Annual Report 2000 - 2002

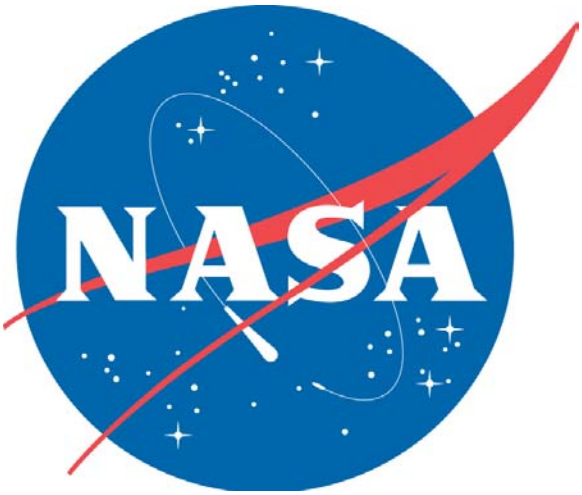
AEN

Computational Sciences Division

Mission Statement

The **AEN** infolab actively contributes to the development of NASA missions by playing a leading role in the area of information technologies and their applications, and by orchestrating new technology development with its members, partners and NASA customers in mind.

To this end, **AEN** pursues world class R&D activities, ensures the creation of added value via the transfer of expertise and technology, promotes the establishment of strategic alliances, facilitates networking, carries out technology development and contributes to the innovative training of a highly skilled workforce.



AEN Infolab
Computational Sciences Division
NASA Ames Research Center
Computational Science Division
Mail Stop 269-2
Moffett Field CA, 94035

Message from the **AEN** Infolab

2002 marks yet another year of achievements for **AEN** infolab. In its R&D projects, knowledge transfer activities and relations with the university community, **AEN** has once again outdone itself with its spirit of innovation and timely pursuit of its strategic and operational objectives.

An important highlight of the past year was the development and adoption of the pursuit of ground, air and space R&D plan, and endorsed by three NASA code R enterprise key programs and FAA. This plan will pave the way beyond the year 2010 and it will position us to meet the many, increasingly complex challenges that lie ahead with information technologies (IT) — an agency that faces constant change and whose skilled IT workforce is highly mobile and in great demand, an agency where customer expectations continue to rise at the same time as funding dwindles.

In drawing up its plan, **AEN** infolab also took the time to redefine its mission, placing greater emphasis on its role on space research and responding to the development of human space flight, yet not losing sight of its plans to maintain ahead projects of national scope. **AEN** has focused primarily on four research areas namely Knowledge-base systems, Operations Research, Information Grids and Visualization.

Looking **Ahead**

In the upcoming years, **AEN** intends to maximize its presence on several fronts, while continuing to bring the dynamic forces together at prestigious performance schedules such as costing and speed. There are many events that provide eloquent testimony to **AEN** unique and vital role in NASA.

The 2003 fiscal year will be dedicated to pursuing the objectives of the new three-year plan and to implementing the necessary stepping stones. Among other things, we plan to further tighten the link between AEN in-house R&D activities and International Space Station, the new economic realities of NASA, and NASA needs for knowledge transfer and application development.

In closing, we wish to offer a heartfelt thanks to our NASA fellow and the entire computational Sciences Division staff. Without the ongoing contribution and commitment, AEN could never have become the bustling hub that it is today.

David A. Maluf, Ph.D.
AEN infolab lead

Within the context of its R&D projects, AEN provided support to 9 students, via NASA Universities Collaboration Programs and NASA Minority programs. AEN also continued working towards the Computational Sciences Division and the Information Technology Directorate goals and vision.

Appraisal of the 2000-2002 three - years plan: three productive years

Working in collaboration with the NASA programs and the office of Chief Technology Office, AEN undertook to assess its 2000-2001 three-years plan. The results were extremely encouraging. AEN role as a forerunner, promoter and orchestrator in the field of information technologies, particularly in aeronautics, together with the Boeing Company, ATAC Corporation, three other NASA Centers and the Federal Aviation Administration (FAA) shared the success in meeting numerous expectations in particular L1 milestones and Government Performance Result Act (GPRA) milestones, were noted with great satisfaction.

The 2000-2002 year was one of review, evaluation and change in the federal sector. Like all organizations operating in a field such as information technologies, AEN was no exception to the rule. This past year in fact gave it the opportunity to show its true mettle—its ability to adapt rapidly and act effectively.

Financially speaking, the 2000-2001 year ended on a very strong note, with extremely positive results. All the objectives set by the programs were achieved, and in some cases, greatly surpassed. AEN had 16 staff members and ended the fiscal year with a budget of $2.4 million per year. AEN staff completed 12 R&D projects.

Towards the year **2003**

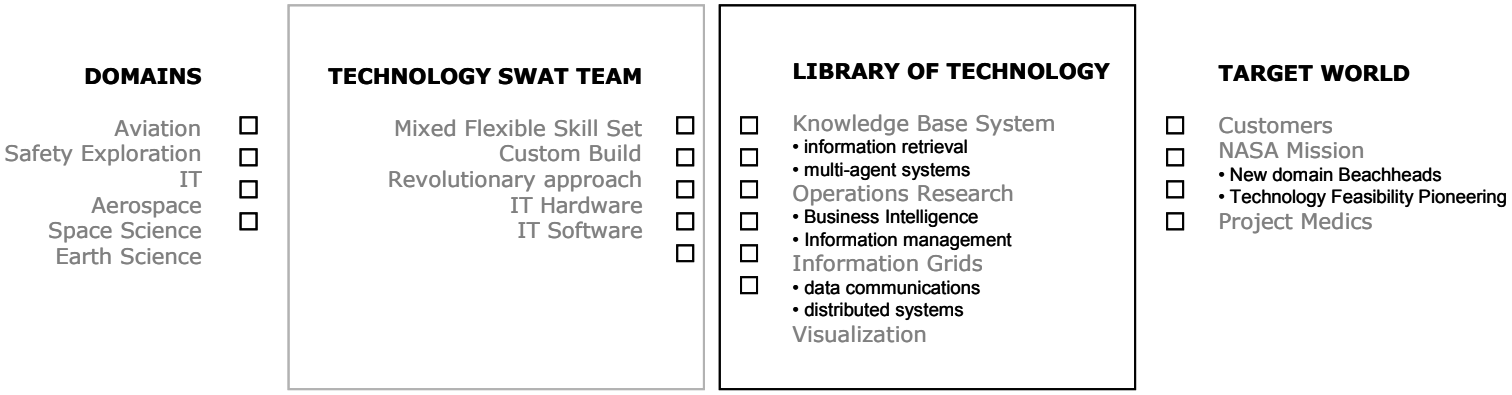
On the strength of the existing workforce and with a watchful eye on the division in which it is evolving—an environment characterized, among other things, by rapid change, highly mobile human resources, higher customer expectations, a decrease in funding, and the growing recognition of the need to pool efforts in the IT field—**AEN** adopted a new plan for the 2003-2004 period. The new plan reflects these emerging realities and charts the path and strategic alliance (industry and in-house) actions **AEN** intends to take over. In conjunction with the **AEN** and particularly the scientist and project managers its R&D focus, **AEN** mission is thoroughly revamped adding three distinct alliances in light of the realities of the current business context and the expectations of NASA goals.

