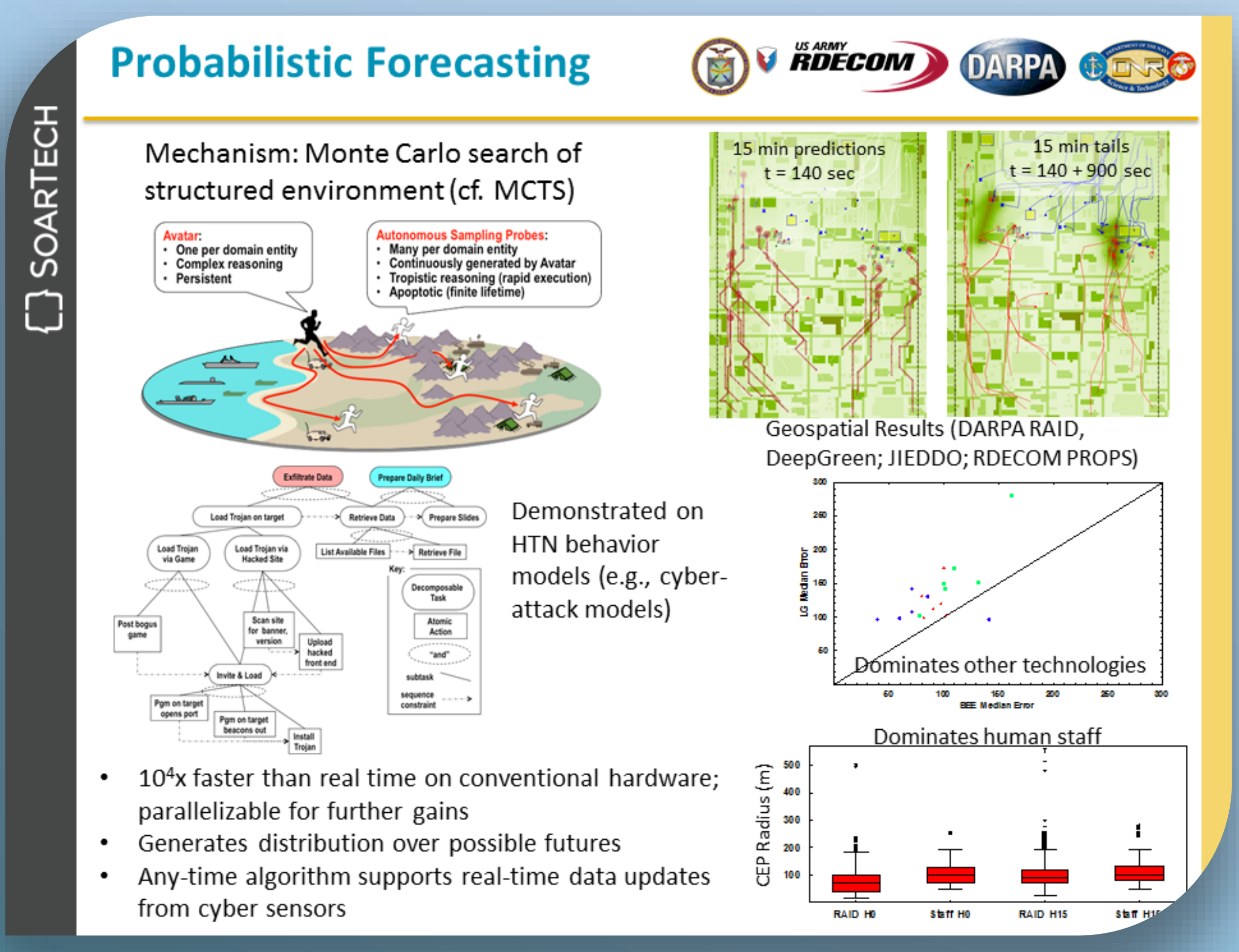
SOARTECH

Modeling human reasoning.
Enhancing human performance.

INTELLIGENT SYSTEMS FOR FORECASTING AND DETECTING INSIDER THREAT

OUR EXPERTISE AND PROVEN CAPABILITIES	DECISION SUPPORT	BEHAVIOR MODELING	CYBER SIMULATION
	Multi-Future Probabilistic Forecasting	Cognitive Red-Team Agents	Cyber Sandbox for Insider Threat Training
AUTONOMY	Multiple agents search alternative paths through complex behavior models in parallel	Enables scalable, repeatable wargaming and testing of security and network infrastructure	Agent-based cyber ecology provides autonomous adversarial and legitimate users
ADAPTATION	Any-time forecast adjusts in real time to incoming data; runs 10^4x faster than real time	Learned behavior model exposes novel attack vectors	Dynamic Tailoring adapts adversaries and environment to maximize learning
HUMAN/SYSTEM INTERFACE	Yields probability distribution over alternative futures to support ACH and mitigate cognitive anchoring	Agents acting as virtual threats allow human experts to test variations in high level goals	Constructive sims are readily available for continuous training and evaluation

Relevant Research to be Leveraged:



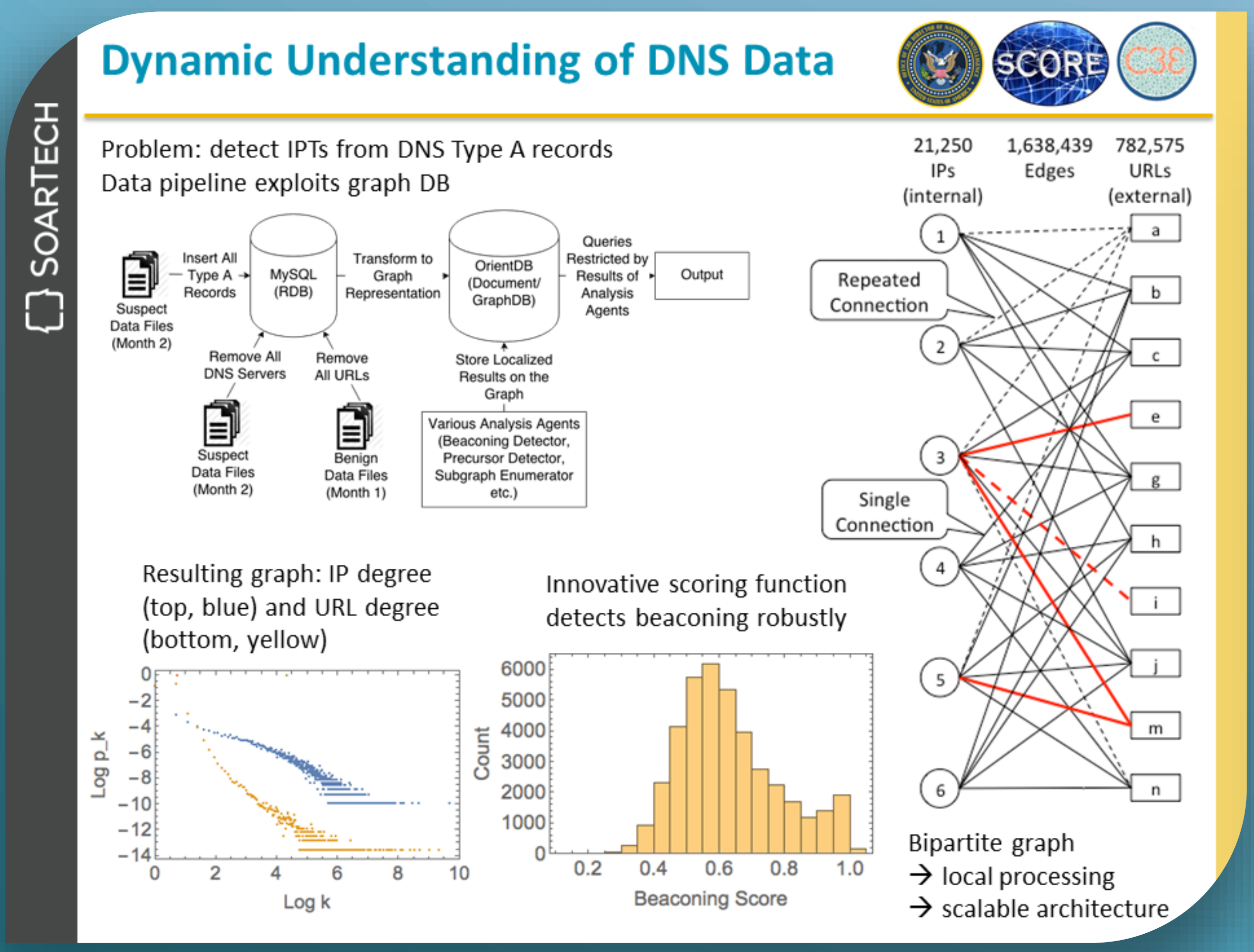
Probabilistic Forecasting

Mechanism: Monte Carlo search of structured environment (cf. MCTS)

Geospatial Results (DARPA RAID, DeepGreen; JIEDDO; RDECOM PROPS)

Demonstrated on HTN behavior models (e.g., cyber-attack models)

- 10^4x faster than real time on conventional hardware; parallelizable for further gains
- Generates distribution over possible futures
- Any-time algorithm supports real-time data updates from cyber sensors


SOARTECH
SCORE
C3E
Insert All Type A Records
MySQL (RDB)
Transform to Graph Representation
OrientDB (Document/ GraphDB)
Queries Restricted by Results of Analysis Agents
Output
Suspect Data Files (Month 2)
Remove All DNS Servers
Remove All URLs
Store Localized Results on the Graph
Suspect Data Files (Month 2)
Benign Data Files (Month 1)
Various Analysis Agents (Beaconing Detector, Precursor Detector, Subgraph Enumerator etc.)
21,250 IPs (internal)
1,638,439 Edges
782,575 URLs (external)
Repeated Connection
Single Connection
1
2
3
4
5
6
a
b
c
e
g
h
i
j
m
n
Log p_k
Log k
Count
Beaconing Score

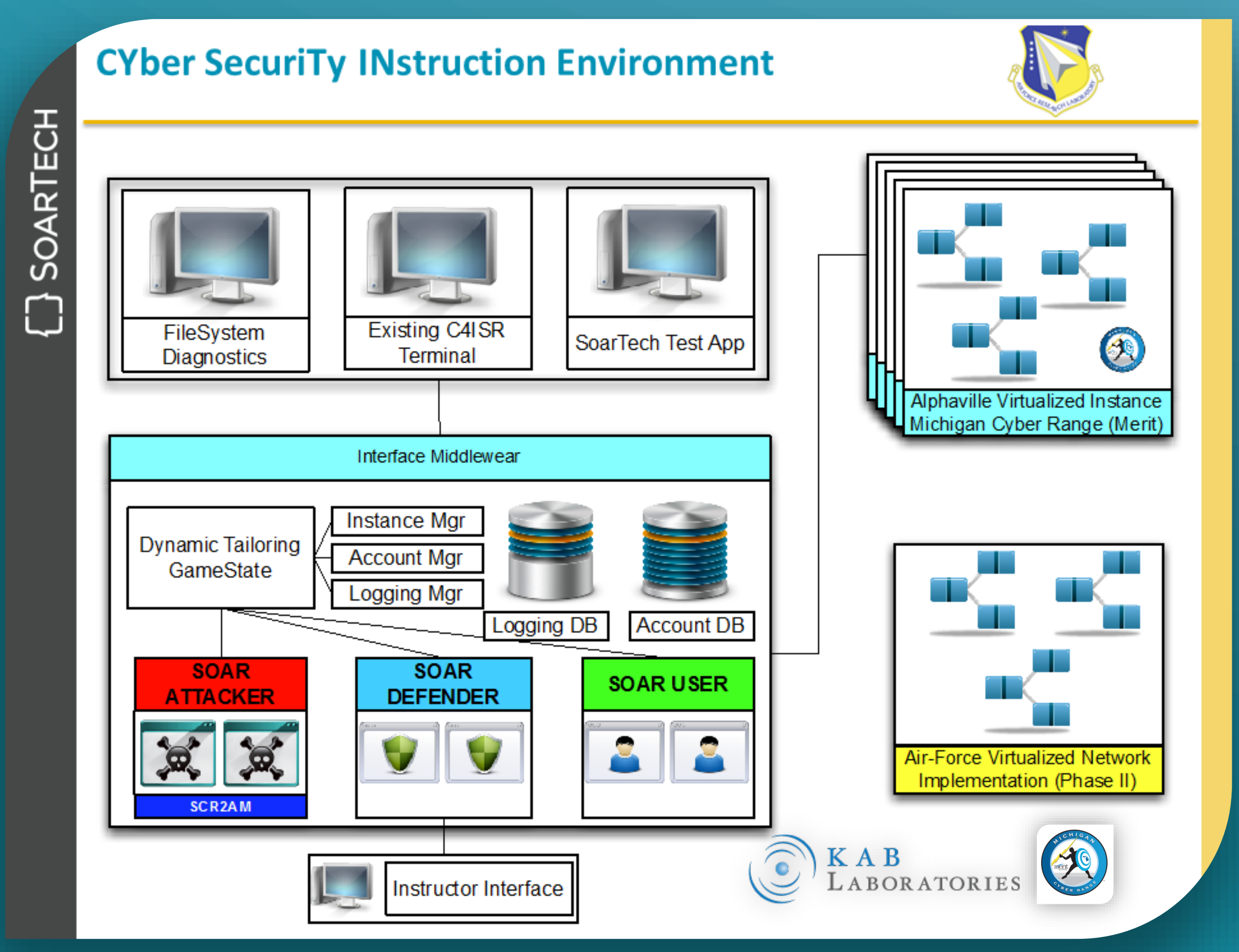
Dynamic Understanding of DNS Data

Problem: detect IPTs from DNS Type A records
Data pipeline exploits graph DB

Resulting graph: IP degree (top, blue) and URL degree (bottom, yellow)

Innovative scoring function detects beaconing robustly

Bipartite graph
→ local processing
→ scalable architecture



CYber SecuriTy INstruction Environment

Research Area of Interest:

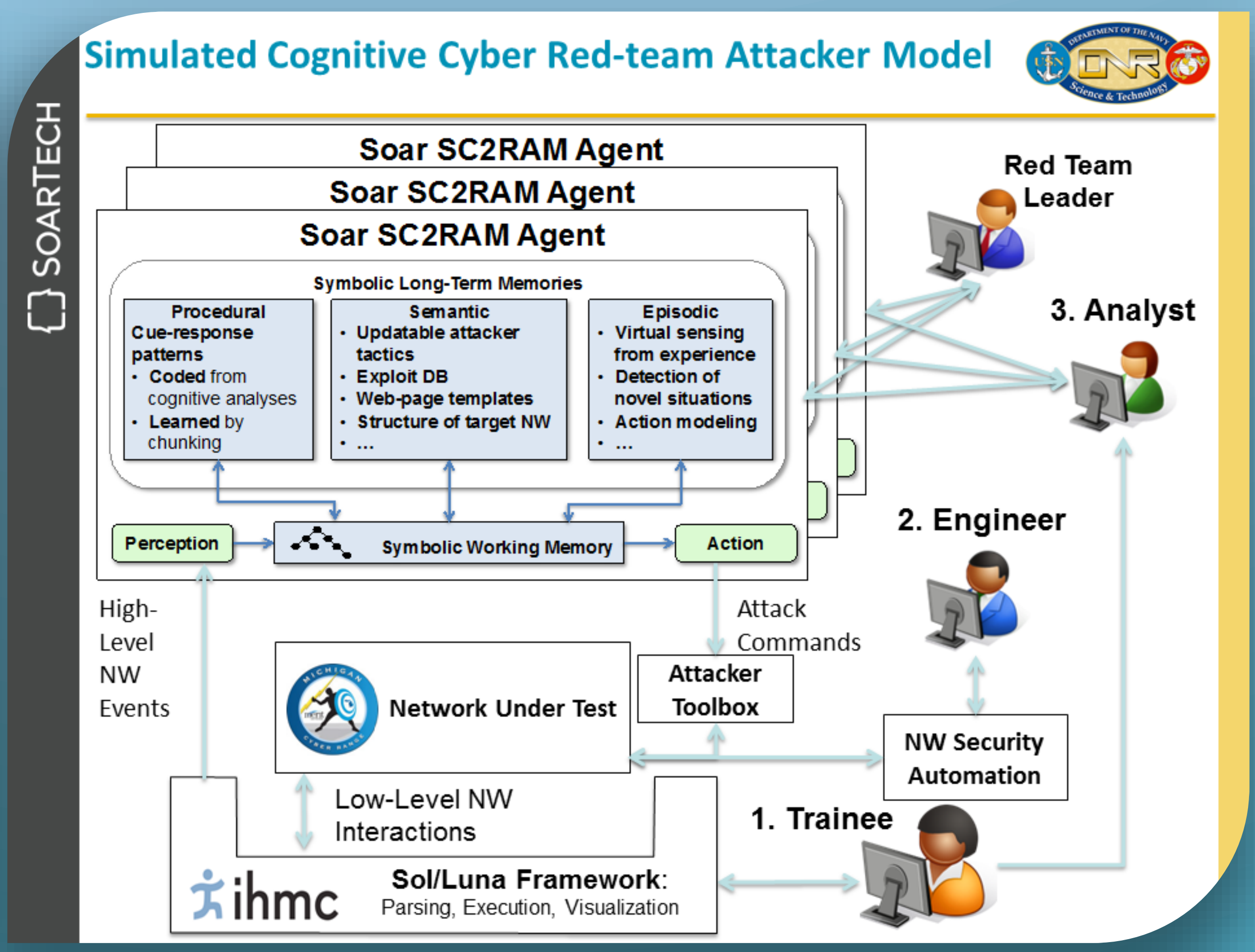
Current approaches to detecting insider threat are *reactive* and *limited*:

- *reactive* because they focus on what threats have done in the past, rather than anticipating what they may do in the future.
- *Limited* because they focus on network cyber vulnerabilities without reasoning about threats' goals and objectives.

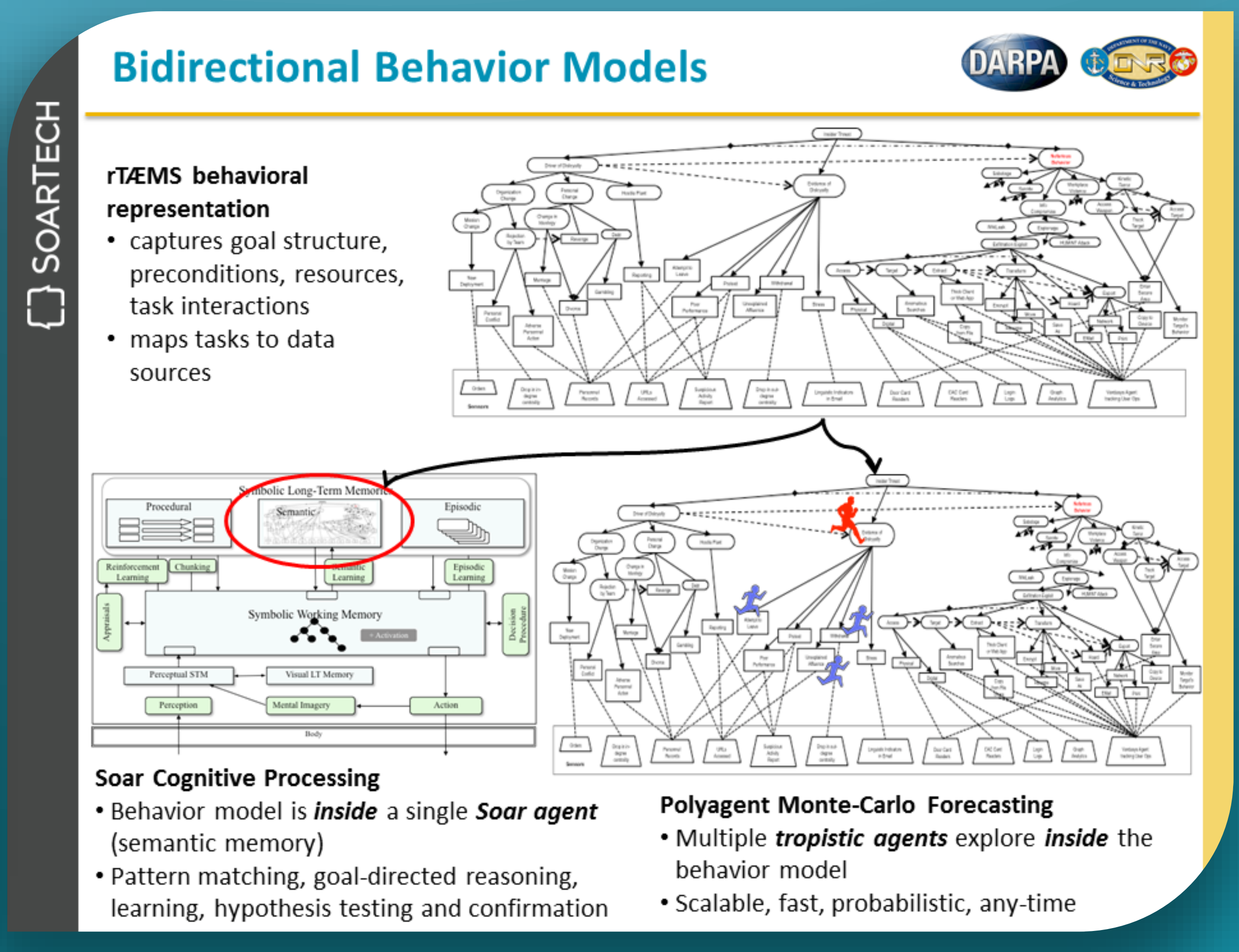
SoarTech's innovative capabilities can provide:

- Models and assessments of behavior for automatic detection of indicative and anomalous behaviors for the *Active Indicators track*.
- Simulation Based Human Systems Integration to model system and enterprise performance for the *Inference Enterprise Models (IEM) track*

ENHANCING INSIDER THREAT DEFENSE THROUGH BEHAVIORAL MODELS AND SIMULATION BASED FORECASTING



Simulated Cognitive Cyber Red-team Attacker Model



Bidirectional Behavior Models

rTÆMS behavioral representation

- captures goal structure, preconditions, resources, task interactions
- maps tasks to data sources

Soar Cognitive Processing

- Behavior model is ***inside*** a single ***Soar agent*** (semantic memory)
- Pattern matching, goal-directed reasoning, learning, hypothesis testing and confirmation

Polyagent Monte-Carlo Forecasting

- Multiple ***tropistic agents*** explore ***inside*** the behavior model
- Scalable, fast, probabilistic, any-time

SOARTECH POCs

Dylan Schmorrow, Ph.D.
Chief Scientist
703.424.3138
dylan.schmorrow@soartech.com

Denise Nicholson, Ph.D., CMSP
Director of X
407.616.7651
denise.nicholson@soartech.com

Jose Nazario, Ph.D.
Senior Scientist
734.887.7644
jose.nazario@soartech.com