



Data and Decision Analytics



Data Analytics Assessment Overview

Problem: There is currently no standard way to implement and assess performance for data analytics

- Heterogeneous data sources/algorithms without ground truth
- Hard to know what capability is being purchased with few means to assess performance of service
- Dynamic mission space with changing requirements

Solution: Data analytics framework

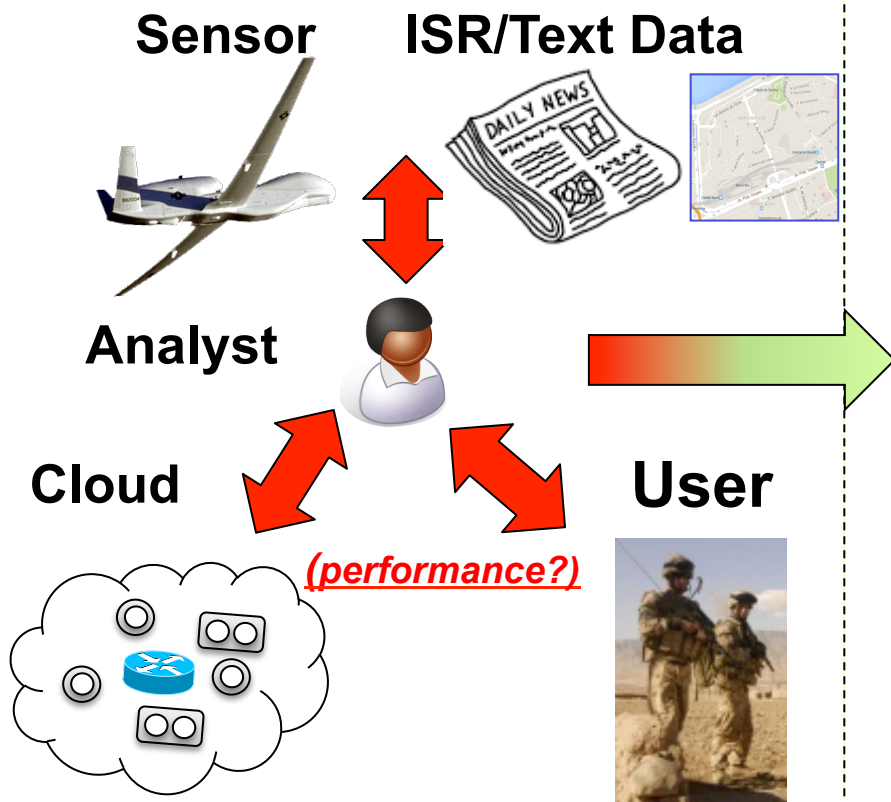
- Standard data models with ground truth
- Development framework to standardize risk analytics on information sources, algorithms, and processing
- Adaptable framework that can change as mission requirements change



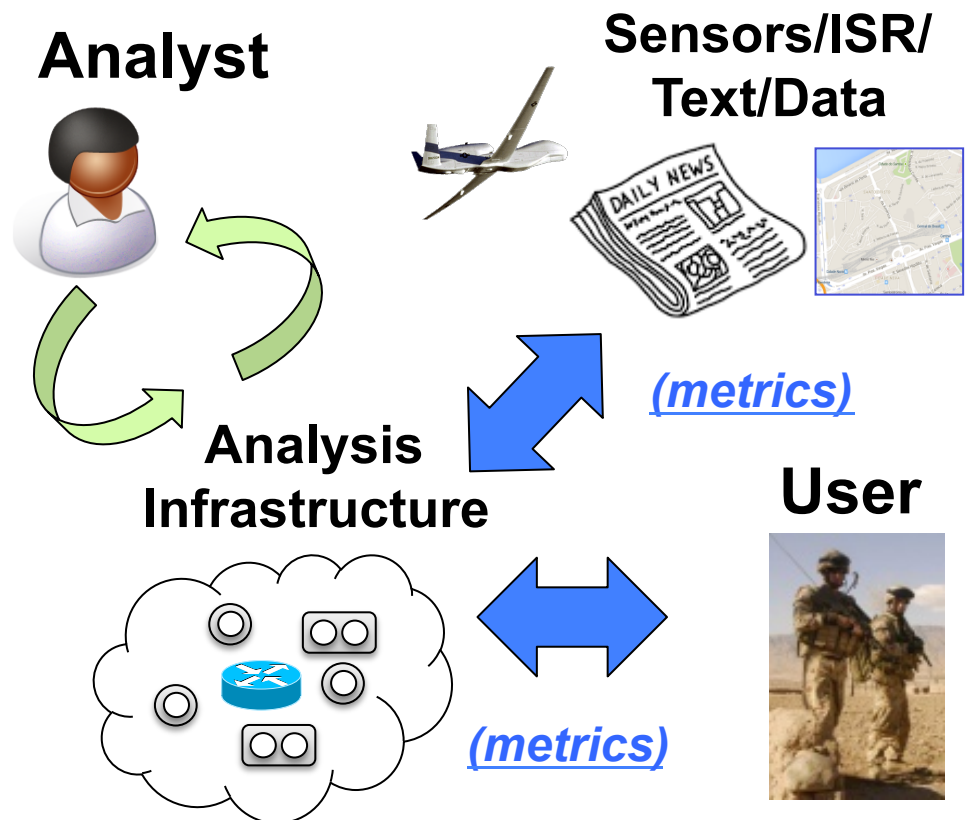
D2D/Data Analytics Approach

Analyst oversees delivery of information products to customer with rigorous quality of service guarantees

Current Approach



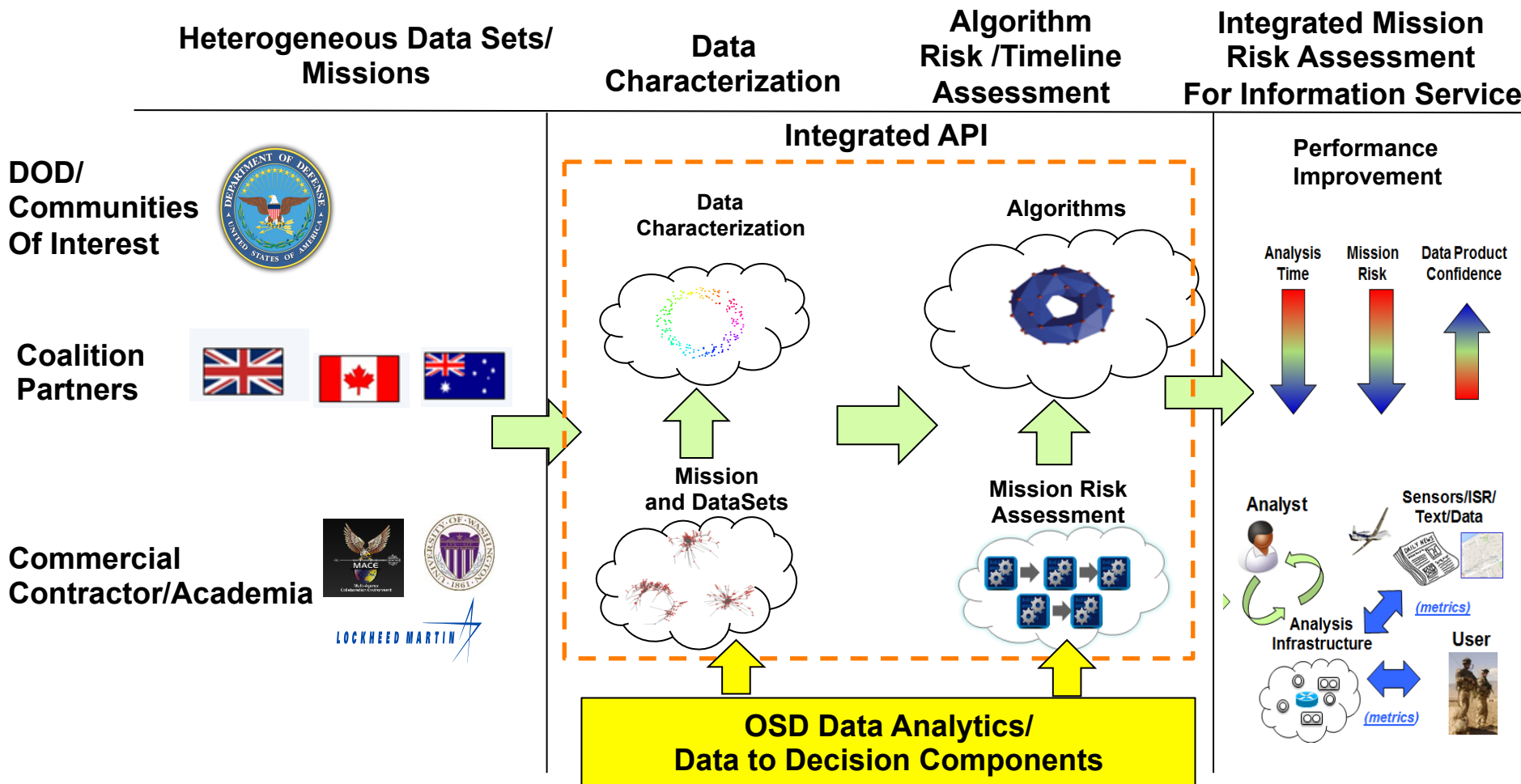
New Approach





Data Analytics Performance Assessment

Implementation and assessment of information service can be standardized to assess overall mission performance





Components Can Assess Multiple Mission Types

Incorporate a cloud based open standard for information services development and assessment so basic components can be used assess multiple types of missions

Data Analytics/ Data to Decision Elements

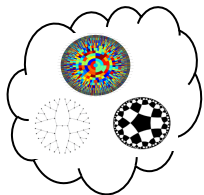
Text Analytics



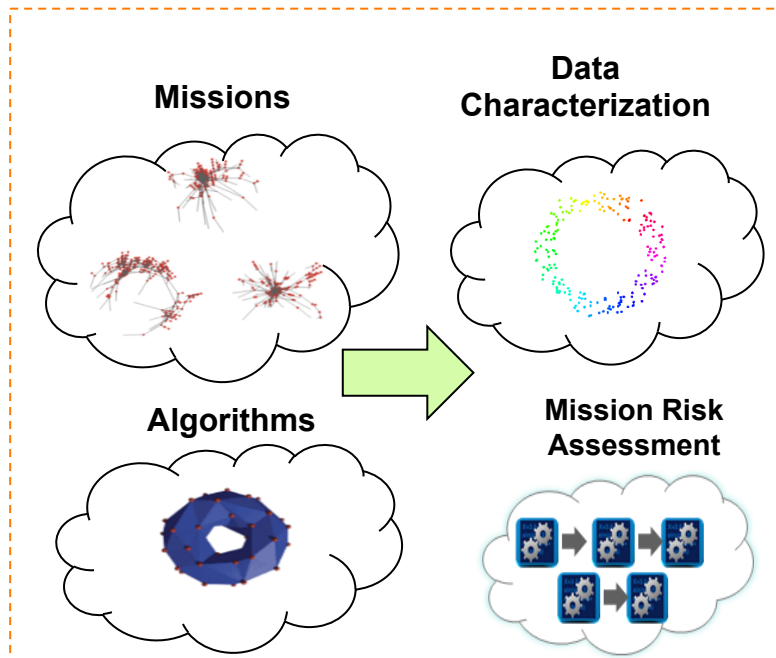
Imagery Analytics



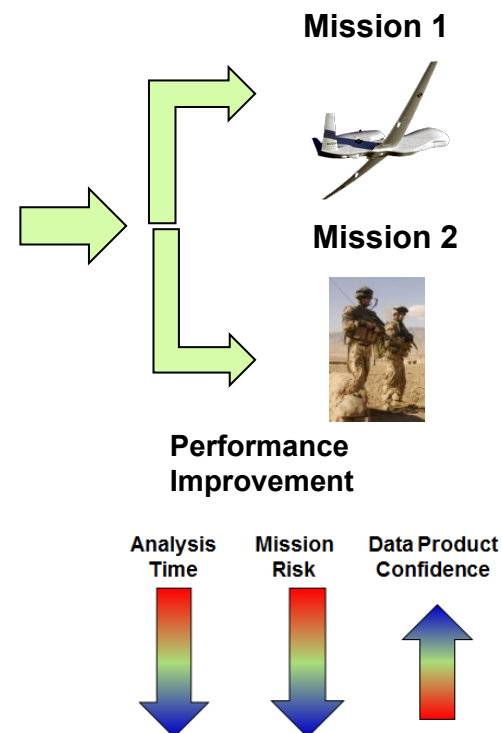
New Algorithm
Research



Transitionable Components



Same Components Provide Assessment For Multiple Customer Missions





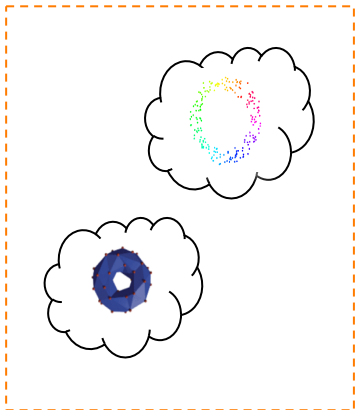
Transition Models

Models can either be added to existing infrastructure or used by existing infrastructure as diagnostics for performance

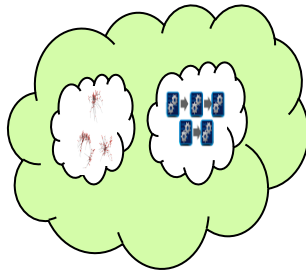
Model 1

(direct integration of components)

Components



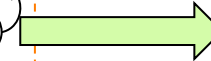
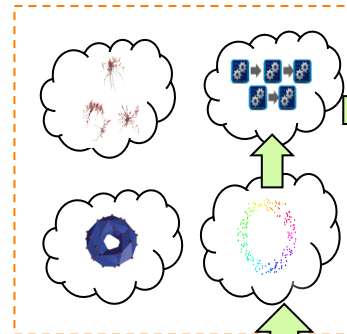
Elements Added to User Infrastructure



Model 2

(user integrates remote elements for their analysis)

Components



Cloud Elements Used for Diagnostics By User



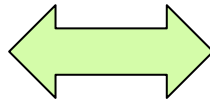
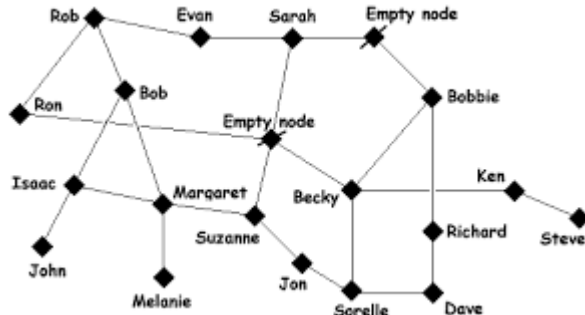


Mission and Data Set Components

Standard threat or mission graphs and the associated data needed to assess a particular threat are available for baseline assessment and design of future missions analysis

Standard Mission Graphs

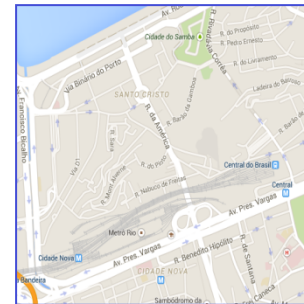
Scenario Graph Specifies
What Data Should Be Collected



Standard Data Sets

Standard Data Sets Specify Ground
Truth for Different Data Types &
Provenance of Relevant Data

Imagery Truth Data



Text Analytic Data





Algorithm and Mission Risk Component

The algorithm and mission risk components can calculate

- Provenance and risk of data + algorithm conclusion
- Timeline for output at given data risk level
- Overall mission risk and certainty of conclusion

Algorithms Data Base

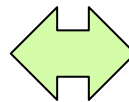
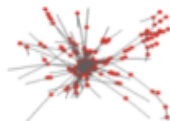
Algorithms data base specifies risk incurred for different data types and fidelities and processing time required for actionable information over a given architecture.

