

Snap-Cards: A Dynamic Data Construct of Rapid Information Gathering and Integration for C2 Effectiveness in Homeland Security

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First Some Context

- **Who we are.**
- **What Intelligent S/W Agents are.**
- **What SnapCards Are.**

About 21CSI

- 21st Century Systems, Inc.® (21CSI®) is a pioneer in agent-based decision support systems for time- and mission-critical military applications
 - Woman-owned, founded in 1996
- Decision support tools across the spectrum of missions
 - Individual Soldier Situational Awareness
 - Distributed Warship Command and Control
 - Decision Under Uncertainty
 - Homeland Security/Force Protection Situational Awareness
 - Secure R&D Collaboration...*and others*
- Our applications run on all types of hardware...
 - Wireless PDAs
 - Laptops, desktops, to massive parallel computers
 - ...*and are Operating System independent*
- Military Small Business Contractor Success Story
 - 100% Commercialization Achievement Index
- Offices in : NE, MO, HI, WA, RI
 - Top Secret Facility Clearance

Software Agents Are:

Software that:

- Maps *precepts* into *actions*, or

Software that:

- Is *autonomous*, *reactive*, *proactive*, *rational*, and *socially adept*, or

Software that:

- Is a proxy contractually bound to Humans
- Is capable of *observing* and *acting* toward a set of goals
 - Belief, Desire, Intention (BDI)
 - Knowledge representation (KR)
- Executes 'autonomously' and (inter-)acts 'rationally'
- Transforms data into knowledge within the semantics of a domain

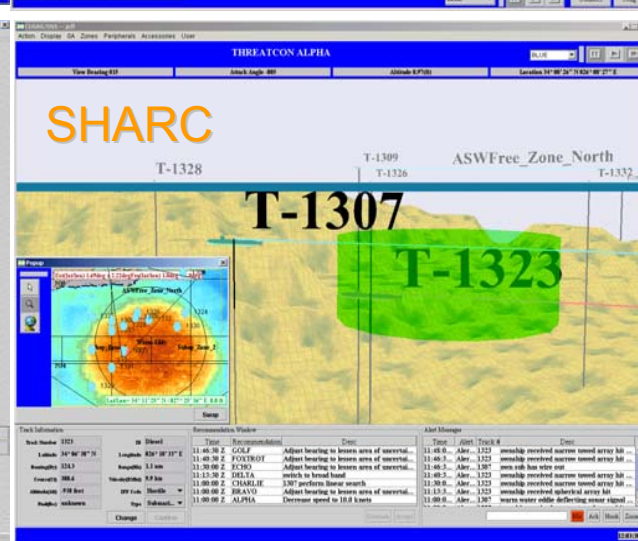
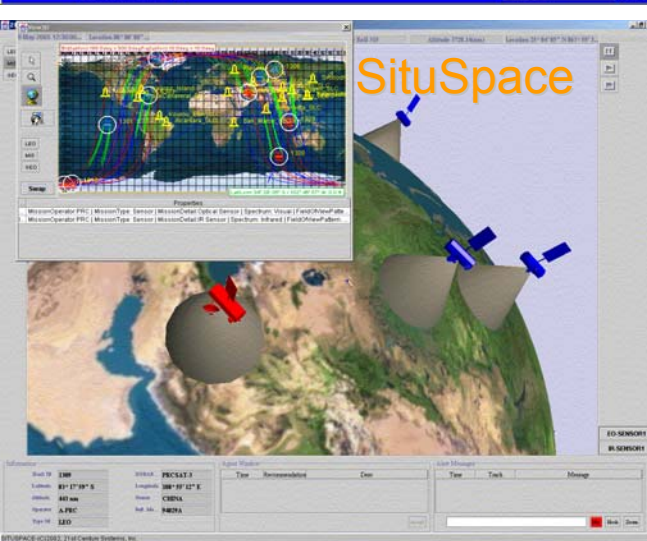
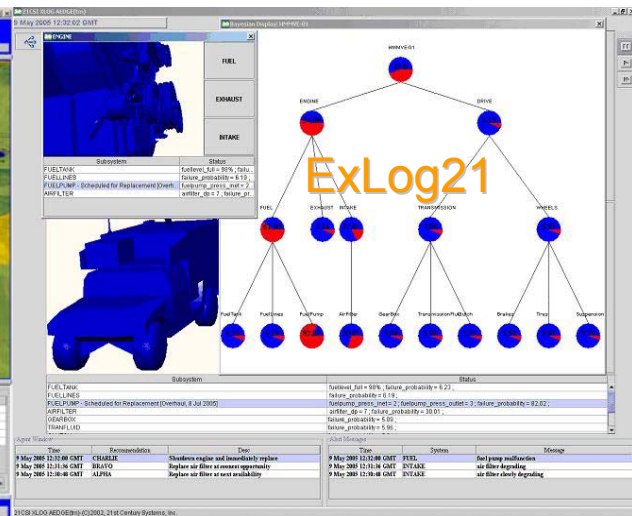
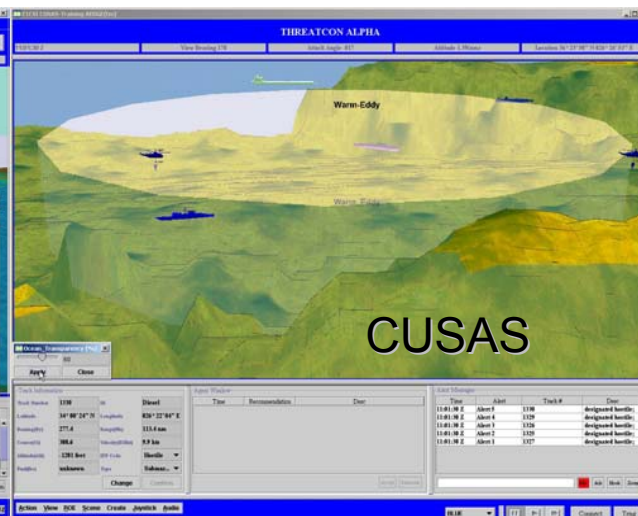
Agents Can:

- Monitor and Alert
- Perform repetitive, time-consuming tasks
- Consider and evaluate alternatives
- Coach and Advise
- Mimic and Learn
- Act as the 'glue' for legacy systems
- Provide a trusted environment
 - Information integrity
 - Contract enforceability
 - Flexibility, Scalability

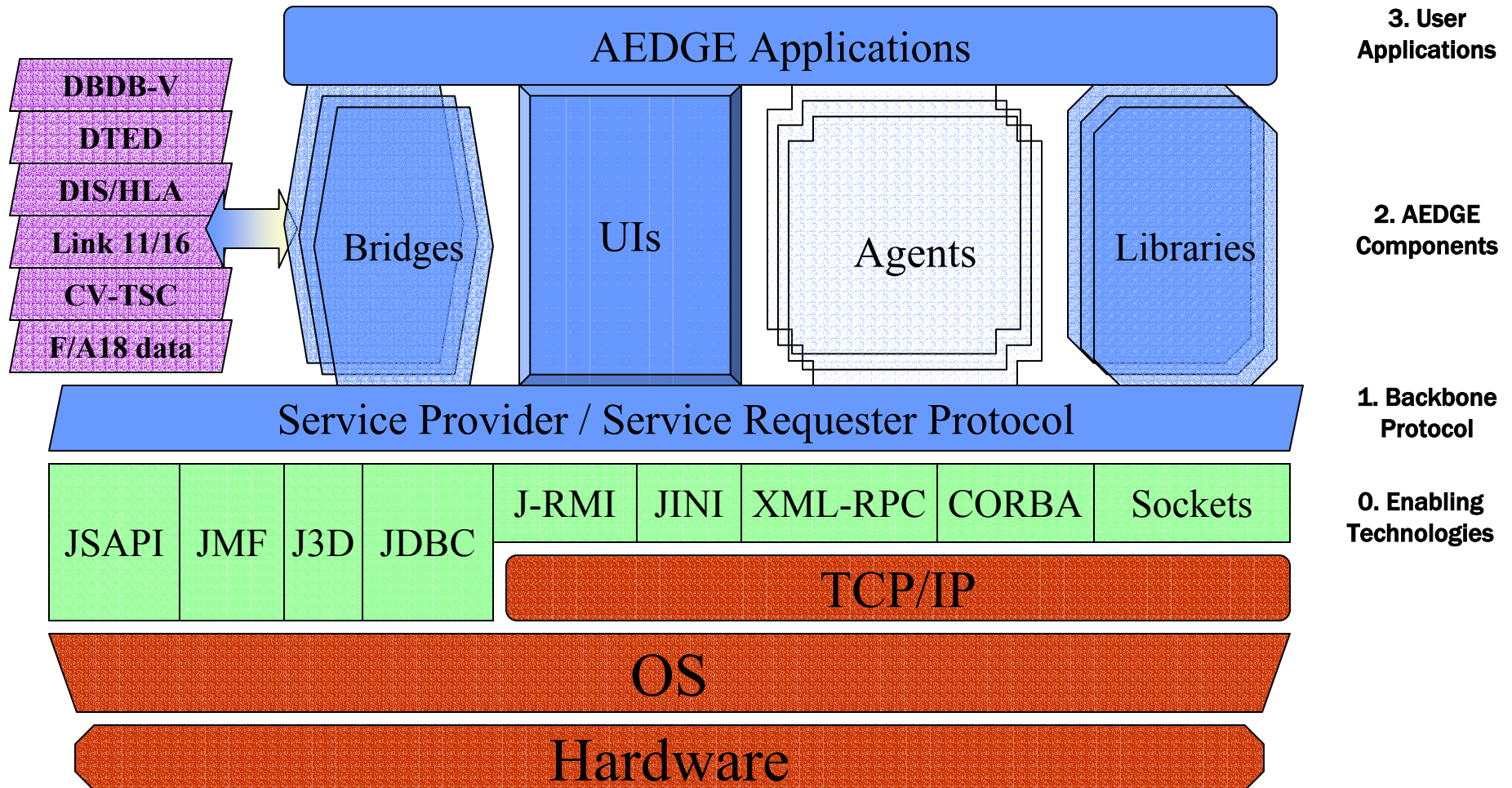
Agents in AEDGE

- AEDGE (Agent Enhanced Decision Guide Environment)
- AEDGE is an architecture that lets Agents 'plug' into a complete computational framework
- AEDGE has several diverse agent applications
- AEDGE 1.0 is current version, AEDGE 2.0 is in development

Some AEDGE1.0 Applications



AEDGE1.0 Tiers



Outline

Basic Concept

- I. INTRODUCTION**
- II. THE SNAP-CARD CONSTRUCT**
- III. SYSTEM CONCEPT AND FUNCTION**
- IV. SNAP-CARDS IN C2 AND HOMELAND SECURITY APPLICATION**
- V. CONCLUSION**

Basic Concept

A dynamic data construct.

- Built on the basis of smart media concept
 - designed to meet the needs of :
 - information empowerment,
 - representation flexibility,
 - application versatility.
- Rapid interchange / effective information integration
 - facilitates :
 - prompt reporting, gathering, tracking, and analysis of information from heterogeneous resources,
 - effective data fusion for C2 situation awareness
 - fast communication and response

I. INTRODUCTION

I. INTRODUCTION (1)

The demand

Deliver time-critical information to war fighters promptly

- Right information to right place at right time and in right format
- Data flexibly coded, concisely presented, and quickly transferred
- Integration of information from multiple heterogeneous sources

I. INTRODUCTION (2)

The demand (Cont.)

A concise and adaptive data structure

- Rapid reporting, gathering, tracking, and analysis of information from wide spread of heterogeneous resources,
- Facilitating information fusion
- Prompting fast decision making and event responses
- Suiting wireless communication environment

I. INTRODUCTION (3)

A systematic construct

Four main functional blocks

- Networked environment
 - human operators
 - automated sensors
 - intelligent software agents
- Snap cards
 - created, transmitted, integrated, and responded through the software agent operations
- Snap Card Assessment Processor
- System control agents

I. INTRODUCTION (4)

An example of application

Prototyped and tested in a Surveillance System Concept (SSC) - Sentinel Net for Force Protection (FP)

- a DoD SBIR project
- Now in Phase II



II. THE SNAP-CARD CONSTRUCT

II. THE SNAP-CARD CONSTRUCT (1)

Basic entries of snap-card

Four basic entries

(1) Card identifier

a unique code about the source

(2) Card suite

severity and emergency levels of event

(3) Card values

specific activity in certain pre-defined event types

(4) Card links

multimedia pieces of information.

II. THE SNAP-CARD CONSTRUCT (2)

Basic features of snap-card

Basic features:

- (1) dynamical,
- (2) self-organizing,
- (3) variable complexity,
- (4) incremental construction,
- (5) action embedment.

Enabling functionalities

- ☐ concise representation,
- ☐ rapid interchange,
- ☐ effective processing

II. THE SNAP-CARD CONSTRUCT (3)

Basic constructs of snap-card

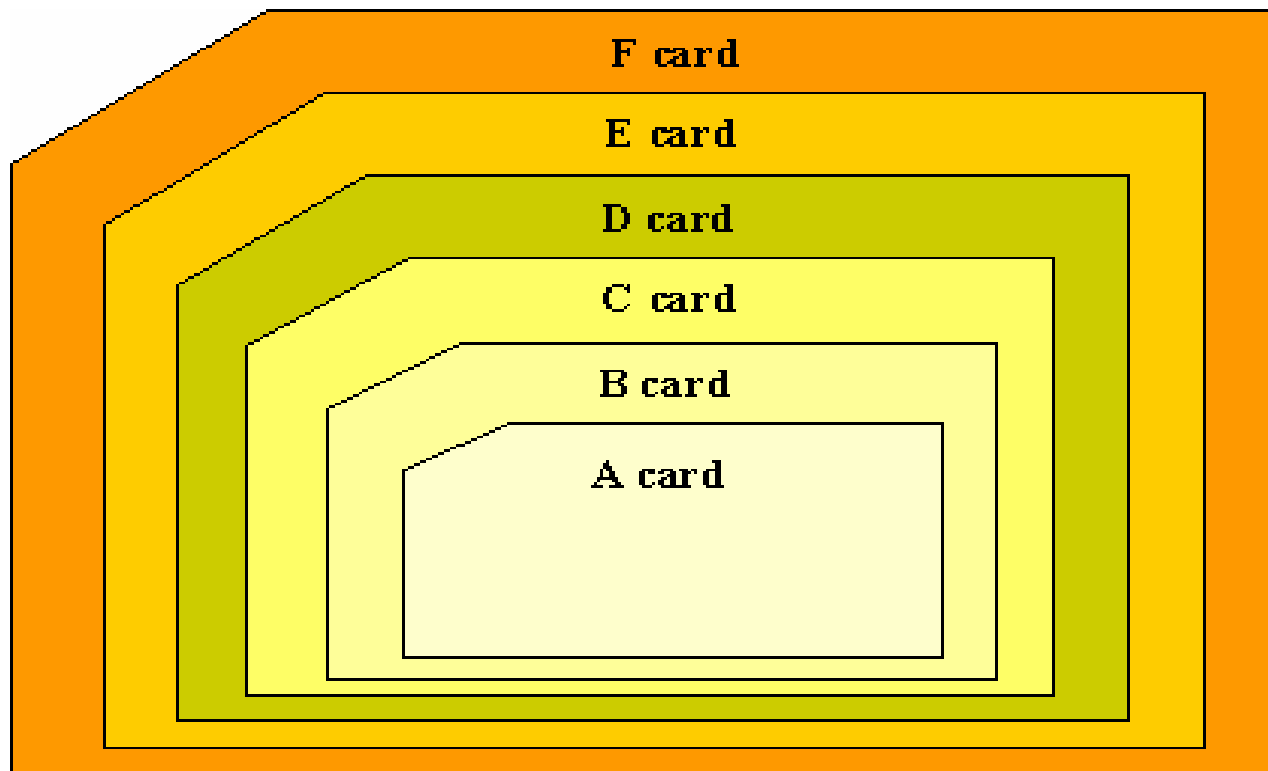
Card Classifications:

- | | |
|--|----------|
| <input type="checkbox"/> A bstract Card | — A-CARD |
| <input type="checkbox"/> B asic Card | — B-CARD |
| <input type="checkbox"/> C ommentary card | — C-CARD |
| <input type="checkbox"/> D ata-gram Card | — D-CARD |
| <input type="checkbox"/> E xtended Card | — E-CARD |
| <input type="checkbox"/> F unction Card | — F-CARD |

II. THE SNAP-CARD CONSTRUCT (4)

Basic constructs (Cont.)

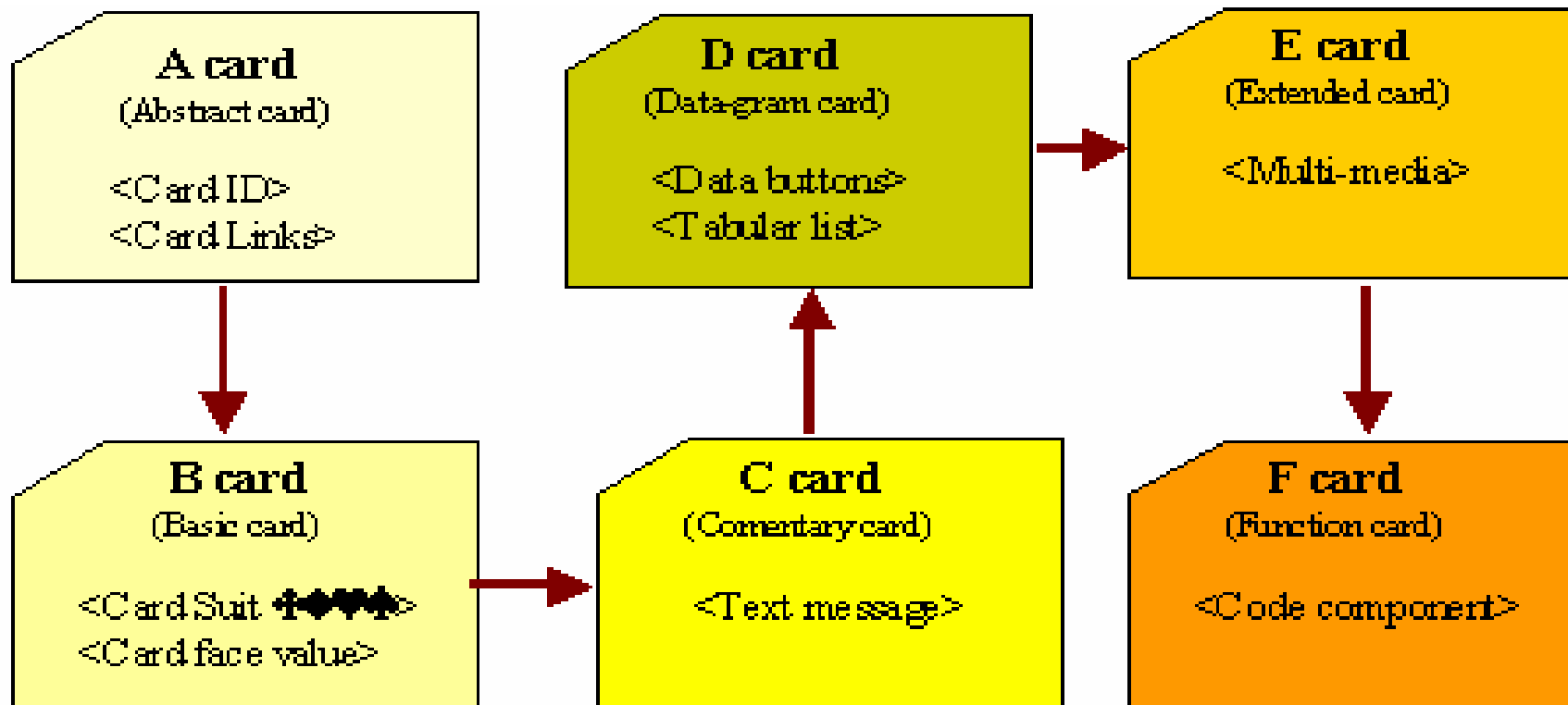
Inclusive relation of card types



II. THE SNAP-CARD CONSTRUCT (5)

Basic constructs (Cont.)

Transitional relation of card types



III. SYSTEM CONCEPT AND FUNCTION

III. SYSTEM CONCEPT AND FUNCTION (1)

System level architecture

Four functional blocks:

- Network environment – an agent network for
 - set-up, activation, access, and utilization of the cards
- Snap-card stacks – organization and archive
 - event categorizations
- System control agents – coordinate
 - creation, modification, access, and activation of the snap-card
 - access control, event inference, parameter adaptation, situation assessment.
- Card base/repository –a card queue.
 - an event control agent in charge of setting the processing priorities and preliminary processing of the events.

III. SYSTEM CONCEPT AND FUNCTION (2)

Operation enabling functions

Six major operations:

- **Card creation** – invoked when a situation arises that either an information sharing or a collaboration of agents must take place.
- **Card posting** – to whom (agents) the card should be sent, or where (in what scope) the card should be cast.
- **Card retrieving** – agents identify cards that are relevant to their roles and functionalities, and actively participating in the collaboration.
- **Card execution** – receiving agent is responsible for processing the data or executing the program specified in the card entries.
- **Card archiving** – a central tracker (an agent) performs the collection, sorting, and archiving operation
- **Card modification** – agents add certain information or marking certain fields, and then post the card again.

III. SYSTEM CONCEPT AND FUNCTION (3)

Operation facilities

■ Card transmission/Communication – three schemes:

- Uni-cast
 - – a point-to-point transmission,
- Multi-cast
 - – a one-to-many transmission
- Broad-cast
 - – a one-to-all transmission.

Uni-cast has closed loop acknowledgement.

Multi-cast has periodic status checking.

Broad-cast has flags signaling the transmission activity.

III. SYSTEM CONCEPT AND FUNCTION (4)

Operation intentions

- **Wild Card** – A scheme for uncertainty handling and adaptation
 - Card contains some fields that are not (or cannot be) definitely specified
 - A wild card may match several snap-card integration slots in the automatic assessment processor (AAP).
 - A wild card slot in AAP may be matched by several different snap cards.

A wild card is NOT an information-incomplete card.

IV. SNAP-CARDS IN C2 AND HOMELAND SECURITY APPLICATION

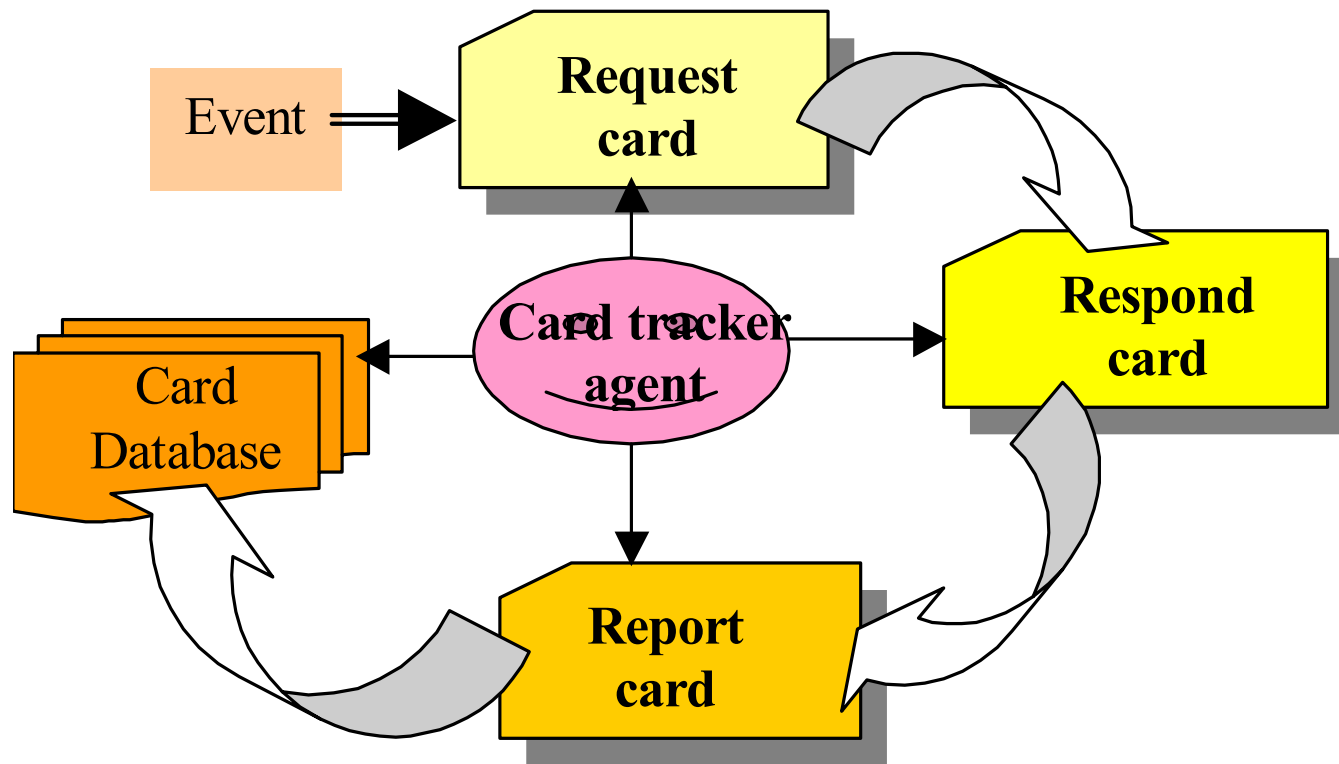
IV. SNAP-CARDS IN C2 AND HOMELAND SECURITY APPLICATION (1)

General application examples

- **E-collaboration**
 - engineers, architects, Subject Matter Experts, etc.
 - share data/information,
 - work on drafts/plan/blueprints,
 - cooperate on problem solutions.
- **Multi-source, geologically distributed intelligence**
 - integrating information over a sensor grid.
- **Group of decision making .**
- **Task/operation/mission management and coordination**
 - issue, track, and inspect working plan,
 - check schedule and assignment
 - coordinate plan executions.

IV. SNAP-CARDS IN C2 AND HOMELAND SECURITY APPLICATION (2)

Common operation scheme



A snap-card event transition protocol

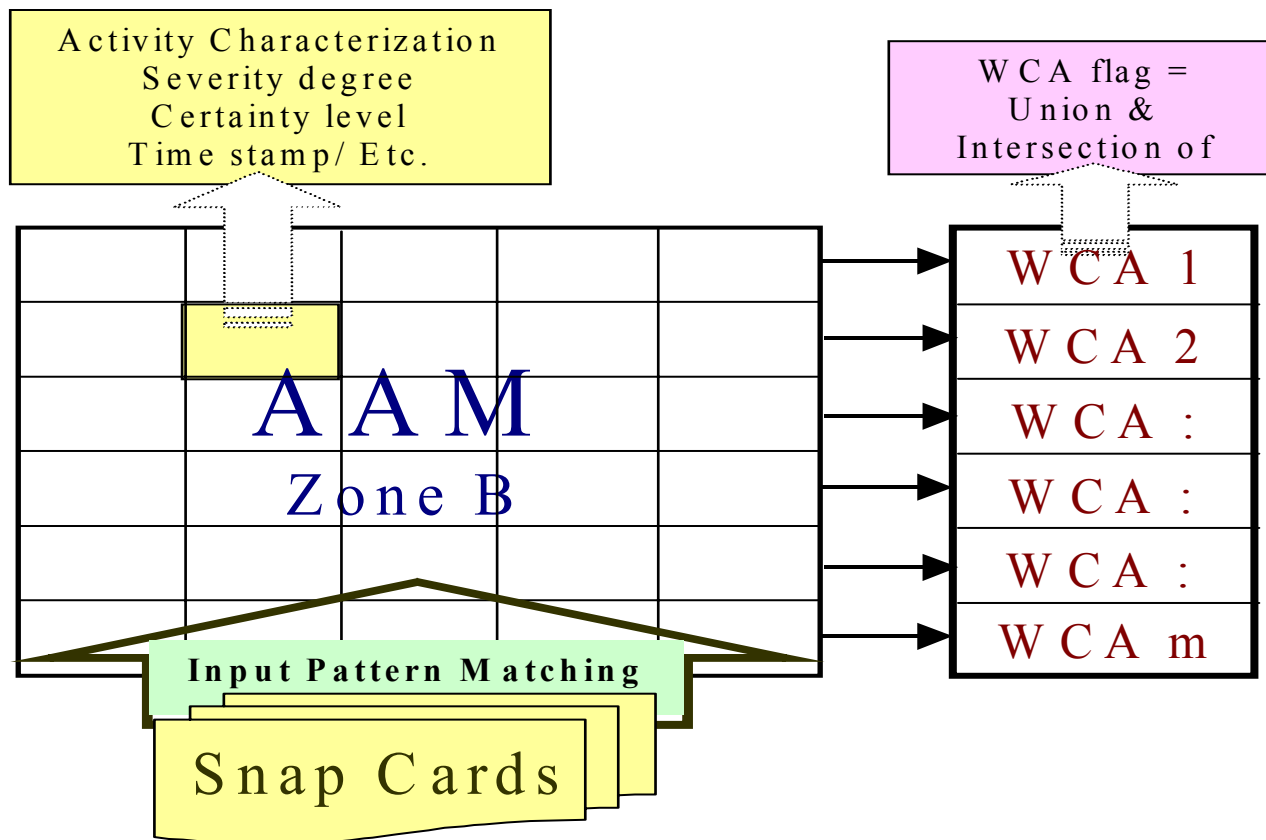
IV. SNAP-CARDS IN C2 AND HOMELAND SECURITY APPLICATION (3)



IV. SNAP-CARDS IN C2 AND HOMELAND SECURITY APPLICATION (4)

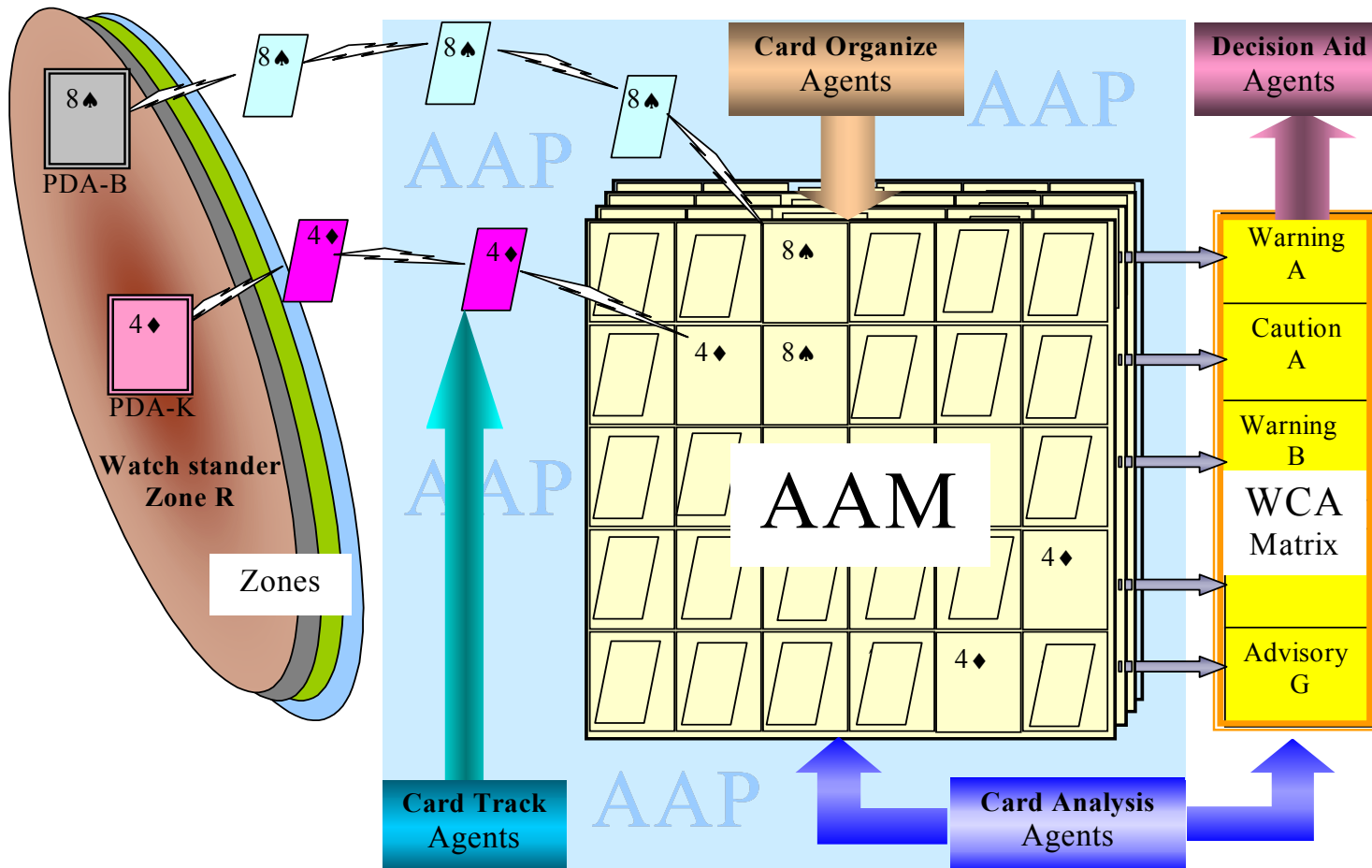
Data fusion using snap cards

AAM construct for snap card information fusion



IV. SNAP-CARDS IN C2 AND HOMELAND SECURITY APPLICATION (5)

A snap card operation environment (Agents facilitates snap card processing)



V. CONCLUSION

Conclusion

Summary features of Snap Card paradigm.

- A dynamic data structure facilitating command and control of dynamic systems and process automation,
- A smart-media/intelligent data structure facilitating data fusion/integration operations,
- A rapid information exchange format facilitating instant wireless communication,
- An incrementally constructible open data construct facilitating user interface diversity.