# NASA Ames Research Center
# Northwest Airlines Briefing
# December 11-12, 2001


James Bell, Systems Analysis Branch

Dan Clancy, Chief, Computational Sciences Division

Tom Edwards, Chief, Aviation Systems Division

Tom Hinke, Senior Scientist, NASA Advanced Supercomputing Division

Patty Jones, Deputy Chief, Human Factors Division

John Melton, Systems Analysis Branch

Mark Schwabacher, Computational Sciences Division

Huy Tran, Program Office

Bill Van Dalsem, Deputy Manager, CICT Program

# Outline

- Why are we here?
- What do we bring – Core Technologies
- What have we been thinking?
- Where would we like to go from here?

# Why are we here?

- **We have technical capabilities that we believe could be of value to the aviation industry**
  - To help address the problem of passenger identification and threat assessment
  - To provide processing scalable to a nationwide system
  - To identify operational problems
- **We would like to explore where we could make a useful contribution by working with the various aviation industry stake-holders including the**
  - FAA
  - Air carriers
  - Airports
  - Transportation Security Administration
  - Vendors
  - Research community

# Core Technologies: Vulnerability and Risk Assessment

- **Aviation Safety Reporting System (ASRS)**
  - Receives, processes, and analyses first-hand reports that describe unsafe occurrences and hazardous situations in the aviation system.
  - Uses formal data analysis methods to identify system risks and vulnerabilities.
  - See http://asrs.arc.nasa.gov/

# Core Technology:Information Extraction

- **Data Mining and Analysis**
  - Statistical machine learning and unsupervised learning (one of the top research labs in the country in this area)
    - Very close ties to broad academic and industrial research community.
  - Agent-based mining on a distributed computational grid
  - Link analysis, association rules and anomaly detection

# Core Technology: Distributed heterogeneous infrastructure

- **Developed technology to access and organize data from multiple outside sources**
  - Maintain dynamic, distributed, situational models that are continuously updated and examined for trends, relationships, and/or anomalies
- **Developing and fielding Information Power Grid (IPG) which is a seamless, scalable infrastructure integrating:**
  - Distributed collections of both:
    - High-end processors
    - Medium and low scale processors
  - Distributed sensors and data sources
  - Resources that might cross administrative boundaries
  - Uses what has become the de facto standard grid software

# Core Technology: Neuro-electric sensing

- Time based pattern recognition
  - Used for analysis of EEG and ECG signals
  - Already in development for brain-machine interface work.
- Non-invasive neuro-electric sensors
  - Under development as collaborative venture between NASA Ames and commercial partner

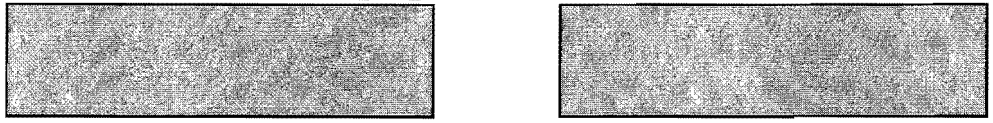
# Core Technology: Human Factors

- **Twenty-five year record of providing the aviation industry with scientific principles and practical solutions for improving safety and effectiveness of crew training and line operations**
  - Fatigue research influenced changes in duty-time regulations, led to widely-attended fatigue counter-measure workshops
    - See http://human-factors.arc.nasa.gov/zteam/
  - Research on role of team effectiveness in flight safety resulted in new regulations, industry-wide implementation of Crew Resource Management (CRM)
    - CRM is a system-wide concept that emphasizes effective teamwork and decision making
  - Flight training research resulted in new regulations, industry-wide implementation of Line-Oriented Flight Training (LOFT)
    - LOFT is simulation-based training that relies on realistic extended scenarios