Mission Risk Analysis

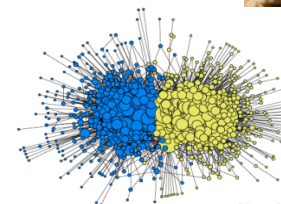
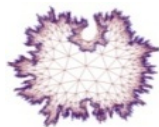
Database of algorithm conclusions against different scenarios with specified truth data.

Overall risk to mission with truth

Assessment of text algorithm

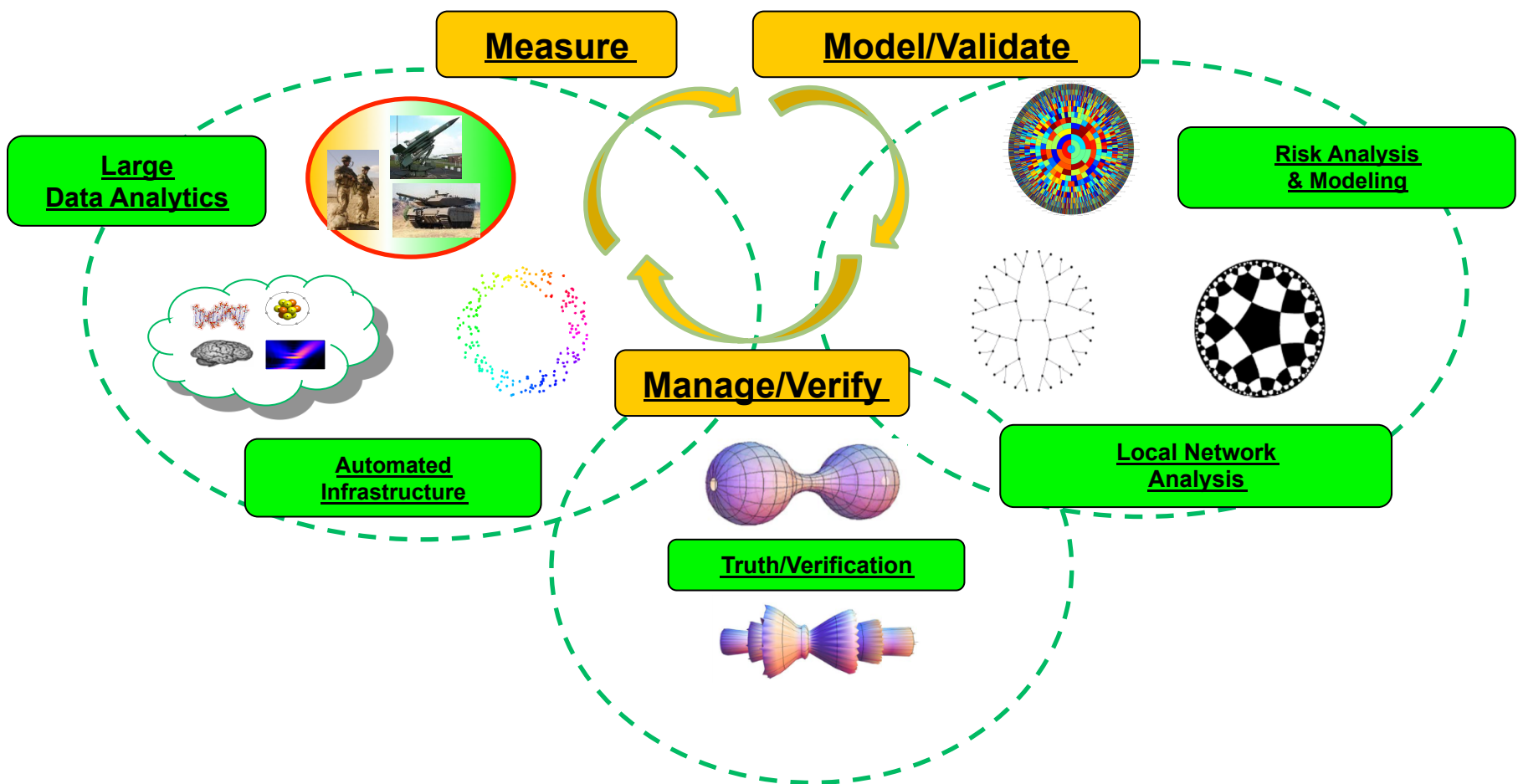


Assessment of track algorithm



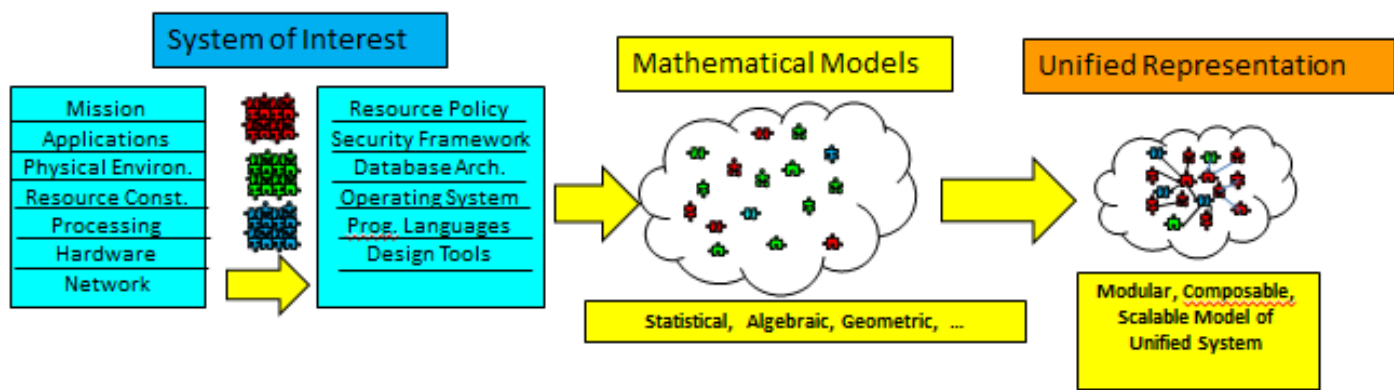
[Karrer & Newman, 2010]

Integrated modeling, validation, verification, and management can characterize mission performance with advanced data models

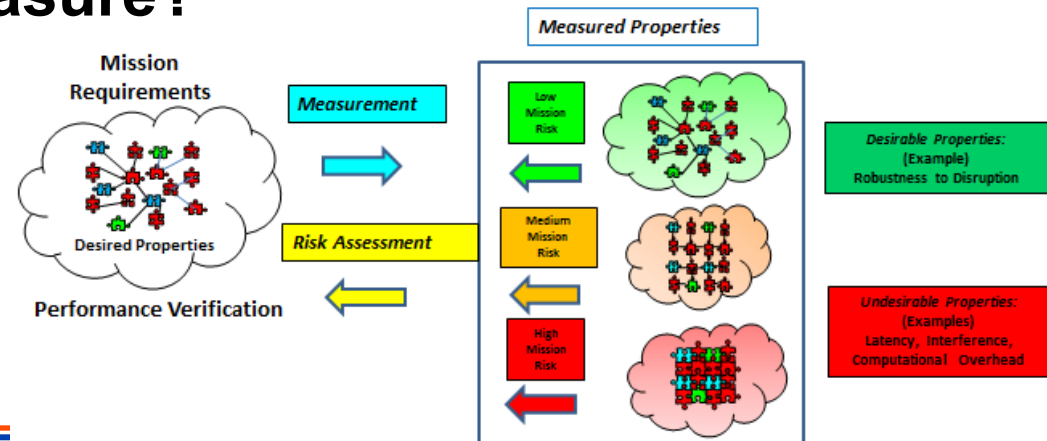


We wish to understand how to measure the state of a mission on an infrastructure

What to measure?



How to measure?

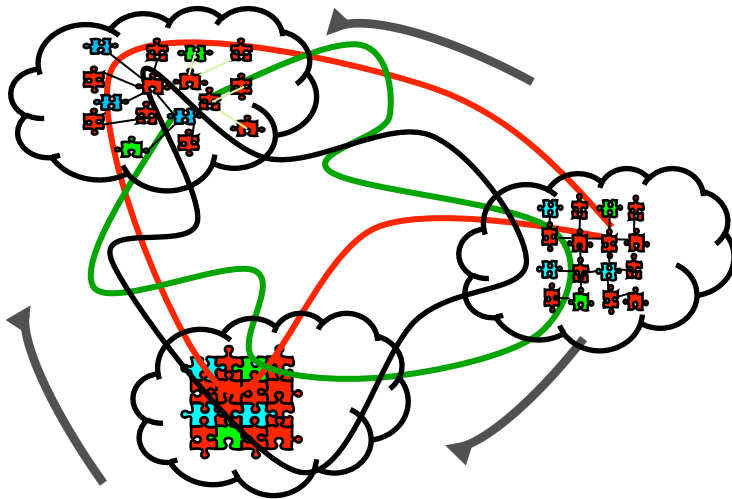




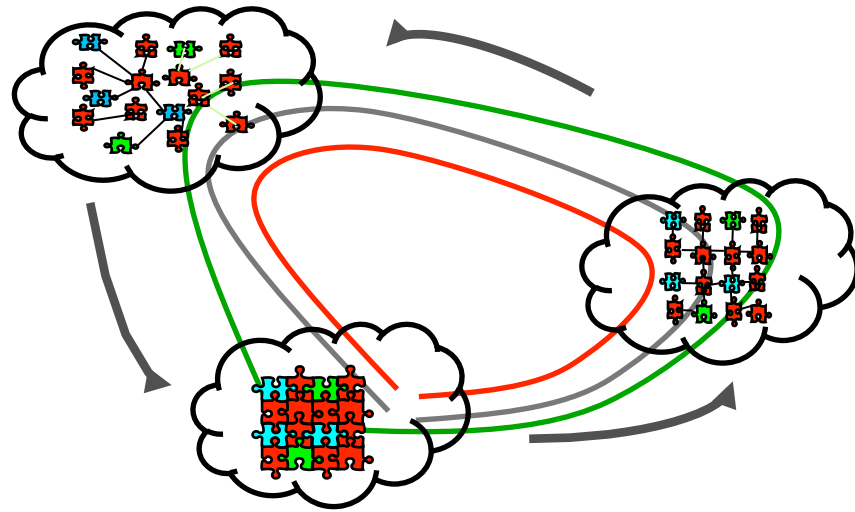
Modeling

We must have validated models of mission performance which can come from known models or empirical data

Mission Operation Trade-space



***Un-validated Modalities
(high mission risk)***

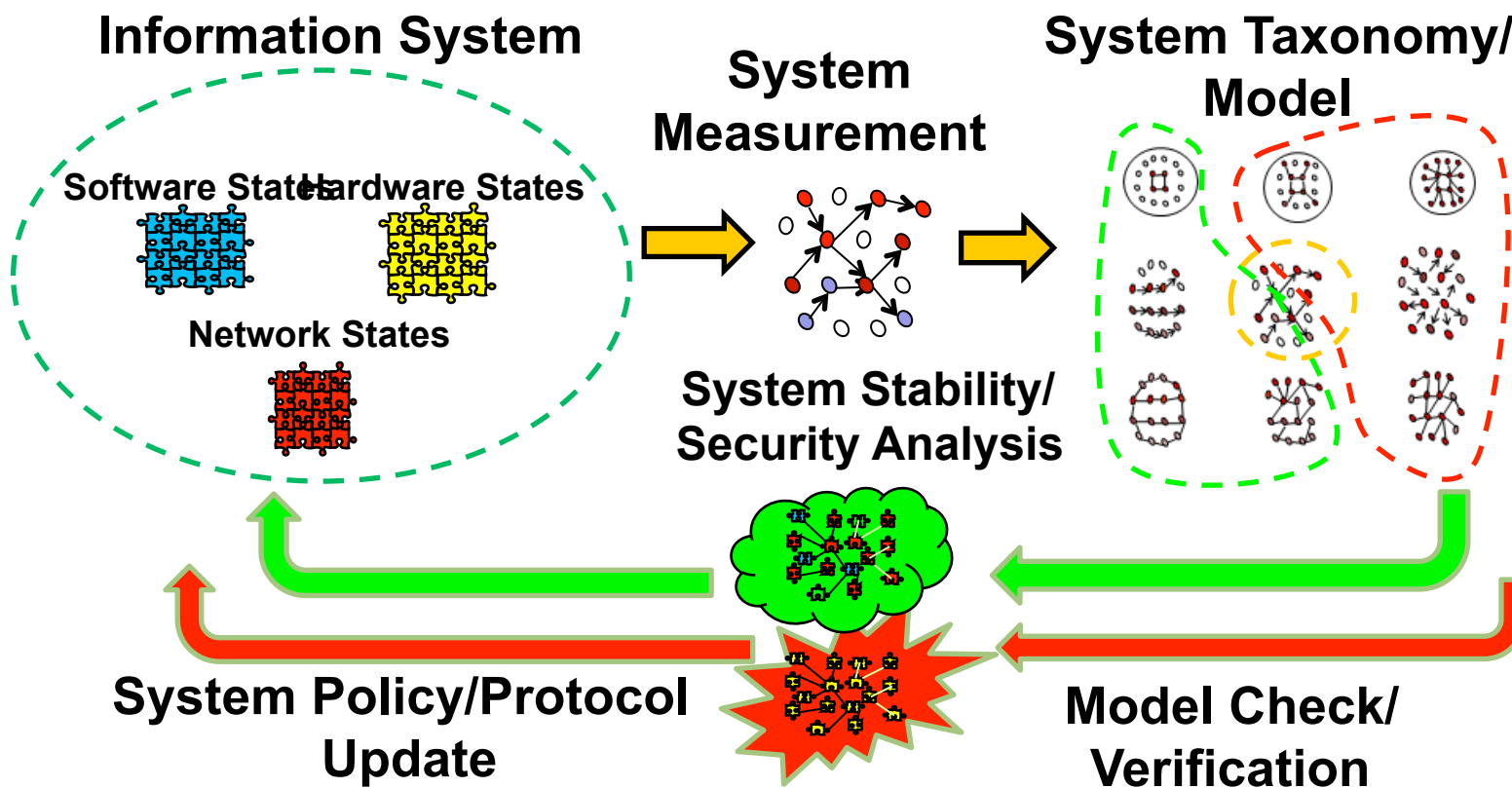


***Validated Modalities
(low mission risk)***



Management

How do we close the loop at multiple architectural layers to assure mission performance and verify system policy/protocol is working?