We are also taking the opportunity to further define the distinctive characteristics for which **AEN** wishes to be known: namely its *expertise, rapid response time, insightfulness, quality services and objectivity.*

Over the next few years, **AEN** will continue to ensure that its research activities are shaped by NASA needs and those of its members and partners and by the foreseeable impact of this research on the agency, all the while continuing to build its scientific legacy. **AEN** wishes to actively enhance the competitiveness of its members. It wants to play a significant role in national level arena one of the principal driving forces in the technical and economical development of government and industrial societies.

AEN also intends to continue playing its role of orchestrator and leader, while cultivating its agency reputation. In addition, it fully plans to take concrete steps to consolidate strategic alliances capable of generating critical advances in the IT field. Lastly, **AEN** will work to its utmost to ensure adequate funding for its research activities, even if that means venturing off the beaten path. **AEN** is aware of the financial challenges that OMB is currently facing, yet equally aware of the importance of research, its impact on the economic health of our society and its economic and financial profitability.

AEN Reconfigurable Approach



AEN, **Universities** and **Industries** Joint-Effort

In 2002, **AEN** set up a new approach to promote closer collaboration with universities and industries. Its purpose is to contribute in an innovative way to the grooming of a new generation of IT technology at a faster pace and to reinforce links with its university members.

The total asset of 500,000 dollars in retail value of technology is expected in 2003 and 2004 from industry to NASA through NASA reimbursable agreements (Space Act Agreements and Licensing). **AEN** technology is being licensed to industry through NASA technology office using different vehicles, namely the NASA Ames Research Park with the participation of Silicon Valley industry leaders and universities together with an objective to meet **AEN** and thus NASA priorities.

R&D at AEN: An **Invaluable** Tool **for the** Growth of **NASA**

A Redefined **Mission** to **Strengthen** our **Role**

AEN recently planned for the years 2003–2005, in which it redefines its mission and role regarding NASA leadership. While maintaining its position in the vanguard of research and innovation, **AEN** plans to contribute more than ever to NASA and thus the development of our society. To achieve this goal, it intends to strengthen its presence at NASA and in the Silicon Valley area in order to:

- further promote across NASA cross enterprises the use of information technologies and even throughout the U.S federal agencies and state;
- offer greater support to the growth of enabling IT technology at NASA and U.S.
- step up efforts to transfer **AEN**-developed technologies to industry by cultivating greater awareness of the various innovation offered by **AEN**;
- tighten links between universities, NASA and corporations by contributing as an orchestrator for these dynamic forces.

Confirmation of our **Core** Research Areas

In order to ensure its strategic role as both leader and orchestrator in the IT field, AEN confirmed its focus plan the research areas that have greatest promise for benefit at NASA. These research areas are as follows:

1. Knowledge-Based Systems (KBS)
- Ontology
- information retrieval
- multi-agent systems

2. Operations Research (OR)
- Business Intelligence
- Information management

3. Information Grids
- data communications
- distributed systems

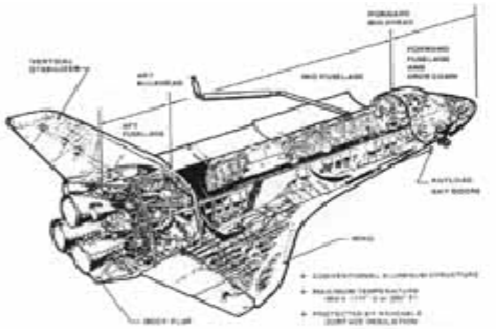
4. Visualization

Landmark Achievements of our **R&D**

It is therefore with great pride that we present the results for the 2000-2001 year. The drafting of a plan, and our reflection on the **AEN** performance philosophy—these are only some of the many activities that have enabled us to even better understand the environment in which we are evolving and to chart our future course more effectively. In terms of our R&D projects, the scientific staff is made up entirely of internationally acclaimed experts. **AEN** and its academic and industrial partners underscored major contribution in the area of IT, on both the federal sector and industrial and academic levels.

Knowledge Based Systems

VIRTUAL IRON BIRD - DIGITAL SHUTTLE: (2002-2005, ECS Program)



Digital Shuttle
Virtual space shuttle orbiter model

Engineering Objects (EOs)
Ontology Composition

Digital Shuttle will create a virtual space shuttle orbiter model, based around intelligent Engineering Objects (EOs) and immersive display methodologies. The goal is to collect all the knowledge of the orbiter in one place and make it accessible, improving not just the PLM of the system but also overall safety.

A large part of the project is to generate CAD (Computer Aided Design) for the orbiter. Since the STS was designed before modern 3D computer graphics, there is no CAD data. This is a large project but an essential step for visualization of the orbiter and its systems.

