Conclusions and Recommendations

Prepared by:

ICNS Conference Executive Committee:

Brent Phillips, Federal Aviation Administration

Ronald L. Swanda, GAMA

Michael S. Lewis, Boeing

Randy Kenagy, Aircraft Owners and Pilots Association

George Donahue, George Mason University

Al Homans, ARINC

Robert Kerczewski, NASA Glenn Research Center

Marty Pozesky, MTP Associates

May 24, 2004
1.0 INTRODUCTION

The NASA Glenn Research Center organized and hosted the Fourth Integrated
Communications, Navigation, and Surveillance (ICNS) Technologies Conference and
Workshop, which took place April 26-30, 2004 at the Hyatt Fair Lakes Hotel in Fairfax, Virginia.

This fourth conference of the annual series followed the very successful first ICNS Conference
(May 1-3, 2001 in Cleveland, Ohio), second ICNS conference (April 29-May 2, 2002 in Vienna,
Virginia), and third ICNS conference (May 19-22, 2003 in Annapolis, Maryland).

The purpose of the Fourth ICNS Conference was to assemble government, industry and
academic communities performing research and development for advanced digital
communications, surveillance and navigation systems and associated applications supporting
the national and global air transportation systems to:

- Understand current efforts and recent results in near- and far-term R&D and technology
demonstration.

- Identify integrated digital communications, navigation and surveillance R&D
requirements necessary for a safe, secure and reliable, high-capacity, advanced air
transportation system.

- Provide a forum for fostering collaboration and coordination.

- Discuss critical issues and develop recommendations to achieve the future integrated
CNS vision for national and global air transportation.

The workshop attracted 316 attendees from government, industry and academia to address
these purposes through technical presentations, breakout sessions, and individual and group
discussions during the workshop and after-hours events, and included 16 international
attendees. An Executive Committee consisting of representatives of several key segments of
the aviation community concerned with CNS issues met on the day following the workshop to
consider the primary outcomes and recommendations of the workshop.

This report presents an overview of the conference, workshop breakout session results, and the
findings of the Executive Committee.

2.0 ORGANIZATION OF THE FOURTH INTEGRATED CNS CONFERENCE AND
WORKSHOP

The Fourth ICNS Conference and Workshop consisted of four primary elements: A Plenary
session consisting of presentations on major topics and trends in aviation; Technical
presentations covering a variety of topics relating to CNS requirements and research needs; six
workshop breakout sessions to generate issues, ideas and recommendations for future CNS
research and development; and an Executive Committee working meeting to condense the
ICNS Conference and Workshop results into a concise summary including key issues and
recommendations.
Welcoming remarks by the Deputy Director of the NASA Glenn Research Center Mr. Richard Christianson, and the Keynote Address by Dr. J. Victor Lebacqz, NASA Associate Administrator for Aeronautics, were followed by a Plenary Session of aviation industry and R&D leaders: Ms. Ann Tedford, Manager, Operations Planning Systems Engineering, Federal Aviation Administration; Mr. Karl Grundmann, Communications Director, Joint Planning and Development Office, Federal Aviation Administration; Mr. Paul Polski, Chief of Staff, Transportation Security Administration, Department of Homeland Security; Mr. John S. Walker, President, J S Walker Group/Aviation Solutions Inc.; Mr. Ira Pearl, Director, Flight Operations Technical Support, Delta Airlines; Dr. Bruce J. Holmes, Associate Director, Airspace systems Program Office, NASA Langley Research Center; and Mr. Sadegh Kavoussi, President, AvMet Applications International, LLC.

Fourteen technical presentation sessions filled the program from April 27 through April 29, 2004:

- Session A1: CNS Systems and Architectures
- Session A2: Communications Datalink
- Session A3: Surface
- Session B1: Weather Information Communications, WINCOMM and Aviation Weather
- Session B2: Surveillance
- Session B3: Simulation and Modeling
- Session B4: Security
- Session C1: Spectrum
- Session C2: Airborne Internet
- Session C3: IP Based Transition for Aviation
- Session C4: SWIM
- Session C5: Airborne Internet
- Session C6: Demonstrations

The list of Session Chairpersons, presenters and titles of their presentations is given in Appendix A of this report. The presentations are posted on the Integrated CNS Workshop website at [http://spacecom.grc.nasa.gov/icnsconf/](http://spacecom.grc.nasa.gov/icnsconf/).

At the conclusion of the presentations, six breakout sessions were held during the morning of April 30, 2004, with participation of the workshop attendees according to their interests. The breakout sessions were:

- Certification: How to get a better Certification Process
- Improving VHF Spectrum Utilization
- System Wide Information Management (SWIM)
- Software Defined Multi-function Multi-Mode Avionics
- Weather Information Communications
- A Global Solution for the Future ATC Communications System

The breakout session results are summarized in the following section.

The Executive Committee met during the afternoon of April 30, 2004, to review the presentations from the technical sessions and the outputs of the six breakout sessions in considering the Executive Committee Comments and Recommendations to be included in the Fourth Integrated CNS Conference and Workshop Final Report. The results of the Executive Committee meeting were collected and compiled into the Final Report by the Executive
Committee Chairman, Robert Kerczewski of NASA, and the Executive Committee Secretary, Marty Pozesky of MTP Associates. The following section presents the Executive Committee’s comments and recommendations.

3.0 THE FINAL REPORT OF THE EXECUTIVE COMMITTEE OF THE FOURTH INTEGRATED CNS CONFERENCE AND WORKSHOP

The Fourth Integrated CNS Conference and Workshop Executive Committee examined the plenary and technical presentations, and in particular the results of the six Workshop Breakout Session to determine the issues and recommendations to be contained in the Conference Final Report. The Workshop Breakout Sessions were chosen to reflect some of the key issues in the aviation industry in regards to aeronautical CNS industry.

In producing this report, the Executive Committee reviewed the Breakout Session outputs individually, and also observed common themes and issues. Results collected from the Executive Committee deliberations are therefore grouped into two areas: Major Conference Summary and Recommendations, and Key Breakout Session Results.

3.1 Major Conference Summary and Recommendations

Themes that emerged during the Executive Committee discussions are organized into five categories, followed by recommendations, presented in the following sections.

3.1.1 US Leadership in Aviation

A recurrent theme at the ICNS Conference has been the observation that the lack of funding and commitment by both the US Government and the US commercial aviation industry has not kept up with the requirements for modern aviation. Plenary session speakers as well as some technical session speakers repeated the theme that the United States is losing its global leadership role in aviation. A strong plea was made for the US Government and the private sector to step out and exert international leadership.

3.1.2 Technology Insertion Cycle

A related theme in both the plenary and technical sessions, and also mentioned in workshop sessions, is the long timeline required to insert new technologies into the aviation system. Technologies can become significantly obsolete during the time from concept development to final implementation in what has become the “normal” aviation technology development and insertion cycle. The Aeronautical Telcommunications Network protocol is an example of a technology that was forward thinking at the time of its initial concept acceptance, but has become obsolete and essentially superceded as the world’s data communication protocol by the ubiquitous Internet Protocol (IP) long before being introduced in any substantial way into the National and Global Airspace System operations.
A result of the long time to implementation is that stakeholders and advocates of new technologies lose interest, and those charged with developing and implementing lose the commitment of their organizations and the user community.

The two processes most associated with the long implementation time lines are certification and standardization. Both processes need to be shortened and made more efficient, without compromising safety.

It is also often noted that the user community, both commercial and private, is very reluctant to add new equipage and technologies to their individual small aircraft or airline fleets. The cost of buying, installing and maintaining new equipage is cited as the primary reason. For the private aircraft owners, the cost of new equipage can simply be prohibitive, with no significant cost recovery mechanism to create an equipage incentive. For the airlines, return-on-investment time frames for new equipage have been reduced to months in the current airline financial environment, making the cost benefit case extremely difficult to make.

In each case, continued emphasis on reducing the cost of new technologies is an obvious need. However, one plenary session speaker went even further to suggest that the aviation system, including the regulatory bodies and air traffic service providers (ATSP, i.e., FAA, etc.) would benefit if they simply purchased new equipment for all users. Short of purchasing the equipment, the mandating of equipage should be considered as well. Such policies are encouraged because they would accelerate equipage, resulting in faster benefits to both the users and ATSPs, and potentially reduced costs to the ASTPs due to a shorter time frame in which the support of legacy systems is necessary.

3.1.3 Airborne Internet

The Airborne Internet has a growing visibility both at the ICNS Conference and within the aviation community. With the establishment of the Airborne Internet Consortium, serious industry efforts are now underway to develop and implement Airborne Internet concepts and applications. The Airborne Internet concept appears to be realizable and of great value to aviation, especially the general aviation community in the Small Aircraft Transportation System (SATS) concept which seeks to increase the use of small, non-towered airport. However it must be strongly coupled with other aviation networking efforts to enable a globally interoperable system for aviation.

3.1.4 Joint Program Development Office

Key US government agencies and departments, including the FAA, NASA, Department of Homeland Security Transportation Security Agency, and the Department of Defense are working together through the Joint Program Development Office (JPDO) to define the long term development requirements for aviation in the US and globally, and coordinate the research programs of the agencies involved to achieve the long-term vision. The development of the long term aviation vision, a detailed research plan to realize the vision, and the commitment of resources to complete the needed research are all desired outcomes of the JPDO.

The outputs from the ICNS Conferences provide important recommendations for future communications, navigation and surveillance requirements that the Executive Committee strongly encourages the JPDO to consider.
3.1.5 Other Issues

Several other issues of interest noted by the Executive Committee from the Conference are summarized below.

FAA programs involving improvements for the general aviation community (e.g. Capstone in Alaska) involve the provision of user equipment for the purpose of operational evaluations of new technologies and systems. Such research efforts involve a close working relationship between the user community and the FAA, and have resulted in successful demonstrations and positive operational evaluations. There are significant continuing benefits for leaving equipment in place after the conclusion of the demonstrations and operational evaluations and such a policy is strongly recommended.

The reorganization of the FAA into the Air Traffic Operations (ATO) which is now underway is a cause of some concern in the aviation CNS community. The new operational paradigm of the ATO is not well understood by the aviation community. The impression evolving is that the ATO will be driven purely by a viewpoint of the FAA’s return-on-investment. The consequences of this type of major paradigm shift are unknown. A better definition of ATO policies and intentions is needed.

Unmanned aerial vehicles (UAVs) were featured by two of the plenary speakers as well as several technical presentations. UAV technology is a rapidly emerging aviation area, with a potentially very significant future market. The impact of UAVs on the NAS needs to be well understood and the insertion of UAV operations has significant safety implications which must be dealt with to the same extent as all other NAS operations.

The Executive Committee also discussed future ICNS conferences. The growth of the ICNS Conference from 2001 through 2004 has been steady and considerable. Attendance and the number of technical presentations have more than doubled. In 2004 this growth was handled by having three parallel technical sessions and extending the conference by a half day. However, additional conference growth cannot be handled in a similar manner, therefore some selection processes may be necessary in the future. The Executive Committee suggests establishing specific focus areas for future conferences and limiting conference presentations to those areas, while including presentations in non-focus areas as poster or display presentations or in brief summary presentations. The Executive Committee also suggests that workshop breakout sessions be integrated throughout the conference, rather than all at the end, to enable attendees to participate in more than one session, and to connect workshop sessions to related technical presentations sessions, all within the focus areas of the particular conference. A conference summary session, in which major themes of technical sessions are presented, is also suggested. The Executive Committee encourages increased international participation through improved publicity and the use of international mailing lists if possible. A final recommendation of the Executive Committee is to keep the conference in the Washington DC metropolitan area – this has been a successful policy to date and enables participation by location within the area of the largest geographical concentration of aviation industry and government organizations.

The Executive Committee will continue to meet periodically to assist in the development of future ICNS conferences.
3.2 Summary of Executive Committee Recommendations

The key Executive Committee recommendations resulting from the 2004 ICNS Conference and Workshop are the following:

1. The United States public and private aviation community – government, industry, and user community – needs to step up and exert international leadership in aviation.
2. The length of the technology development and insertion cycle is a serious impediment to achieving the goal of creating a transformed, 21st century aviation system, and must be reduced.
   a. Certification and standardization processes are the two main drivers to lengthening the time to technology insertion and both must be addressed.
   b. Reducing the cost, and improving the cost-benefit ratio will contribute to making technology adoption more rapid.
   c. The direct purchase of user equipment by the ATSP and/or government regulatory agency, and the mandating of equipage are policies that should be considered to shorten the technology transition time.
3. The development and implementation of airborne internet technologies and applications should be strongly supported, but must be strongly coupled with other aviation networking efforts to enable a globally interoperable system for aviation.
4. The Joint Program Development Office must develop the long term aviation vision, a detailed research plan to realize the vision, and the resource commitment to complete the needed research. The JPDO should also consider the outputs of the INCS Conferences as part of this process.
5. The FAA and other organizations involved should consider a policy of leaving equipment in place after the conclusion of the demonstrations and operational evaluations to obtain the significant continuing benefits available.
6. The FAA should better define its policies and intentions in reorganizing into the ATO to the community so that possible consequences can be considered and analyzed.
7. The impact of UAVs on the NAS needs to be well understood and the insertion of UAV operations has significant safety implications which must be dealt with to the same extent as all other NAS operations.

3.3 Key Breakout Session Results

The key results from each of the six Workshop Breakout Sessions, as prepared under the direction of the co-chairpersons of each session, are presented below.

3.3.1 Certification: How to Get a Better Certification Process

The Certification Workshop Session members established the goal of identifying candidate research topics to minimize certification as a "risk to the commercialization of CNS technologies" by reducing time and cost of certification while maintaining the appropriate level of quality.

In identifying certification research and development, the group first identified the Certification process as shown in Figure 3.3.1.1.
Figure 3.3.1.1 – Certification Process Definition

Certification Process

(TSO, STC, Safety Assess, Env. Qual., Software Assurance, Manuf. Approvals)

Product (or product requirements)

Certified product

Time  Cost  Quality
The certification process includes the identification of functional and performance requirements to satisfy the needs and constraints, and assess the technologies for meeting the requirements. A feasible certification process is the overlap between requirements and technology capabilities as shown in Figure 3.3.1.2.

The members defined an R & D plan consisting of five major elements as indicated in Figure 3.3.1.3.

The definition of functional requirements includes the following two elements:
- Document a regulatory judgment that a device meets all applicable regulatory requirements and can be manufactured properly
- Provide credible prediction of future service experience for new devices

The definition of performance requirements includes the following two elements:
- Collect historic data
  - Cost of avionics (e.g. comm) over time
  - Comparison cost of certified vs. non-certified products
- Identify Metrics
  - Ratio Price/Development Costs
3.3.2 Improving VHF Spectrum Utilization

Objective: Identify technologies to improve the performance and spectrum efficiency of future VHF communication systems.

Summary: VHF spectrum utilization is a major consideration in developing future air-ground communication systems. Several research initiatives were identified that hold promise to improving the spectrum utilization and efficiency of future communications systems. They include:

**Near Term Possibilities:**
- Improved VHF Antennas
- Frequency pooling techniques
- Reallocation of existing assignments – specifically the movement of AWOS/ASOS services to the 112-118 MHz band
- Dynamic geographic frequency allocation

**Mid Term Possibilities**
- Use of OFDM technology for communication
- Use of C-band for terminal area communications
- Use of full duplex techniques

**Longer Term Possibilities**
- Dynamic Frequency Allocation in VHF Band
- Use of Cellular Techniques
- Superconducting Filters
- Spread Spectrum Techniques
It was also noted that introduction of future security improvements needs serious consideration as we move forward to the next generation system.

All of these techniques should be investigated with particular emphasis on contacting DARPA to identify emerging opportunities.

3.3.3 System Wide Information management - SWIM

The SWIM Workshop Session identified issues and strategies in three areas: policy, technologies, and transition. These are summarized below.

SWIM Policy Issues and Strategies:

- Objectives, scope and boundaries of SWIM need to be clearly defined and articulated.
- How will international harmonization be achieved? (information standards, architecture, policy)
  - EUROCAE WG 59 Interoperability
  - EUROCAE WG 61 Architecture
- What is the security policy and its objectives? (access, ownership, levels, strategy)
  - Needs to be identified early and coordinated
- How might SWIM take advantage of the work done in support DoD’s GIG?
- How can we simplify the safety certification process?
- What are the data and information approval requirements for specific applications?
- Does the SWIM team understand the implications of certification on development?
- How will standards be influenced, adapted and enforced?
- What is the strategy for performance management and metrics?

SWIM Technology Issues and Strategies:

- How will architecture address the four domains: oceanic, en route, terminal, airport?
  - Physical, data, and application
- How should the data be modeled and validated?
- Security architecture should be developed in concert with technology architecture.
- Business case needs to be identified and articulated.
- Scalability, flexibility, evolvability are key considerations for the architecture.
- How will SWIM architecture accommodate COTS end systems for NAS subsystems with proprietary interfaces?
- What are the technology gaps?

SWIM Transition Issues and Strategies:

- Is there a sufficient understanding of the current architectures?
- What are the current activities and how will they be leveraged to benefit SWIM?
  - How will the East Coast broadcast services migrate to SWIM?
  - Investigate UAL’s EFB for applicability to SWIM.
- What are the defined future ATC capabilities?
- How will existing operational capabilities be maintained?
- How can we gain early buy-in from aviation industry and other stakeholders?
  - Develop business case to improve ROI.
  - Identify early benefits.
  - Conduct outreach to stakeholders.
What are the windows of opportunity for SWIM?
  - What is the ROI?
  - How will operating costs be reduced and/or services be improved?
What are the plans for vulnerability and security analysis and risk management?
What are the plans for program management and evaluation criteria to be incorporated in the transition plan?

3.3.4 Software Defined Multi-mode, Multi-function Avionics

The Software Defined Multi-mode, Multi-function Avionics Workshop Session identified the primary software defined avionics issues for five areas: Market drivers, equipage, implementation, cost, and certification. These are summarized below.

Software Defined Avionics Market Driver Issues:

- What are the most desirable/marketable combinations of legacy and/or emerging CNS functions and/or modes?
  - For those combinations, what are the application(s), flight domains and aircraft categories?
    - Multi-mode avionics more marketable than multi-function avionics (easier certification; esp for integration of communication modes and integration of navigation modes; market: international air traffic, international business jet operators)
      - Desirability of software reconfiguration as opposed to multiple hardware implementations
      - Easier international standardization
    - How do we capture the best of open architectures vs. proprietary innovations?
      - The market size just isn’t that large; hard to obtain enough market share when market isn’t large to begin with.
    - Other
      - Potential for reduction of legacy ground infrastructure once a certain percentage of the (military) fleet is equipped (UHF, TACAN)
      - Potential for implementation of SDA in ground infrastructure for future-proofing (next generation air-ground com) and cost reduction
  - What are the most desirable/marketable combinations of legacy and/or emerging CNS functions and/or modes?
    - For those combinations, what are the application(s), flight domains and aircraft categories?
      - Synergistic integration and fusion of existing and emerging functions may enable higher total system performance reliability and therefore operation in more desirable airspace and airports, preferential routing, etc.
        - May require policy & procedure changes
        - Self-separation at high altitudes
        - Reduced spacing for oceanic routes
        - Human machine interface (managing/reducing workload, novel or more intuitive ways of presenting information)
    - Other benefits:
      - Reduced training needs
Reduced costs of equipage, maintenance, spare parts
Added capabilities for greater reach into other markets (increase revenues)
Reduced downtime for re-equipage via software download (raises significant certification issues)

- What are the most desirable/marketable combinations of legacy and/or emerging CNS functions and/or modes?
  - For those combinations, what are the application(s), flight domains and aircraft categories?
- Drawbacks
  - Complexity issues
  - Human machine interface (too complex??)

Software Defined Avionics Equipage Issues:

- What equipage/sparing strategies are enabled by software defined avionics to reduce cost?
  - For broad suite of integrated functions (e.g. VHF/UHF/L-Band)
  - For narrow suite of functions (e.g. VHF/UHF and L-band)
- Box level reconfiguration of functionality as opposed to board level replacements
  - Issues of open (built to a standard performance and interface specification) vs. proprietary architecture
  - The level of functional integration may be offset by single point of failure
- Graceful degradation to minimal functionality
- Certification of the suite of components at the functional level is responsibility of avionics integrator
- Reduced box count, reduced physical size of box, reduced spare parts (helps with cost, reliability, maintainability)
- Need to address safety and robustness aspects of reduced equipage (A failsafe capability? A safe restart mode? Graceful degradation to minimum capabilities for safe flight?)

Software Defined Avionics Implementation Issues:

- What implementation considerations are most critical for success?
  - E.g. open SDA architecture; integration level of hardware and software; performance degradation from integration; security concerns
  - Consider a tailored subset of the SCA as a viable alternative for civil aviation (as opposed to JTRS subset of SCA)
  - Partitioning DO178b software certification specifications
    - Aspects of certifying multiple modes in the same function may be different from certifying multiple functions in an SDA
  - Antennae issues (location, interference) caused by multi-function avionics
  - Need to consider the human-machine interface
    - Should be intuitive
    - Opportunity to take advantage of background/experience of rising generation of users
    - Should leverage the fusion of …
  - Minimize downtime for MRO (maintenance, repair, operations)/Upgrades
Sparing philosophy and equipage issues may force novel implementation backups

What implementation considerations are most critical for success?
- E.g. open SDA architecture; integration level of hardware and software; performance degradation from integration; security concerns
  - Security & Safety: multiple channels for varying security levels (e.g. red/black portions of JTRS architecture)
  - Must still maintain safety and security standards of today
  - Authentication, verification and validation aspects of SDA

Software Defined Avionics Cost Issues:

- How will initial cost, annual operating costs and life cycle cost of SDA have to compare with that of conventional avionics to be attractive in the next 5 years?
  - What are the best ways to improve those cost perceptions?
    - Pricing strategies of initial investment
    - Who should pay for initial equipage costs?
      - Benefit to FAA and NAS?
      - Benefit to user of NAS?
    - Leveraged development of ground and airborne components that perform the same function (hardware and software components)
    - International operability to increase market size
    - International harmonization of standards to increase market size
      - RTCA & EUROCAE

Software Defined Avionics Certification Issues:

- What are specific concerns facing certification of SDA?
  - What recommendations will reduce cost and time of certification and life-cycle recertification of SDA?
    - The nature of the software architecture for the SDA greatly affects its certifiability
    - Certify at the performance level as opposed to the internal implementation level
    - Aircraft location at time of upgrade (reconfigurations on ground or in flight would have different security, safety and certification issues to consider)
    - Is the FAA certification methodology equipped to address certification of SDA? Does it impress another policy decision by the FAA concerning how certification is accomplished?
    - Can software development tools aid the certification process with certifiable process steps/tools?
    - Lessons learned from prior experience from SDA:
      - Avidyne avionics radio for NEXCOM
      - Honeywell EPIC radio
      - Scalability, flexibility, adaptability

3.3.5 Weather Communications

There is a broad spectrum of weather information which can serve aviation but it is clear that the requirements for information will vary dramatically by the type of user and class of service. In
addition, issues regarding where the information is to be processed (tailored) for the individual user – on the ground or in the aircraft – will significantly impact the capacity of the data link and communications channel needed to provide weather information.

The need for weather information will play a strong role in future systems design and planning – free flight capability may become critically dependent upon the availability and quality of weather information.

There also needs to be research into how aircraft derived weather information can be disseminated to other aircraft and how much context sensitive weather information is required in the future NAS.

3.3.6 A Global Solution to Future ATC

This workshop concentrated on identifying several aspects of a future ATC Communication System; in particular, the workshop focused on identifying key performance characteristics of a future global solution; political, organizational, and technical strategies for developing a solution; and some possible candidate technologies to be considered; and important issues to be addressed in the future. Several key concerns were identified – any one of which has the potential of delaying or invalidating a unified approach to a future system. Key elements that were identified in each area were as follows:

System Characteristics

- Support for 2015 – 2025 time frame.
- Global Interoperability – not necessarily a single standard signal-in-space but interoperability provided through software or multi-mode radios.
- Need to efficiently serve different classes of users – air carrier, military, general aviation, etc.
- Improved safety and security
- Spectrum planning as an adherent element of architecture – may not be totally within Aviation VHF Band
- Support for data and voice communications
- Air-to-air as well as air-to-ground operational support for “Free Flight”
- Ease of Transition
- Flexible future evolution

Possible Technologies for Consideration

- TCP/IP and its derivatives (including voice over IP as a possible back-up)
- Airborne Internet
- Ad Hoc Networking
- Domain dependent technology (oceanic vs terminal)
- Packetized Voice
- Improved compression and encryption
- Narrowband, wideband, and broadband technologies

Planning and Development Strategies

- Early involvement of the users in the development of systems
- Use of multi-mode radios or software radios as a key element on the ground and in the aircraft
- Early planning on a world-wide basis recognizing Europe's unique problem with 8.33
- Extensive use of simulation in evaluating alternative systems
- NASA and FAA leadership in defining and simulating technologies

**Key Problems and Pitfalls to Avoid**
- Avoid long transitions because they are expensive and limit capability
- Identify method to speed up certification of multi-mode and software radios
- Achieve full user involvement and support
- Identify and negotiate realistic spectrum requirements
- Achieve policy commitments as early as possible and stick to them

### 4.0 CONCLUSION

The Fourth ICNS Conference and Workshop continued a series of successful conferences and workshop dating to the first conference, held in May, 2001. Each conference has exceeded the previous one in terms of attendance, number of presentations, and overall value to the aviation community and to NASA as conference host. The over 300 participants and over 100 presentations at the 4th ICNS Conference are a testament to the growing recognition of the importance of developing an advanced, high performance and high capacity integrated communications, navigation and surveillance infrastructure to carry the national and global airspace systems into a next generation of safe and efficient growth. The aviation community has been an enthusiastic participant in the definition and development of the future ICNS infrastructure through the ICNS Conferences, and has contributed substantially to the development of NASA CNS R&D programs through this process.

A summary of conclusions and recommendations resulting from the 4th ICNS Conference has been compiled based on the ICNS Conference Executive Committee deliberations on the afternoon of April 30, 2004, and is presented in this report. The Committee based its work on the review of the Conference plenary session and technical session contributions of the conference participants, as well as the breakout workshop session results. The workshop breakout sessions developed summaries of their deliberations, which are contained in full in section 3.3 of this report. As a result of time limitations of the Committee meeting, the conclusions and recommendations represent the highlights and key issues gleaned from the conference and workshop results. These conclusions and recommendations are presented in sections 3.1 and 3.2.
## APPENDIX A
The Technical Sessions of the 4th Integrated Communications, Navigation and Surveillance Technologies Conference

### Tuesday, April 27, 2004

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>Chair</th>
</tr>
</thead>
<tbody>
<tr>
<td>07:15 – 08:15 am</td>
<td>Registration/Continental Breakfast</td>
<td></td>
</tr>
<tr>
<td>08:15 – 08:25 am</td>
<td>Overview Week</td>
<td>Denise Porchak, Conference Chair, NASA Glenn Research Center</td>
</tr>
<tr>
<td>08:25 – 08:35 am</td>
<td>Welcome</td>
<td>Rich Christiansen, Deputy Director, NASA Glenn Research Center</td>
</tr>
<tr>
<td>08:35 – 09:05 am</td>
<td>Keynote Address</td>
<td>Victor Lebacqz, Associate Administrator for Aeronautics, NASA Headquarters</td>
</tr>
<tr>
<td>09:05 – 09:15 am</td>
<td>Opening Remarks</td>
<td>Pete Vrotsos, Plenary Chair, NASA Glenn Research Center</td>
</tr>
<tr>
<td>09:15 – 09:35 am</td>
<td>The ATO and the NAS Architecture</td>
<td>Ann Tedford, Manager, Operations Planning Systems Engineering, Federal Aviation Administration</td>
</tr>
<tr>
<td>09:35 – 09:55 am</td>
<td>JPDO Overview &amp; Status</td>
<td>Karl Grundmann, Communications Director, Joint Planning &amp; Development Office, Federal Aviation Administration</td>
</tr>
<tr>
<td>09:55 – 10:20 am</td>
<td>BREAK</td>
<td></td>
</tr>
<tr>
<td>10:20 – 10:40 am</td>
<td>Department of Homeland Security Programs</td>
<td>Paul Polski, Chief of Staff, Transportation Security Administration, Department of Homeland Security</td>
</tr>
<tr>
<td>10:40 – 11:00 am</td>
<td>Enabling America’s Next Generation of Aviation Vehicles - UAV’s</td>
<td>John S. Walker, President, JSWalker Group/Aviation Solutions, Inc.</td>
</tr>
<tr>
<td>11:00 – 11:20 am</td>
<td>CNS Implementation - An Airline Perspective</td>
<td>Ira Pearl, