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**
- Sensor -> ISR/Text Data
- Analyst
- Cloud

**New Approach**
- Analyst
- Analysis Infrastructure
- User
- Cloud

User

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited./OSD Case # 15-S-1708
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.
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)

**Model 2**
(user integrates remote elements for their analysis)
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
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
Integrated modeling, validation, verification, and management can characterize mission performance with advanced data models.
Measurement

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.

*Un-validated Modalities (high mission risk)*

*Validated Modalities (low mission risk)*
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

Desired Outcome

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

Making DOD Apps on MAP-Reduce Cloud Computing Engine Measurement Based Graph Analytics System Performance Verification Computed System State Representation
Advances such as software defined networks are changing stove piped network management to a heterogeneous management problem which requires dynamic assessment.
Commercial pressure on spectrum is changing the static and highly segregated assumptions about physical layer performance.

**Current State** – Static/stove-piped

**Future State** – Highly coordinated/ & dynamic
Unified Operation

Measure and verify information system properties among various system constraints

Measured Performance Regions

- **Deterministic Content**
- **Hybrid Content**
- **Random Content**

- **Deterministic Protocol**
- **Hybrid Protocol**
- **Random Protocol**

- **Deterministic Architecture**
- **Hybrid Architecture**
- **Random Architecture**

**Heterogeneous Information**

- **Network States** (packets, packet blocks, packet groups)
- **Software States** (variable, subroutine, program)
- **Hardware States** (register, ram, virt. mem)

**System Measurements**

- **Global Properties**
- **Unstable/Un-resourced**
- **Insecure**

- **Stable/Resourced**
- **Secure**

**Less:** Information Loss Under Disruption/Live
**More:** Latency, Resource Intensive/Safe

**Best Integrated Performance Region**

**Less:** Latency/Disruption Tolerant/Safe
**More:** Controllable/Live

**Statistical Properties**

**Measured Performance Regions**

- **Measured Performance Regions**
- **Measured Performance Regions**
- **Measured Performance Regions**
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.
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.