Interactions