Metrics of Performance

Metrics of performance allow timelines, tracking, and mission performance to be rigorously assessed analyst/commander in real time.

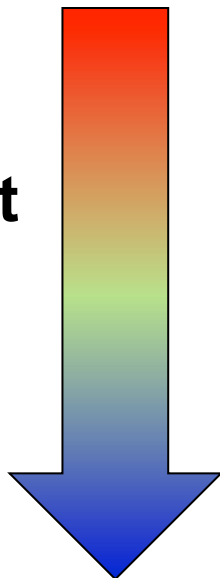
Example Metrics

Timeline Reduction

**Rigorous Mission
Threat/Risk Assessment**

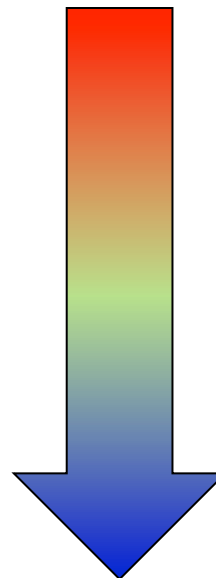
**Rigorous Data Product
Confidence Analysis**

**Analysis
Time**

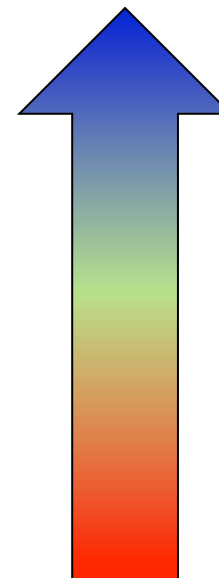


Desired Outcome

**Mission
Risk**



**Data Product
Confidence**

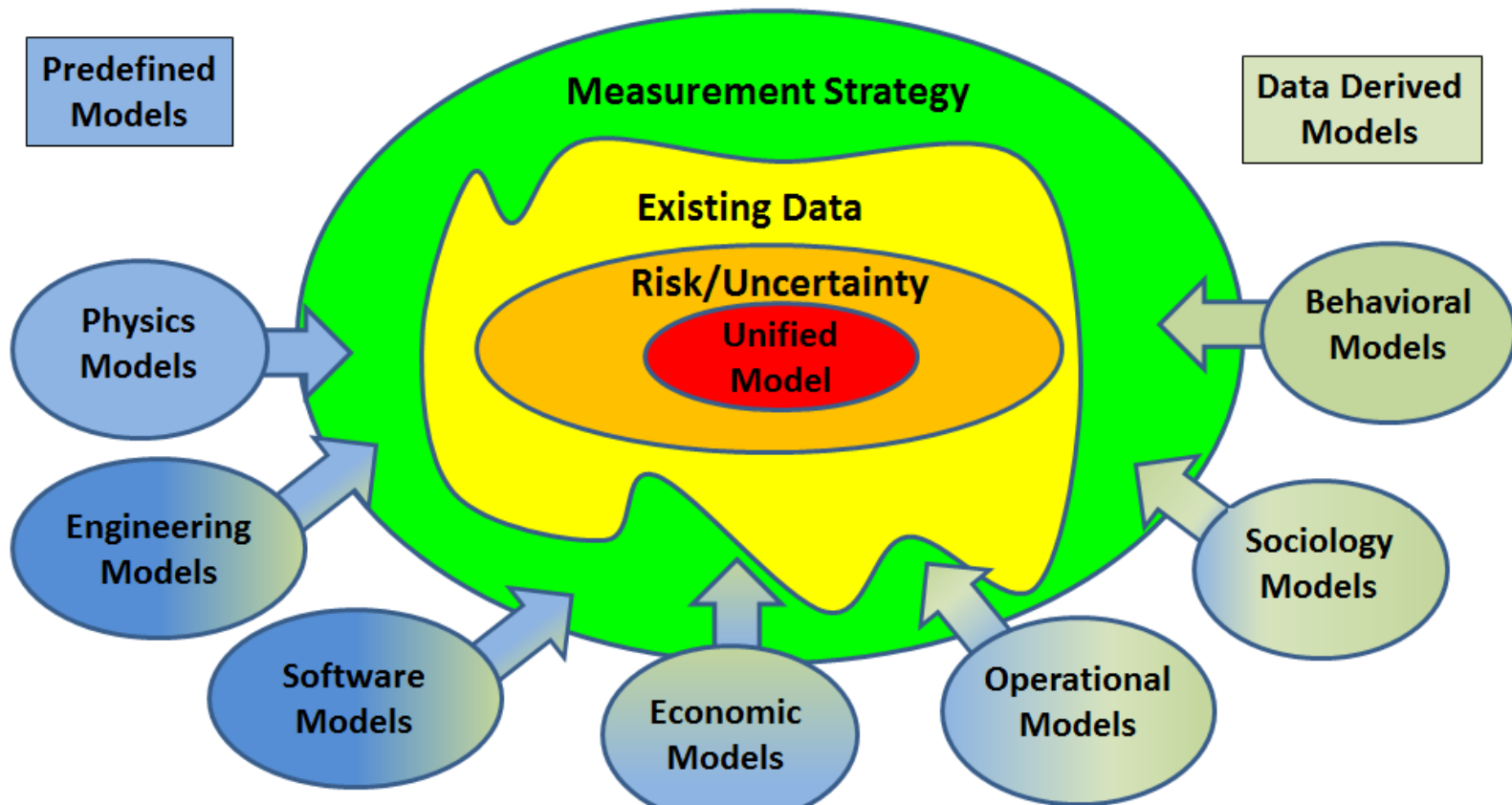




Risk Analysis and Modeling



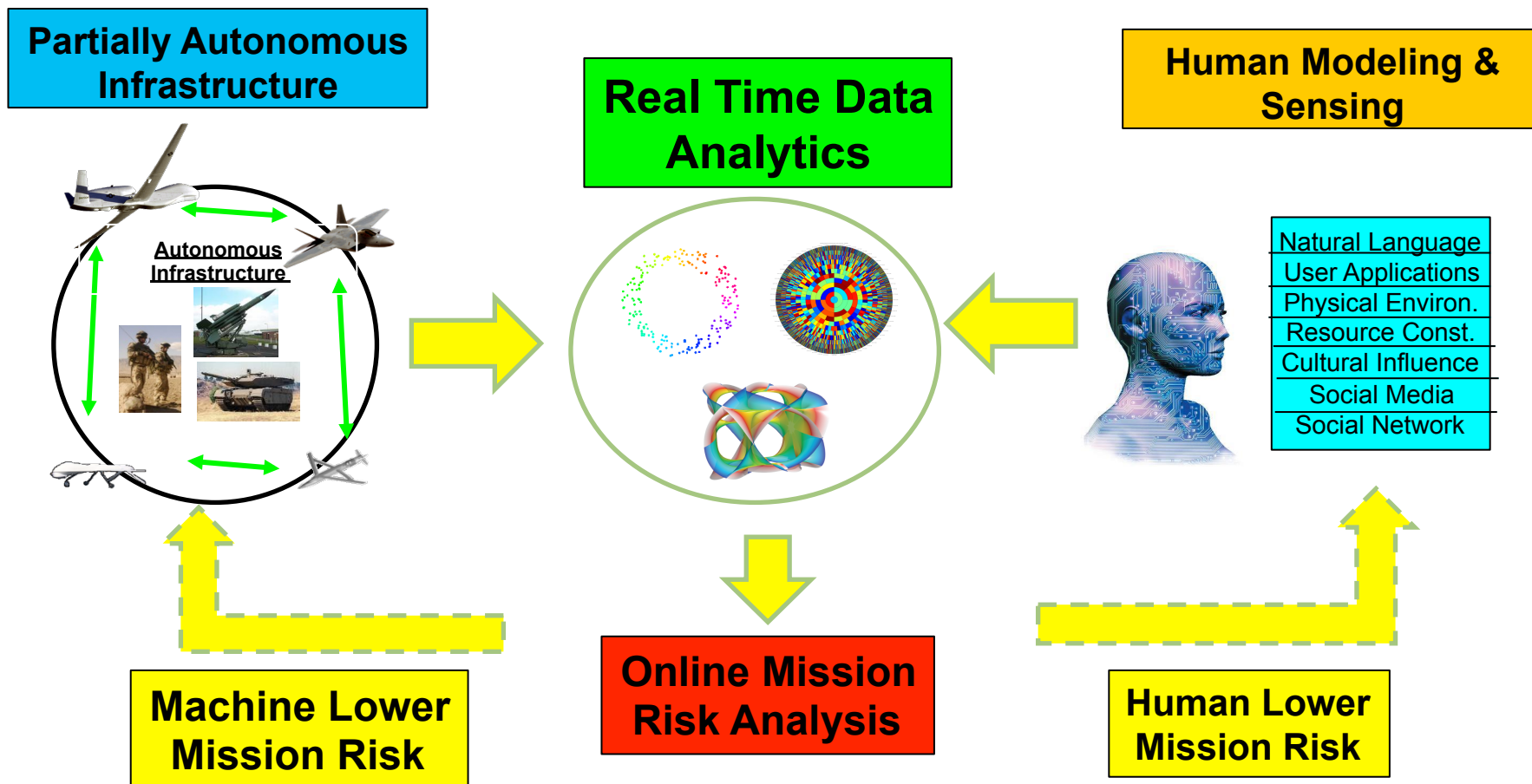
Unified methods for data modeling require a rigorous risk assessment in order to assure commanders, analysts, and system operators of performance.





Risk and Autonomy

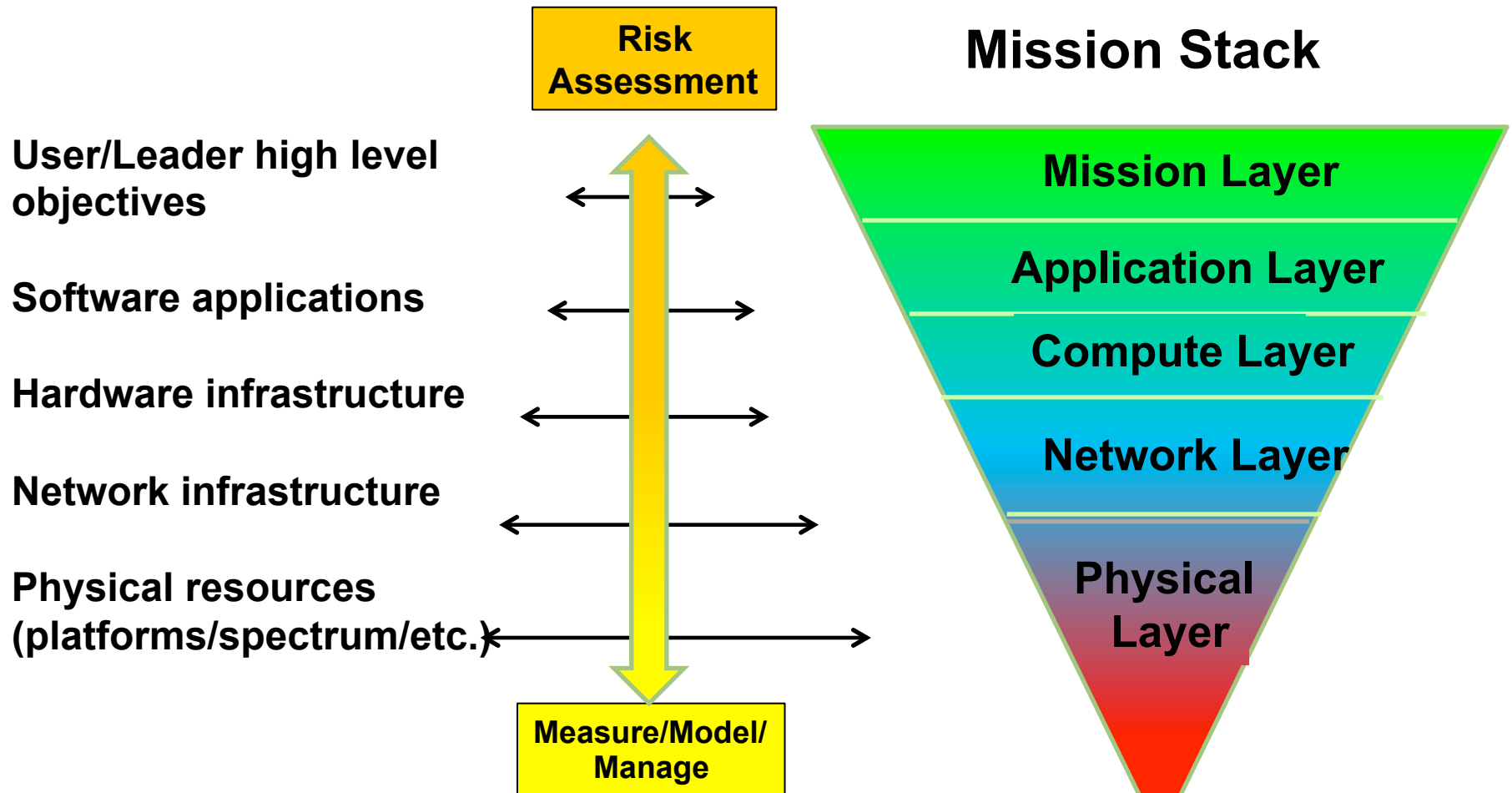
For automated system performance to be trusted and effective, a strategy for autonomy that enables the lowest mission risk in balancing human workload with automation should be followed





Mission Stack

Measurement, modeling, and management of mission stack must have rigorous performance and risk metrics associated with them

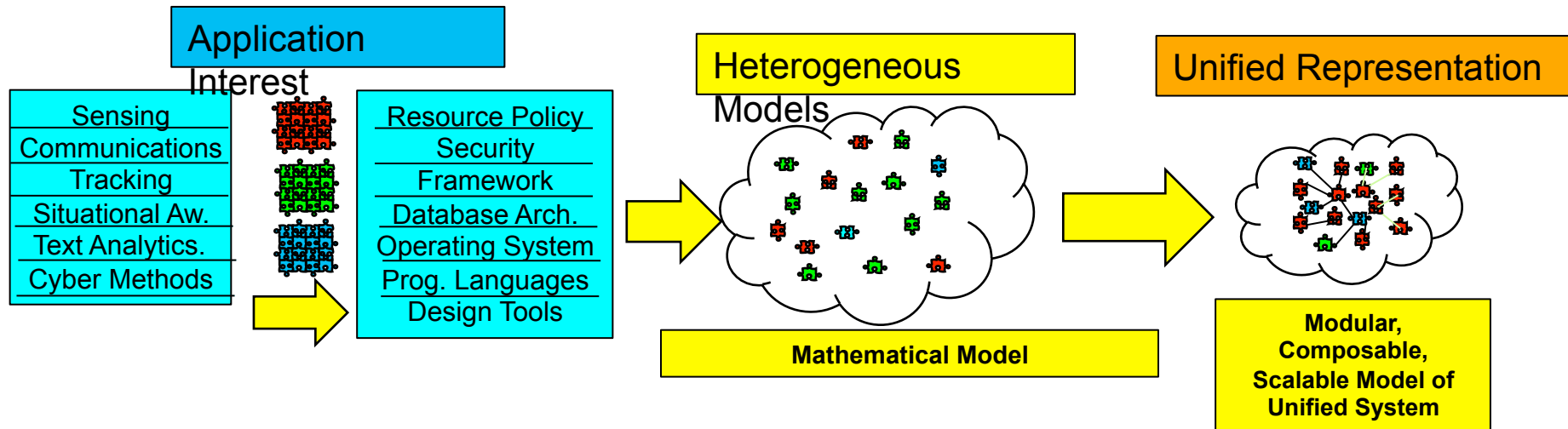




Application Layer

The mission layer may be made up of multiple applications such as sensing, communication, tracking, situational awareness, command and control, etc.

-These methods must be integrated with one unified representation for validation and verification.

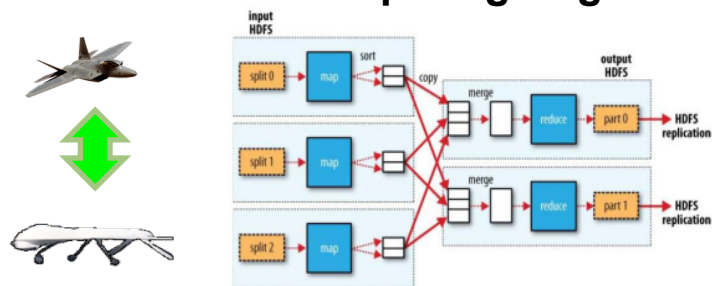




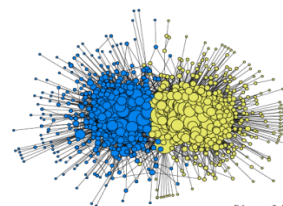
Compute Layer

Current computational infrastructures (cloud resources) are currently high distributed and resource allocation is static. Making this process more dynamic will resilient system performance.

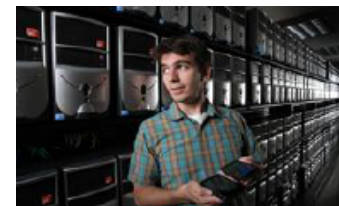
Critical DOD Apps on MAP-Reduce
Cloud Computing Engine



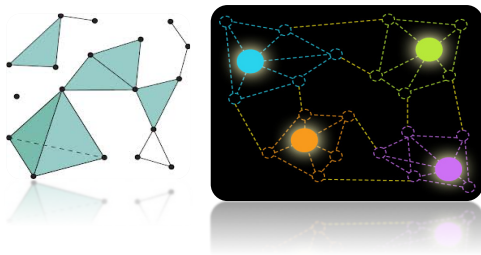
Measurement Based Graph Analytics



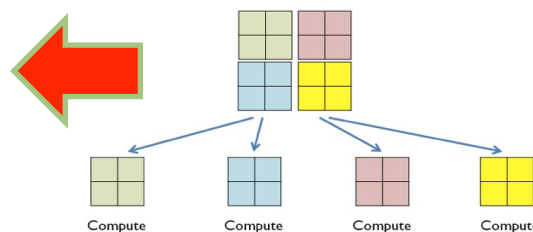
[Karrer & Newman, 2010]



System Performance
Verification



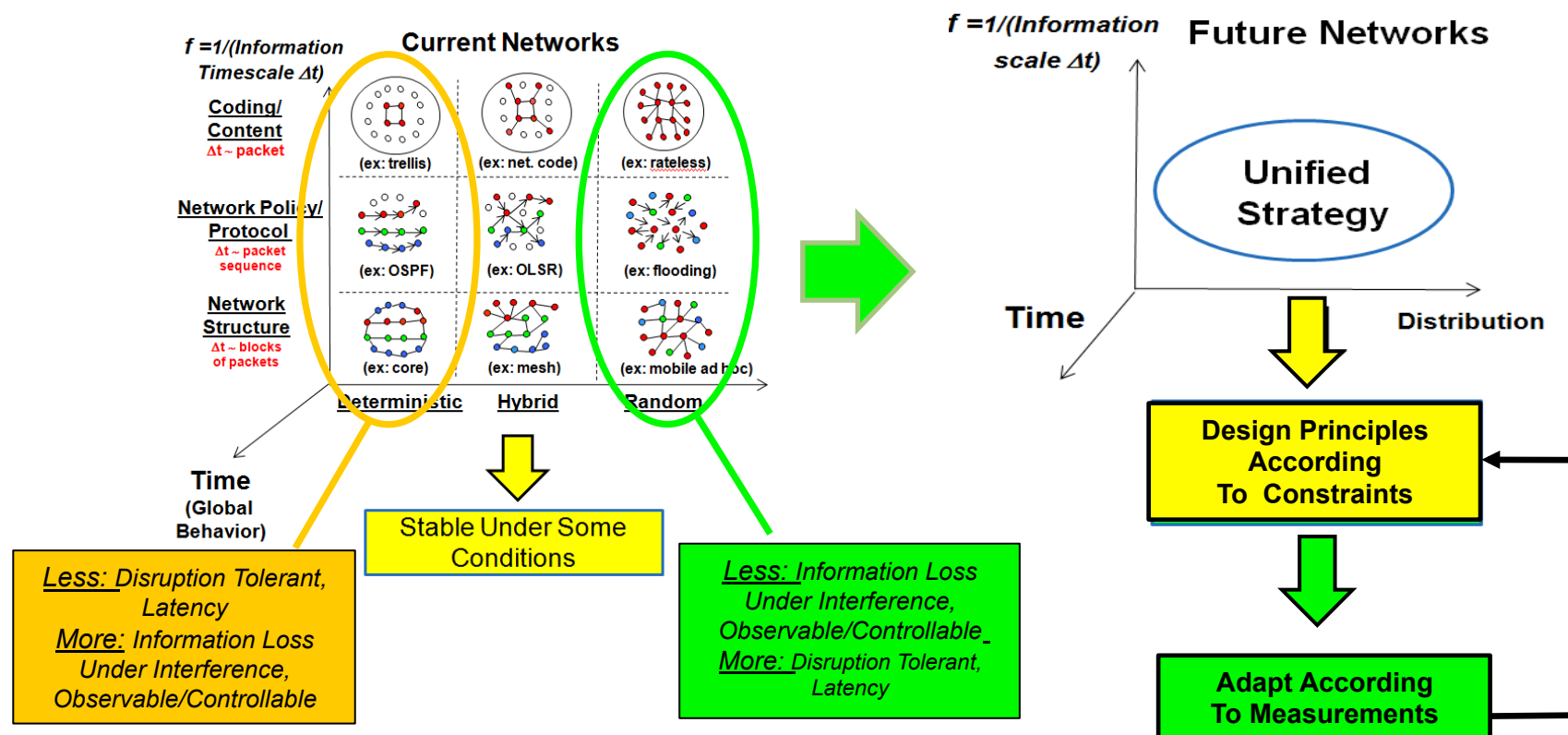
Computed System
State Representation

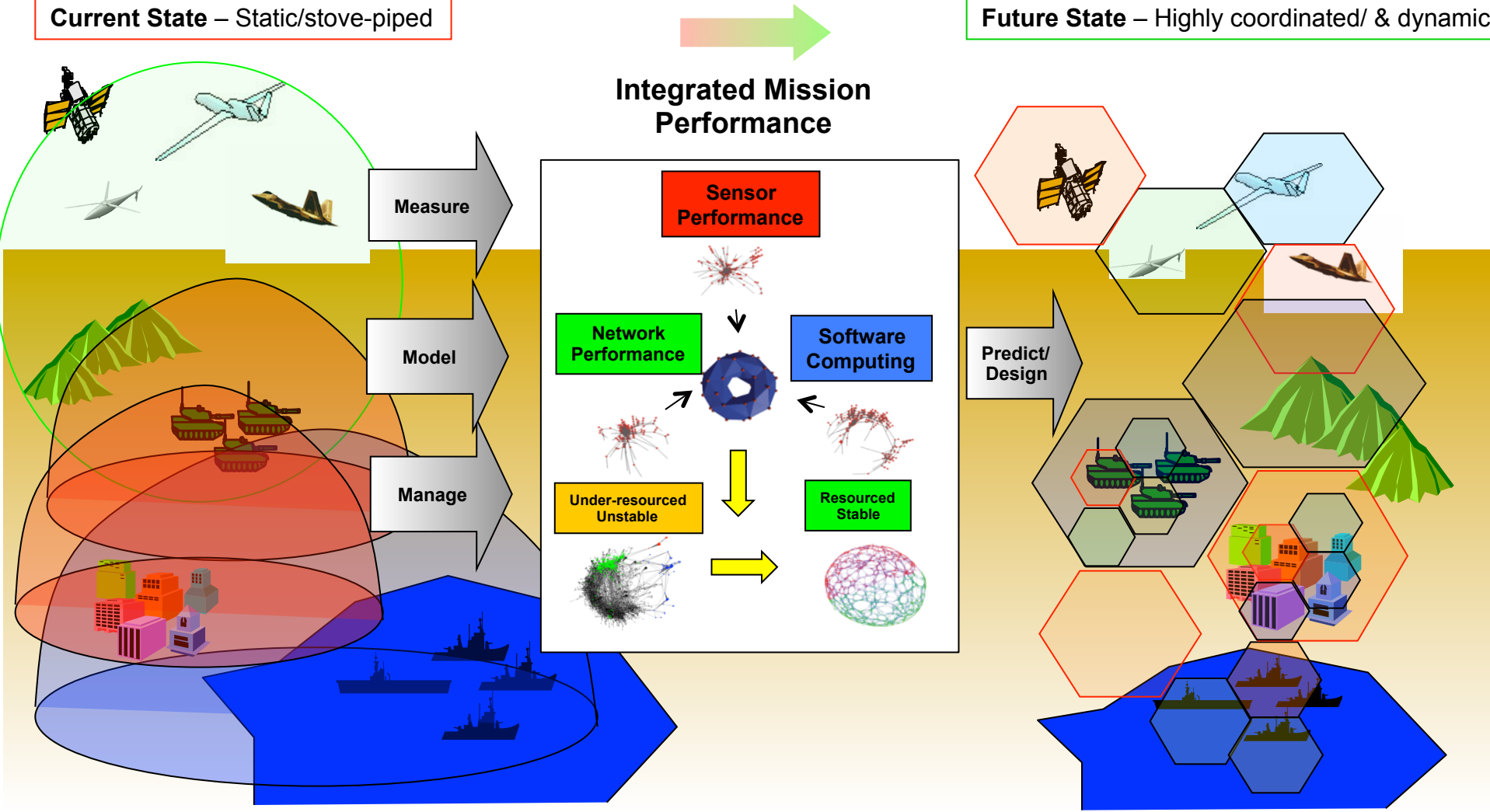




Network Layer

Advances such as software defined networks are changing stove piped network management to a heterogeneous management problem which requires dynamic assessment







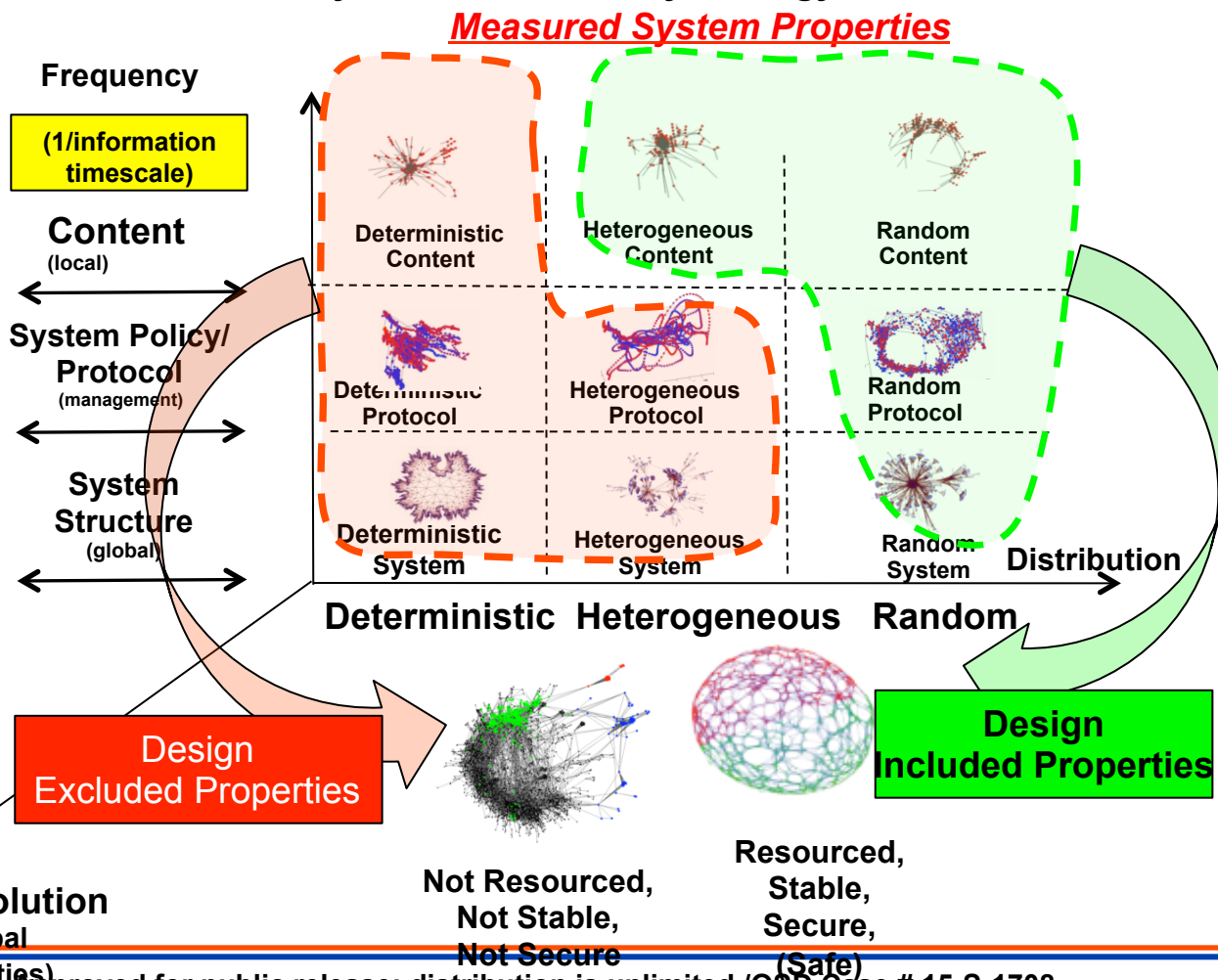
Unified Operation

Units of information translate across heterogeneous domains and can be used to measure and quantify system performance

- Taking this approach can lead to a unified systems and security strategy

Basic Information Unit Scales

Data Network	Wireless Network	Hardware/ Software	Social	Biological
Packet	Modulation Unit	Register/ Variable	Words	DNA
Packet Groups	Waveform	Ram/ Subroutine	Phrases	Protein Synth.
Packet Blocks	Signal Array	Virtual Mem./ Program	News Reports/ Blogs	Cell Function
Digital Systems			General Systems	





Current & Future DOD Architectures

An integrated framework to measure, model, and manage mission performance from the application to the physical asset enables to achieve mission performance guarantees in its future infrastructure

Introduce Into DOD Systems

Measure Model and Manage Using Advanced Data Methods

Enable Mission Performance Guarantees