The EOs represent knowledge collections of entities within the orbiter, and are defined hierarchically (e.g. washer inside valve inside faucet inside galley...). The knowledge collection includes legacy data and documents such as drawings, mishap reports, materials requirements, stress profiles, etc., as well as data yet to be generated such as the CAD models. It also includes systems knowledge, e.g. a brake on the landing gear is connected to both the hydraulic system (for actuation) and the electrical system (for status and fault indicators).

Digital Shuttle data is severely heterogeneous. Knowledge management will help keep it organized. 3D graphics will be used for interaction and information navigation. 3D displays, including projected screens, head mounted displays, and special purpose 3D hardware will provide different levels of image quality. Audio and tactile devices will be used to augment user interaction so that it is not limited to visual capability. The immersive nature of the interaction will provide the user with a way to navigate the complex, varied data in Digital Shuttle, as well as being the mechanism to understand the data itself.

KNOWLEDGEABLE AGENT-ORIENTED-SYSTEM KAOS: An Open Agent Architecture Supporting Reuse, Interoperability, and Extensibility (2000-2001, IT Base Program)

The objective of the KAoS (Knowledgeable Agent-oriented System) agent architecture is to address two major limitations of current agent technology: 1. failure to address infrastructure, scalability, and security issues; and 2. lack of semantics and extensibility of agent communication languages. The first problem is addressed by taking advantage of the capabilities of commercial distributed object products (CORBA, DCOM, Java) as a foundation for agent functionality, and supporting collaborative research and standard-based efforts to resolve agent interoperability issues. The second problem is addressed by providing an open agent communication meta-architecture in which any number of agent communication languages with their accompanying semantics could be accommodated. Unlike most agent communication architectures, KAoS explicitly takes into account not only the individual message, but also the various sequences of messages in which it may occur. Shared knowledge about message sequencing conventions (conversation policies) enables agents to coordinate frequently recurring interactions of a routine nature simply and predictably. The KAoS architecture succeeds to the extent that it allows agents to carry out useful work while remaining simple to implement.

Although it is still far from complete, our experience with the current KAoS architecture has shown it to be a powerful and flexible basis for diverse types of agent-oriented systems. KAoS has been demonstrated for heterogeneous database access for airport, airline and thus optimizee surface operations. AEN contribution as well as the Boeing Company contribution made the resulting source publicly available.

DIRECT ACCESS VIRTUAL INFORMATION DIRECTORY: Virtual access to the International Space Station (2002-2005, CICT Program)

Based on XDB-IPG (NETMARK) (see Information Grids Section Below) product standard the Direct Access Virtual Information Directory is middleware technology that integrates heterogeneous data bases. This project provides client applications such as Virtual Station and Advanced Diagnostic Systems rapid access to remote, distributed heterogeneous data. Based on input data such as part/drawing number, description or ISS Caution and Warning event code the middleware identifies relationships among documents. After retrieving and archiving relevant documents in a XDB-IPG for later search and analysis, it feeds a document tree back to the client application. This project also provides a fast mechanism to search on context plus content or relationship concepts among the documents and drawings. Applications that will be fed by this middleware include research projects working on improving operation of ISS.

Direct Access Virtual Information Directory provides virtual Stations access to lifecycle database tools for rapid retrieval of drawings, parts lists, specifications, and procedures in support of ISS training on in flight maintenance. Direct Access Virtual Information Directory's real time retrieval of core system commands and data will provide Advanced Diagnostic Systems and other intelligent technologies integrated information they need to support real-time Fault Detection Isolation Recovery.

DATA REGISTRY: (2000-2001, AVSP Program)

The International Aviation Data Registry (AvDR), developed in early 2000 by the AEN Data Sharing thrust with representatives from the Commercial Aviation Safety Team (CAST) and the International Civil Aviation Organization (ICAO) Common Taxonomy Team, is a rapid proof-of-concept prototype providing a web-based, comprehensive central repository of standard aviation taxonomies and related metadata. The AvDR prototype serves as a tool in supporting the standard setting process for international aviation data by recording and disseminating data standards and facilitating data sharing among cross-aviation information systems and organizations. The AvDR prototype enables system users to better understand the information they are accessing by allowing users to learn about the existence of aviation data standards, understand their metadata (such as data element definitions, formats, etc.), and download the standards for use in their own local system.

The scope of the data for the initial AvDR prototype system includes the ICAO Accident/Incident Data Reporting (ADREP) Explanatory Factors, Aircraft Identification Categories (AIC Make/Model/Series of aircrafts), CAST/ICAO Accident Categories, CAST/ICAO Phases of Flight, and several GAIN Working Group C Standard Sharing Reports (SSR). The initial AvDR prototype is easy to use, maintain, and low in cost. Operating on a computer with a web browser (such as Microsoft Internet Explorer or Netscape Navigator), the initial system allows the user to display a list of standard taxonomies, select a particular taxonomy, and then display and/or download information related to the taxonomy's standard form (such as the purpose of the standard, the number of elements contained within the standard, contextual information about the standard, standard valid values associated with the taxonomy, the definition of the taxonomy and its valid values, the date on which the standard was adopted, and point of contact for questions). The AvDR prototype also consists of several customized search and information retrieval tools, such as a keyword search engine, a hierarchical display of data elements, and a structural display of metadata content.

INTELLIGENT INFORMATION INTEGRATION: Mediated architecture for the Integration of Aviation Data (2001, AVSP Program, IT Base Program)

In the aerospace domain, several independent databases are often used simultaneously where relevant information is required for an individual or group to make necessary decisions. Compounding the problem, many of these databases or information sources are often independently owned, making the movement of data from one source to the other or the modification of data or schema unacceptable. Traditionally, solutions to these problems have included delegating one or more individuals or groups to handle all of the information requests or creating a new local database, thus duplicating data owned by another group.

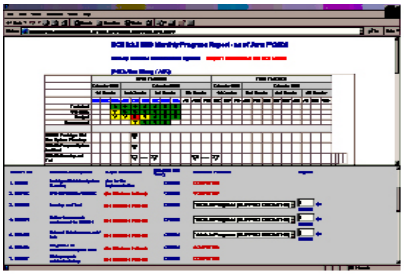
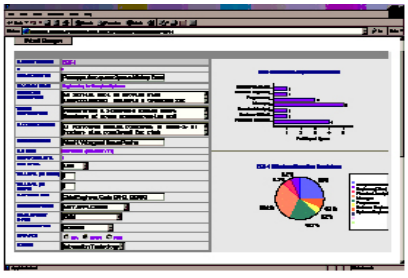
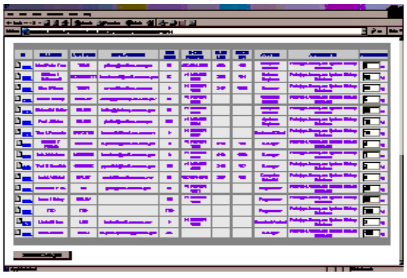
AEN and the Idaho National Environmental and Engineering Laboratory (INEEL) developed data Integration Mediation Systems to address the integration of aviation data, namely radar tracks and weather and simulation results. This was designed and implemented as a collaborative effort among INEEL and NASA. This technology provides a method of preserving a group and/or individual's knowledge about how to access and integrate data for a variety of domains. This domain knowledge includes the definition of the domain's integrated view, the specification of how the data sources fit to this view, the knowledge of how to integrate data across the different data sources, and the knowledge required retrieving data from these sources. This technology was designed to accept the domain knowledge as input into the system so the same software can be utilized by many different domains.

Operations Research

REMOTE AVIATION HELP DESK: RAHD (2000-2001, IT Base Program)

The Remote Aviation Help Desk (RAHD) is an extension of the Boeing Rapid Response Center and a convergence of several advanced Information Technology (IT) projects in collaboration with the Boeing Company and AEN. The goal of RAHD is to prototype advanced information technologies to improve aircraft maintenance operations. Use a target airport and airline carrier to implement incrementally advanced information technology support tools such as Wireless 802.11 Ethernet LAN dedicated connectivity between airline MOC & Maintenance Hangars, Boeing Rapid Response Center & NASA Ames Research Center as the orchestrator, Digital image capture and printing equipment, Desktop videoconferencing, Portable collaboration and maintenance tools and Real-time information wall displays. RAHD has many benefits such as Quicker turnaround in maintenance, Better quality of maintenance (access to more information by experts and access to more experts) and Lower costs (accurate and quicker diagnosis, lesser need of flying experts, cheaper information communication)

BUSINESS INTELLIGENCE (2002-2005, ECS Program)

Within each NASA enterprise, there exists a complex hierarchical structure of program and project line management in place to supervise and oversee the progress of various definitive milestones objectives, goals, requirements, and their respective resources, such as personnel and budgetary allocation. With the increased complexity of managing, tracking, and defining milestone requirements and objectives, there are inconsistencies and uncertainties produced in the accountability associated with the research and development objectives and goals.

There may be unknowingly, redundant requirements, goals, and objectives existing across the various NASA enterprises and results in inappropriate management of both funding and personnel resources. At the same time, the current existing monthly status reports for most programs are cumbersome to generate by hand using proprietary Microsoft-based products, such as Powerpoint presentation slides, Word processing document, and/or Project planner. This usually results in tediously drawing by hand the various tables, color scheme, and icons on presentation slides and word documents. Another problem encountered is the incompatibility among the various Microsoft product versions; such as MS-Office 2000 is not backward compatible with some features of Office 97. The Program Management Tool (PMT), developed by the AEN InfoLab as a business intelligence tool, has provided a solution to these problems.

The Program Management Tool is a comprehensive, web-enabled application tool used to assist NASA enterprises in monitoring, disseminating, and tracking the progress of both R & D program and project milestones and their corresponding resources, such as personnel and budgetary allocations. The tool is aimed at providing strategic center and program management information to stakeholders. The tool is also intended to facilitate ease of use, track accountability, and ultimately improved communication between various NASA enterprises and end-users. The PMT tool is designed to be flexible and extensible to be able to integrate with existing and/or new strategic information systems.

MISHAP KNOWLEDGE MANAGEMENT (2002-2005, ECS Program)

Social and organizational factors are a main source of both the success and failure of complex NASA missions, and this project is exploring how the Internet can improve the means by which NASA addresses these social and organizational factors through knowledge management. As a starting point, this project is focused on mishap knowledge management.

Mishaps are the name NASA uses to refer to mission failures, and such failures provide a focal point for research on social and organizational factors that affect mission safety and success. One reason for this is that as far back as the Apollo missions, whenever there has been a mishap there has been an investigation into the mishap, resulting in numerous and detailed reports on what happened from a physics perspective and why it happened from a human and organizational perspective.

This project will demonstrate a prototype mishap knowledge management system that will make case examples and trend analyses of mishaps more accessible to NASA personnel. This project will also study certain mission practices where such a knowledge management system might have a particularly beneficial impact.

BANDWIDTH ENABLE FLIGHT OPERATIONS: (2001-2002, IT Base Program)

The Bandwidth Enabled Flight Operations project was a research effort to investigate the use of satellite communications to improve aviation safety and capacity. This project was a follow on to the AeroSAPIENT Project, which demonstrated methods for transmitting high bandwidth data in various configurations. The AeroSAPIENT project demonstrated technology that was able to support a high bandwidth computer network connection between a flying aircraft and a ground station via a satellite. A DC-8 research aircraft was used for the flight tests, through which in-flight network communications technology was used to enact several simultaneous applications at a high bandwidth data rate.

Based on these results, the Bandwidth Enabled Flight Operations (BEFO) project was initiated within the Computational Sciences Division at the NASA Ames Research Center. The high level goal was to investigate new ways in which this technology could be applied to improve airline safety and capacity (the ability to move more aircraft and passengers through the airspace system).

Our initial development direction and goals were to: i) Understand the current capacity and limitations of air-ground bandwidth within the commercial aviation industry. ii) Understand what applications potential users (Airlines, Pilots, Cabin Crews, ATC, Maintenance) envisioned to use with increased bandwidth. iv) Develop a prototype cockpit environment in which new concepts could be easily evaluated. v) Collaborate with other groups working on technologies that could be easily integrated into this environment.

Information Grids

VIRTUAL NATIONAL AIRSPACE SIMULATION: Large-Scale Airport Simulations Using Distributed Computational Resources (2000-2001, IT Base Program)

Desktop view
Integrated view of RADAR tracks, weather data and simulation data

Numerical Propulsion Simulations
(Glenn Research Center)

Geographic Information Systems
Geospatial and Weather

Selected Aircraft Flight Simulator
(based on RADAR track)

Aircraft Aerodynamics Simulation
(Ames Research Center)

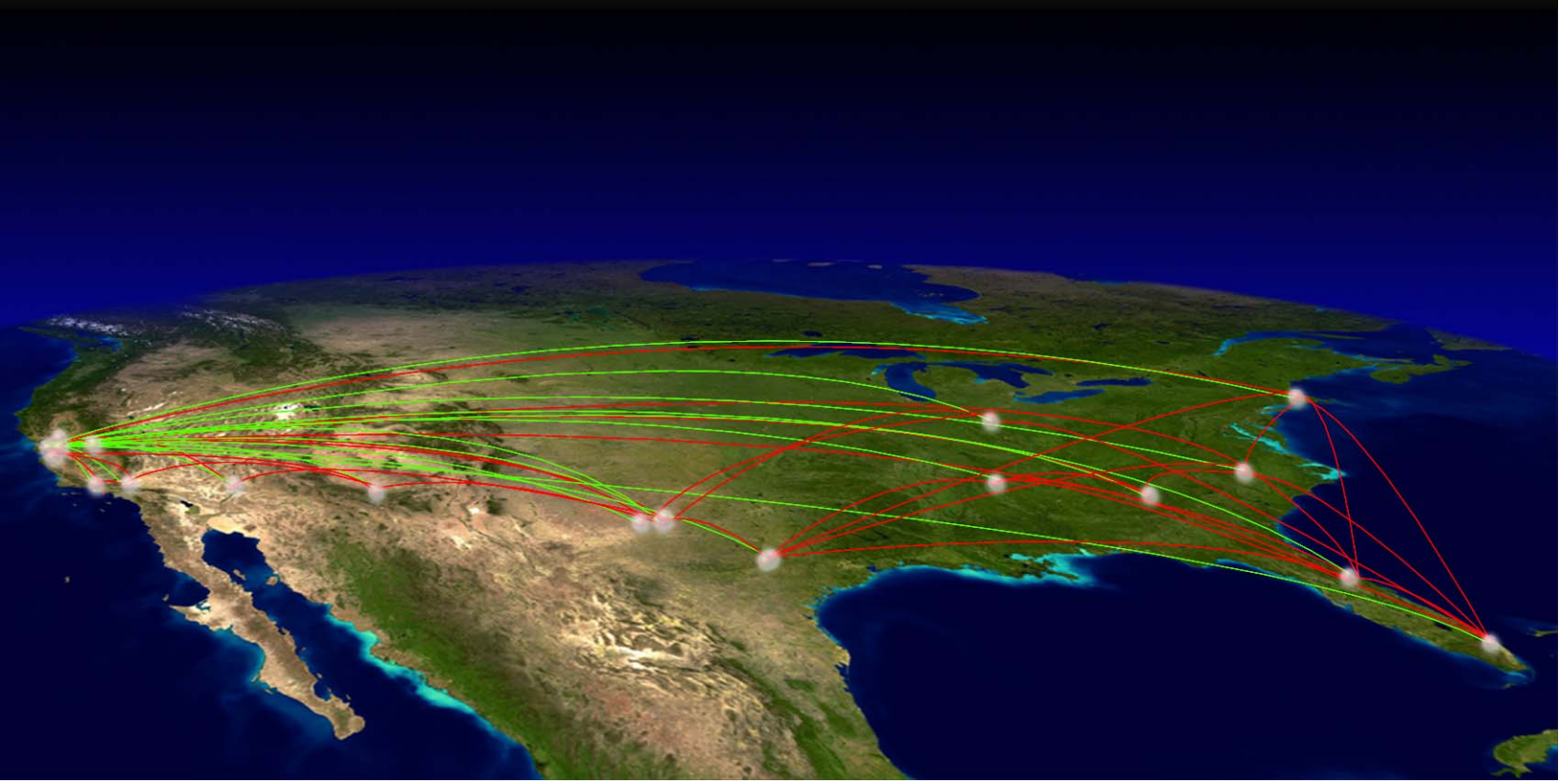
In 2001 researchers at the AEN Info Lab and at NASA Glenn and Langley Research Centers developed a working prototype of a virtual airspace to demonstrate the concept of complex and computationally intensive integrations using distributed computer resources. The Virtual National Airspace Simulation (VNAS) prototype ran on computers making up a VNAS grid which provided the underlying infrastructure to support whole aircraft modeling.

Each night operational data from up to 2,000 flights was batch processed by three aircraft component simulators running on grid machines. FAA and other government data collection systems provided measured operational data such as weather and radar tracks to the VNAS prototype. The input data was processed by three software simulators: i) the Numerical Propulsion Simulation System (NPSS), an engine simulation, ii) Wing Sim, a wing simulation, and iii) a Boeing 737 landing gear simulation. For each flight the appropriate simulator produced simulation data that reflected the state and performance of a particular aircraft subassembly such as an engine or a wing. When simulations from multidisciplinary perspectives finished, an Intelligent Information Management Node managed the retrieval and integration of simulation and monitoring data. When the integration process completed the combined operational and simulation data was archived at the central site.

By identifying precursors to component failure this nation-wide simulation environment supports the development of strategies for improving aviation safety. It also supports improvements in the design process and reduction in operational costs. Multidisciplinary aircraft simulations can be inserted at the front end of the engineering design process. Simulations of interdependent components can provide airframe manufacturers with risk exposure measurements for new designs or modification of existing ones. Early understanding of a new design or change can be fed back into the process, reducing overall design time. Whole aircraft simulations can also be used by airlines to assess the impact of current or proposed policies and procedures on operations and maintenance. Insight from subassembly simulations of engines can lead to condition based maintenance and more optimal scheduling of repairs.

The deployment and support of PDARS information R&D and the information dissemination across the U.S. PDARS is an advanced high-tech government infrastructure, maintained and operated independent from private network or public network access. PDARS enables a seamless grid of radar sensor, and analyses across the FAA facilities across the U.S. (Western region, Southwest Region and Southern Region and partially the Midwest Region). PDARS covers 2/3 of the entire National Airspace.

PDARS Information Grid
17 sensors and centers across US



PERFORMANCE DATA ANALYSIS REPORTING SYSTEM: (2000-2005, AVSP, Program, FAA)

This project demonstrates a proof-of-concept research on system-wide infrastructure to aid in the projection of effects of decision-support when Courses-of-Action (CoA) and assessments in the National Airspace System is needed by the Federal Aviation Administration (FAA). The objective is to significantly augment FAA decision services by making RADAR TRACON information accessible as well as other information components for fast-time distributed advanced analysis to be utilized for decision making across the U.S continental FAA centers and Air Route Traffic Control Centers. The Performance Data Analysis Reporting System PDARS is a joint research and development project between NASA and the FAA to continue support FAA R&D needs. NASA will provide a system-wide network infrastructure (design, implementation, deployment, and support) across the continental U.S. covering FAA centers and Air Route Traffic Control Center (ARTCC) sites. The PDARS project is an FAA mission critical infrastructure environment and is developed under **AEN** to allow the deployment advanced highly secure, seamless distributed systems and data analysis technology to a system-wide level capability.

The deployment and support of PDARS information R&D and the information dissemination across the U.S. PDARS is an advanced high-tech government infrastructure, maintained and operated independent from private network or public network access. PDARS enables a seamless grid of radar sensor, and analyses across the FAA facilities across the U.S. (Western region, Southwest Region and Southern Region and partially the Midwest Region). PDARS covers 2/3 of the entire NAS.

NASA-XDB-IPG: NETMARK (2001-2004, IT Base Program CICT Program)

The NASA-XDB-IPG product standard definitions describes the schema-less open database framework and architecture for managing, storing, and searching unstructured and/or semi-structured documents from standardized and interchangeable formats, such as XML in relational database systems. The features of NASA-XDB-IPG take advantages from the object-relational model and the XML standard described above, along with an open, extensible database framework in order to dynamically generate arbitrary schema stored within relational databases, object-relational database management system.

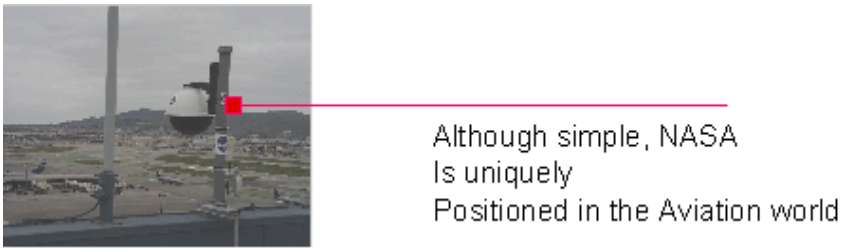
NASA-XDB-IPG Information Power Grid Platform is a safe, flexible, and complete cross-platform solution for developing robust universal applications for Information Grid Internet and corporate intranets. The open and extensible data access APIs are a set of essential interfaces that enable developers to build their applications and yet interoperate and the data level. The NASA-XDB-IPG Platform provides uniform, industry-standard, seamless connectivity and interoperability with enterprise information assets.

The NASA-XDB-IPG API is an emerging NASA standard for database-independent and application independent connectivity between the programming language and a wide range of databases. NASA-XDB-IPG technology allows developers using the standard programming languages build for existing standards, namely SQL, to exploit write once for universal access capabilities for applications that require access to enterprise data.

The NASA-XDB-IPG API makes it possible to do three things: Insert information universally and Get information universally. NASA-XDB-IPG is the result of a NASA initiative to formulate an Information Grid database management system with an integrated hybrid cooperative approach to combine the best practices of both the relational model utilizing SQL queries and the object-oriented, semantic paradigm for supporting complex data creation. The NASA-XDB-IPG product standard is intended to achieve, a highly scalable, information grid on demand database framework. NASA-XDB-IPG takes advantages of the existing object-relational database standards using physical addresses data types for very efficient searches of records. NASA-XDB-IPG is based on original work developed in early 2000 as a research and development prototype to solve the vast amounts of unstructured and semi-structured documents existing within NASA enterprises. Today, NASA-XDB-IPG standard defines a flexible, high-throughput open database framework for managing, storing, and searching unstructured or semi-structured arbitrary hierarchal models, XML and HTML.

NASA-XDB-IPG defines an innovative schema-less, object-relational open database technique and framework. The object of the NASA-XDB-IPG is to achieve standard as a highly scalable, open enterprise database framework (architecture) for dynamically transforming and generating arbitrary schema representations from unstructured and/or semi-structured data sources. NASA-XDB-IPG provides automatic data management, storage, retrieval, and discovery. NASA-XDB-IPG (Netmark) is being commercialized.

REMOTE TOWER SENSOR SYSTEM (2000-2002, IT Base Program)



The Remote Tower Sensor System (RTSS) is a proof-of-concept prototype system developed by the AEN Information Sharing group in collaboration with the Federal Aviation Administration (FAA) and the National Oceanic and Atmospheric Administration (NOAA) to provide real-time weather observations for synthetic vision augmentation for both local and remote low and/or zero visibility operations. Forecast of the onset and/or dissipation of low clouds are of major concern of NOAA, the FAA, and the aviation community. Low clouds prevent aircrafts from landing on the two primary runways at the same time at the San Francisco International Airport (SFO), because the two SFO runways are spaced much closer together than other airports. The inability to implement dual approaches decreases the airport arrival rate by about half, far below scheduled demand levels, during peak arrival periods each day. The dissipation of clouds in the approach zone typically occurs during late morning. Since there is a very high demand for arrival capacity during this period, the precise timing of the transition to visual approaches has a significant impact on the return to full capacity operations. Better weather forecasts result in more efficient utilization of available airport arrival capacity. The RTSS systems were utilized at both un-towered airports, such as Half Moon Bay (HMB) as well as at major airport hubs, such as San Francisco International Airport (SFO), Seattle-Tacoma International Airport (SEA), and Atlanta Hartsfield International Airport (ATL).

The RTSS system also has a real-time, automated visibility image management system to track and monitor changing airport and/or terminal conditions based on advanced image analysis and processing algorithms. The visibility management system predicts low to high visibility tends corresponding to suggestive zero to one incremental values for images captured by the camera systems. The images are captured and archived on a daily basis for every fifteen minutes time intervals. The visibility management system then processes each captured images and updates the visibility versus time graphical plots. The image processing algorithm to compute visibility has filed as an intellectual property disclosure. The RTSS system has been commercialized.

MANAGEMENT

David Maluf Ph.D.
AEN Lead
Information Sharing L3 AVSP, L3 IT Base Data Sharing, CICT L4 Information Synthesis, ECS L3 Engineering Information Management.
Yuri Gawdiak
AVSP L2 ASMM, IT Base L3 Data Sharing
David Bell Ph.D.
RIACS Task Lead
ECS L4, Mishap Investigation
William McDermott
IT Base L4, Virtual National Airspace Simulation
Peter Tran
QSS Task Lead
Gregory Pisanich
QSS Task Lead

AEN MEMBERS (as of 2000 2002)

Linda Andrews
Kevin Bass
Chris Berg
David Bell Ph.D.
Kenneth Chu
Jason Duley
Walt Froloff
Jeff Gale
Yuri Gawdiak
James Gibson Ph.D.
Julian Gomez Ph.D.
Mohan Guram
Moe Khalil
Chris Knight
Tracy La
Chris Leidich
Jenessa Lin
David A. Maluf Ph.D.
William McDermott
Jimmy McClenahen
Gregory Pisanich
Fritz Renema
Peter Tran

PARTNERSHIPS (MOA, MOU, Space Act agreement)

National Science Foundation (NSF)
Federal Aviation Administration (FAA)
Society International Telecommunication Aeronautics
United Airlines
Northwest Airlines
Stanford University
University of California Santa Cruz
Massachusetts Institute of Technology MIT
University of California at Berkeley
San Jose University
Gannon University (Penn)
Florida International University
Xerox Corporation
PARC
Objectivity
Metron
The Boeing Company
Idaho National Environmental and Engineering Laboratory (INEEL)
San Mateo County, California
San Francisco County, California
ICAO

AEN REFERENCES

Knowledge-Based Systems

Journal publications

Refereed

1. McDermott, William., Maluf, David. A., Gawdiak, Yuri.and Tran, Peter, "Airport Simulation Using Distributed Computational Resources,''. *CrossTalk: Journal of Defense Software Engineering Software Technology Support Center, Department of Defense,* 2002.
2. Maluf, David A., Tran, P., ''Articulation Management for Intelligent Integration of Information,'' *Systems, Man, and Cybernetics*, Vol. 31, No 4, ISSN 1094-6977, 2001.
3. Liu, Jiming, Maluf, David A., Desmarais, Michel C., ''A new Uncertainty Measure for Belief Networks with Applications to Optimal Evidential Inferencing, '' *IEEE Transactions on Knowledge and Data Engineering,* Vol. 3, No 3, ISSN 1041-4347, 2001.

Proceedings and workshops

Refereed

1. Maluf, David A., Tran, Peter, La, Tracy, ''An Extensible 'Schema-less' Database Framework for Managing High-Throughput Semi-Structured Documents'', *International Association of Science and Technology for Development, Applied Informatics*, 2003. Smelyanskyi,
2. Vadim N., Morris, Robin D., Kuehnel, Frank O., Maluf, David A., Cheeseman, Peter, ''Dramatic Improvements to Feature Based Stereo'', *Lecture Notes in Computer Science*, Springer Verlag, LNCS 2351, 2002.
3. Maluf, David A., Cheeseman, Peter, Smelyanskyi, Vadim N., Kuehnel, Frank, Morris, R., ''The 3D Recognition, Generation, Fusion Update and Refinement (RG4) Concept'', *6th International Symposium on Artificial Intelligence, Robotics and Automation in Space*, 2001.
4. McDermott, William, Maluf, David A., Gawdiak, Yuri, Tran, Peter, ''Airport Simulations Using Distributed Computational Resources,'' SAE Aerospace and Aerospace Conference, 2001.
5. Papasin, Richard, Tran, Peter, Maluf, David A., Leidich, Christopher, ''Remote Tower Sensor Systems,'' SAE Aerospace and Aerospace Conference, 2001.
6. Maluf, David A. and Wiederhold Gio, " What the Logs Can Tell You: Mediation to Impletment Feedback in Training" submitted to *International Symposium on Methodologies for Intelligent Systems, Lecture Notes in Computer Science, Springer Verlag*, 2000.
7. Maluf, David A and Liu Jiming, "Qualitative Discovery in Medical Databases", *International Symposium on Methodologies for Intelligent Systems, Lecture Notes in Computer Science, Springer Verlag*, 2000.
8. Smelyanskiy, V. N., Cheeseman, P., Maluf, D. A., Morris, R. D., "Bayesian Super-Resolved Surface Reconstruction", *Computer Vision and Pattern Recognition*, 2000.

Operation Research

Journal publications

Refereed

1. David G. Bell, Richard Giordano, Peter Putz, "Inter-firm sharing of process knowledge: exploring knowledge markets," Journal of Knowledge and Process Management, *Volume: 9, Issue: 1, January/March 2002, Pages: 12-22.*

Proceedings and workshops

Refereed

2. Bell, David G., Newman, Susan, Repenning, Nelson, "Process, Practice & Politics: Understanding the relationship between documentation, deployment and daily work", Academy of Management Conference, Denver, CO, August 2002.
3. Liang, Tao, David G. Bell, and Larry Leifer (2001). Re-Use or Re-Invent? Understanding and Supporting Learning from Experience of Peers in a Product Development Community. *Journal of Engineering Education, Vol. 90, No. 4*.
4. Bell, David G., Daniel G. Bobrow, Olivier Raiman, and Mark H. Shirley (1997). Dynamic Documents and Situated Processes: Building on local knowledge in field service. In Wakayama, Toshiro, Srikanth Kannapan, Chan Meng Khoong, Sham Navathe, and JoAnne Yates (eds.), *Information and Process Integration in Enterprises: Rethinking Documents*, Kluwer Academic Publishers, Norwell, MA, 1997.
5. Julian Gomez, "The Convergence of IT and 3D". Proceedings Experiential E-commerce Conference University of Michigan Sept. 2001

NASA

Program Plans

1. Maluf, David A., "Intelligent Information Synthesis", LIV Plan, Communication, Networking and Information Systems CICT program, 2002.
2. Maluf David A., "Engineering Information Management", LIII plan, Engineering for Complex Systems NASA program, 2002.
3. Bell, David G. & Wong, Alan. "Mishap Initiator Identification System Level 1 Milestone Plan (ECS-7) for the Engineering for Complex Systems Program 2002.
4. Maluf, David A.,, "Intelligent Information Synthesis", LIV Plan, Communication, Networking and Information Systems, 2001.
5. Gawdiak, Yuri, "Data Sharing", LIII plan, IT Base NASA program, 2001.
6. Gawdiak, Yuri, "Data Sharing", LIII plan, IT Base NASA program, 2000.
7. Gawdiak, Yuri, "Information Sharing", LIII plan, Aviation Safety Program, NASA program, 2000.

Intellectual Properties

Patents and Patent Pending

1. Extensible Database Framework for Management of Unstructured and Semi-structured Documents (pending)
2. Systems and methods for copying formatting information in web pages (Patent pending).
3. Systems and methods for distributed administration of public and private electronic marketplaces (Patent pending).
4. System that accesses a knowledge base by markup language tags, US Patent #5,737,739.

Disclosure

1. A method to integrate information systems and simulations or a Simulation Transaction Access and Retrieval Gateway.
2. Systems and methods for context-based notification with unstructured and semi-structured documents" (2002).
3. Sensor Systems Image Processing Algorithm to Compute Visibility.

Zooming In on Airport Delays

Mark Brosche of San Mateo conducted some business by phone while waiting for his plane to Los Angeles, after officials at San Francisco International Airport had to delay several flights due to heavy fog yesterday.

CARLOS AVILA GONZALEZ / *The Chronicle*

Digital cameras at S.F. International will detect bad weather earlier

By Michael McCabe
CHRONICLE STAFF WRITER

"We are hoping that we can tell earlier when to shut a runway down."
ALI ABOU-KHALIL
Engineer

For every weary traveler who has had to wait, wait, wait at San Francisco International Airport for the weather to improve, there is now hope that the skies will clear a little sooner.

Or at least we will all see it quicker.

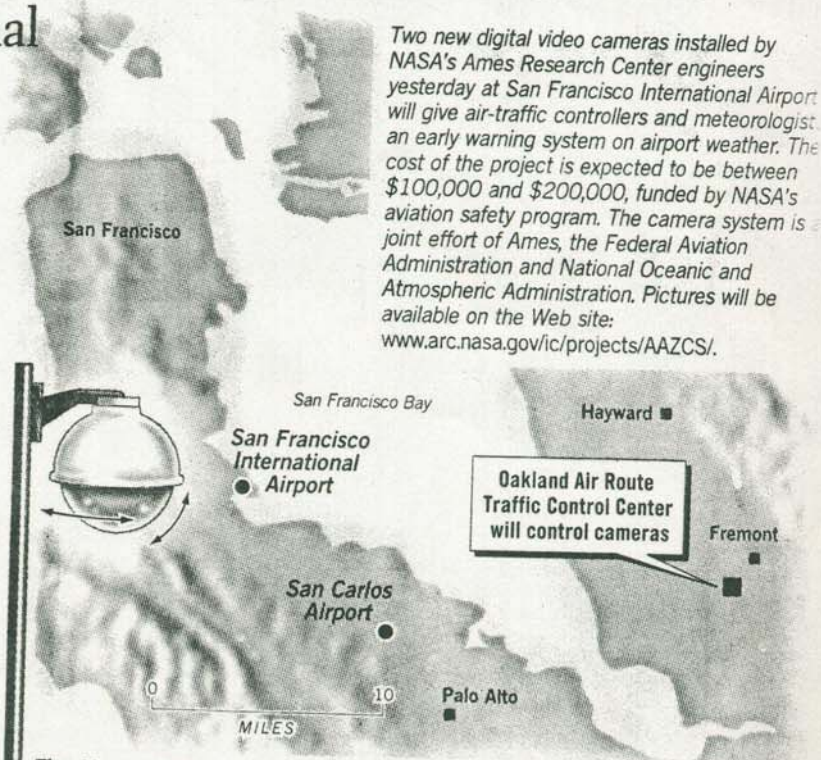
Two new digital video cameras were installed yesterday at the airport tower, high-tech robot eyes that air-traffic controllers and meteorologists believe will provide them with an early warning system on the weather.

For the hundreds of travelers delayed yesterday when the airport was closed for 50 minutes because of dense fog, the cameras might have saved a little time and grief. They are expected to be operating today.

The cameras, working in tandem with two other Sony digital cameras in-

▶ **CAMERAS:** *Page A20 Col. 2*

Two new digital video cameras installed by NASA's Ames Research Center engineers yesterday at San Francisco International Airport will give air-traffic controllers and meteorologists an early warning system on airport weather. The cost of the project is expected to be between $100,000 and $200,000, funded by NASA's aviation safety program. The camera system is a joint effort of Ames, the Federal Aviation Administration and National Oceanic and Atmospheric Administration. Pictures will be available on the Web site: www.arc.nasa.gov/ic/projects/AAZCS/.



The Airport Approach Zone Camera System uses a remote controlled camera that can tilt, pan, rotate and zoom. It can also produce a 220-degree panoramic view of the sky and detect motion in the clouds, allowing meteorologists to track a specific cloud pattern.

Source: NASA, Ames Research Center

JOHN BLANCHARD / *The Chron*