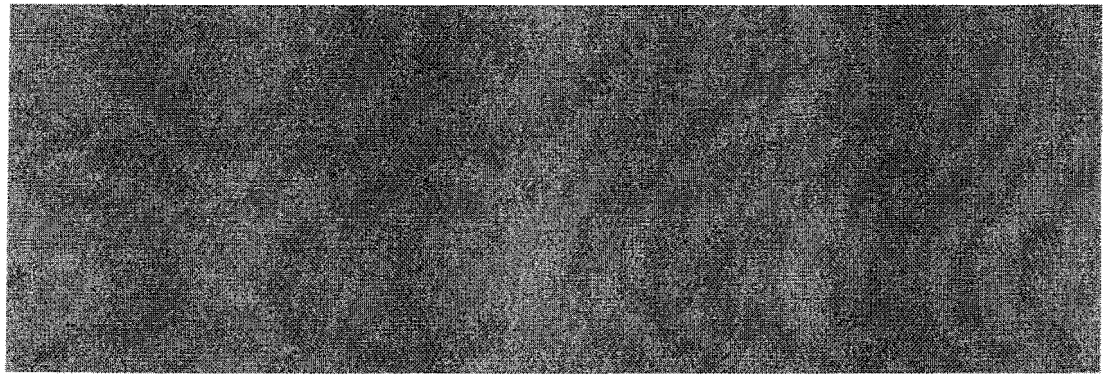
# What we have been thinking for Vulnerability and Risk Assessment

- **Develop Aviation Security Reporting System (ASecRS)**
  - Based on successful Aviation Safety Reporting System (ASRS)
  - Solicit, processes, and analyze reports that describe insecure situations
  - Use formal data analysis methods to identify system risks and vulnerabilities
  - Communicates effectively back to aviation industry

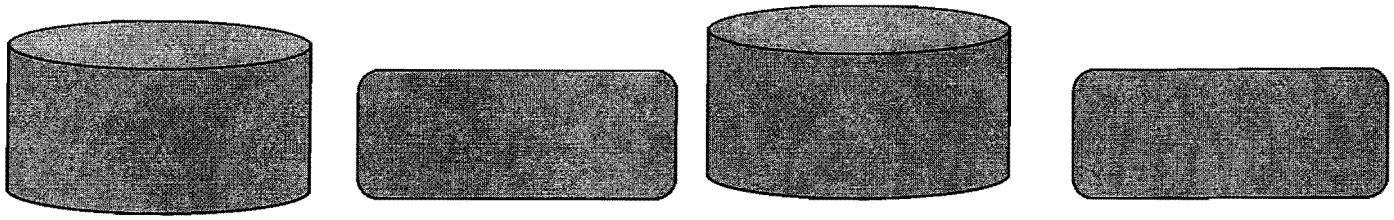
# What we have been thinking for NASA Applications



## Standard Interface



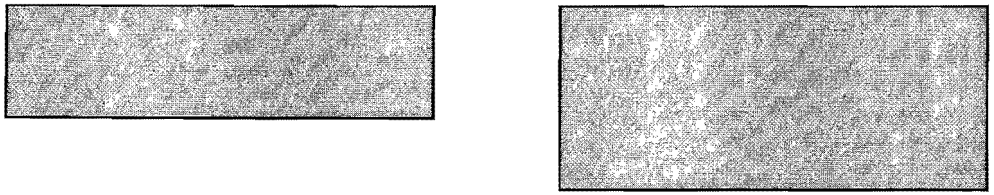
**Grid Services**



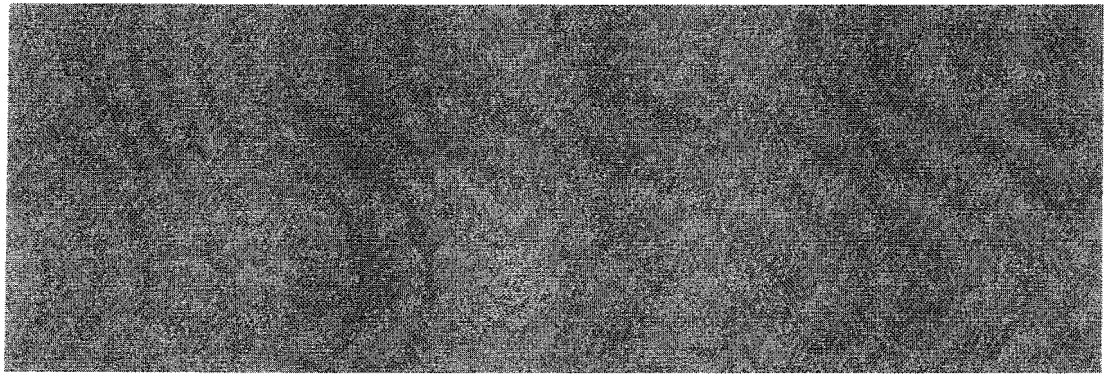


Ames Research Center

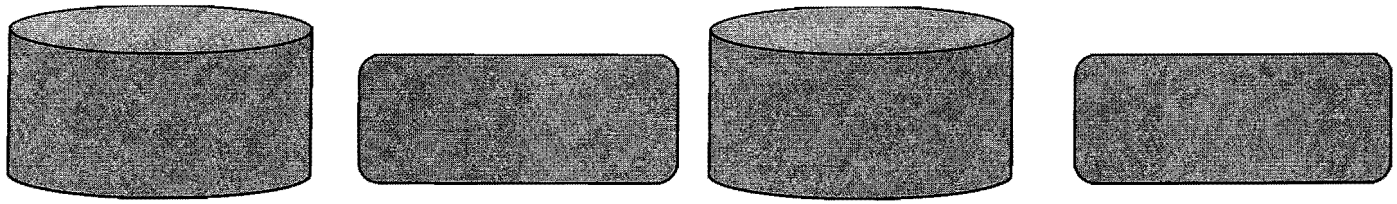
# What we have been thinking for Scalable Threat Assessment



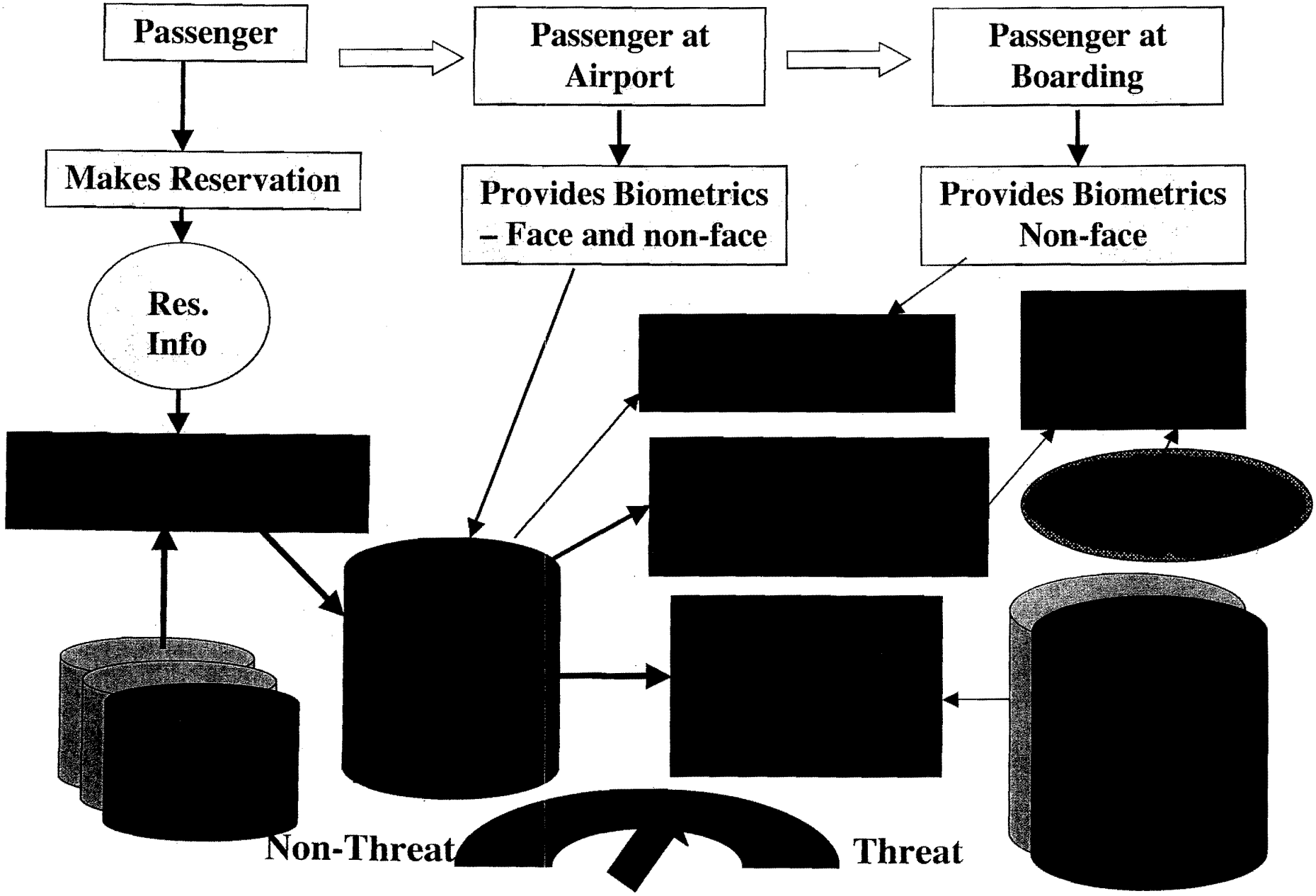
## Standard Interface



**Grid Services**



# Passenger Screening Model



# Requirements
# - Effective Passenger Screening System -

- **Must detect people who are known threats**
- **Must detect people who may pose a threat but are unknown**
- **Must ensure that people cannot bypass screening by**
  - Using false name and/or forged credentials
  - Having substitute passenger board the aircraft in place of a screened passenger
- **Must have acceptable**
  - Pd (probability of correct detection)
  - Pfa (probability of false alarm)
  - Tp (throughput)

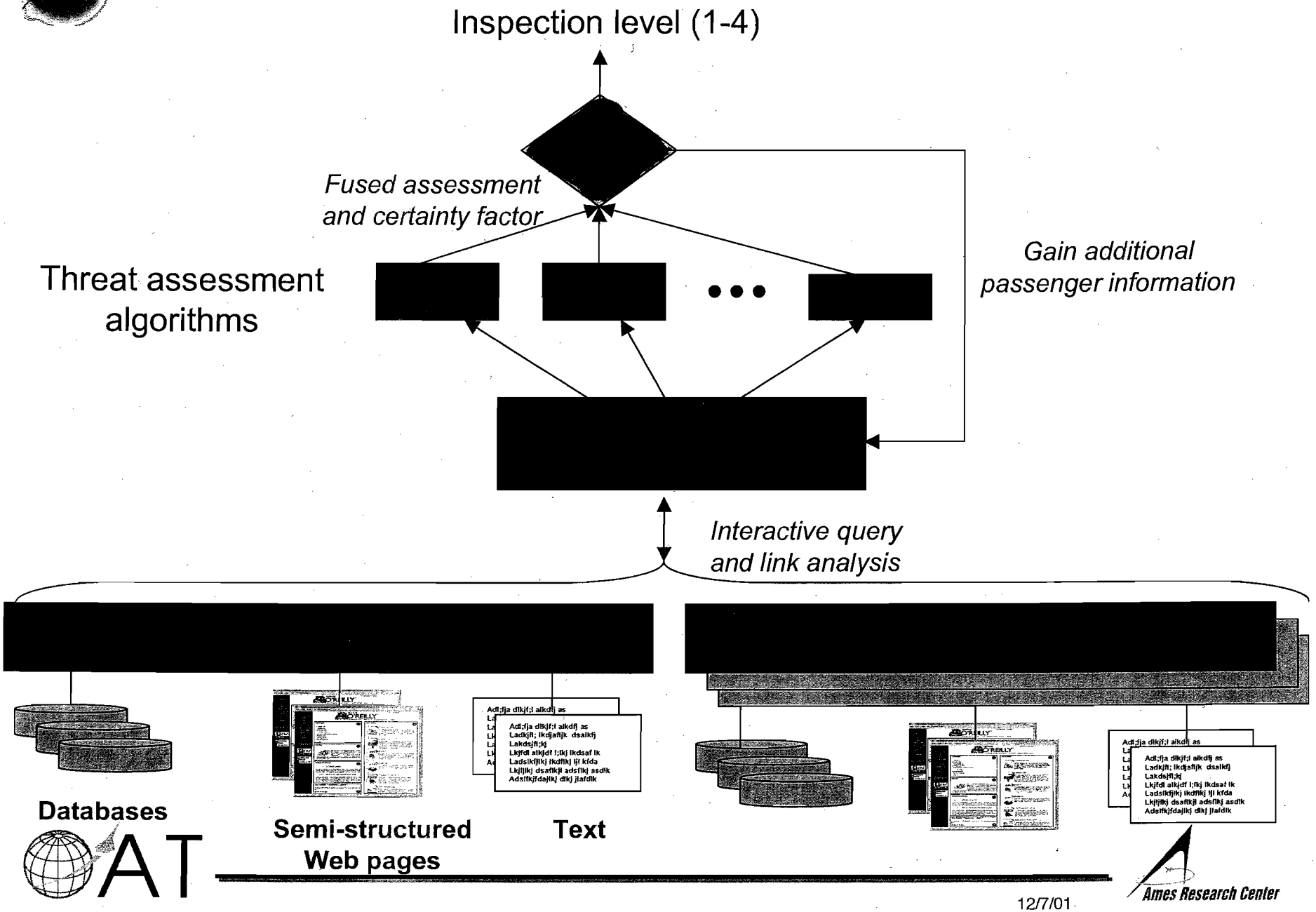
# Requirements

## - Effective Passenger Screening System -

- Will probably want multilevel approach, with different types of sensors with different Pd, Pfa and Tp characteristics
- Must address privacy and "big brother" issues to the extent possible
- Must recognize that due to sensitive data, some agencies may not be willing to release information on known threats
  - But, they may be willing to do red-light/green-light processing on passenger biometric, UID or name

# What we have been thinking for innovative ways of detecting unknown threats

- Use non-invasive neuro-electric sensors to detect passengers who potentially might pose a threat
- Passenger threat assessment using machine learning, data mining, and expert systems, applied to multiple databases containing information about passengers and suspected terrorists (possibly as an extension of CAPPS)


Inspection level (1-4)
Fused assessment and certainty factor
Threat assessment algorithms
Gain additional passenger information
Interactive query and link analysis
Databases
Semi-structured Web pages
Text

# Information access and integration

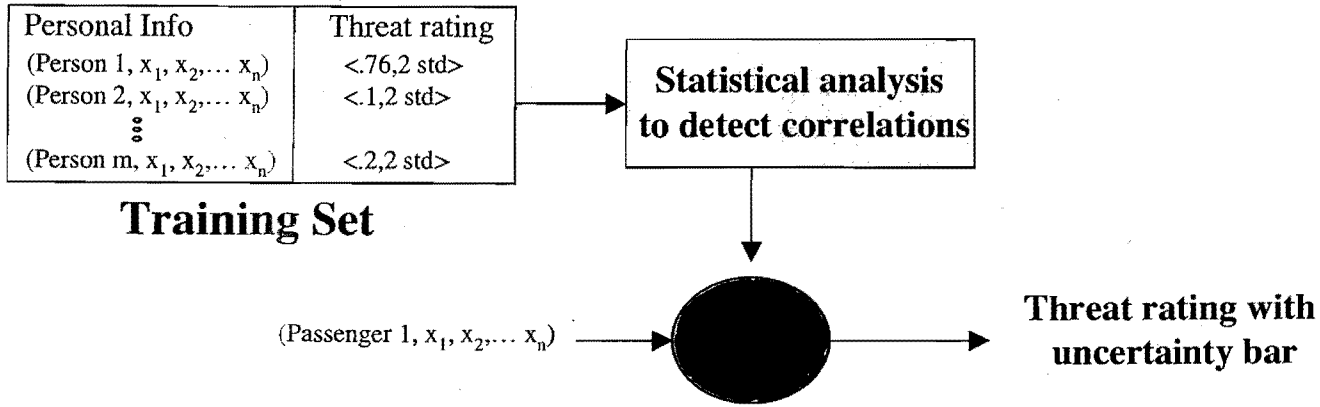
## Key challenges:

- Iterative query process with link analysis
- Matching information obtained to passenger
- Fusing information from separate sources
- Maintaining and updating access and wrapper information for 100's to 1000's of data sources.
- Integrate information access with threat assessment.

# Data Mining for Threat Assessment

**Problem:** Assess threat posed by an individual using statistical analysis of information obtained multiple sources including non-invasive biometric sensing.

**Traditional Approach:** (e.g. algorithms use to assess credit worthiness of an individual)




**Unique challenges for threat assessment:**

- Data for many passengers is very sparse
- Training data is highly skewed (limited examples of threats)
- Need to couple the active acquisition of data into the threat assessment loop based upon the uncertainty of the assessment.
- Need to combine assessment from multiple algorithms and approaches into a single assessment.

**Result:** Approach is good for eliminating non-threats, but not for uniquely identifying threats.

# Where would we like to go from here?

- **We would like to work with others**
- **We would like to build a passenger screening testbed that would include**
  - Biometrics – facial and other
  - Smart card with biometrics
  - Analysis, mining and threat assessment software
  - Addressing issue of scalability for national-scale system using IPG technology
- **We would like to launch a pilot test of the Aviation Security Reporting System**

# Closing thoughts from the Third Aviation Security Technology Symposium

- "Activity is no substitute for progress." [Richard Doney, from the UK Department of Transportation)
- "Don't depend too much on technology." [Joel Feldshul, former Israeli General (Chief of Intelligence), former chairman and CEO of El Al Airlines and now chairman and CEO of an Israeli Security Consulting firm.]
- "We need to ensure that we are not generals planning for the last war." [Nick Cartwright from Transport Canada]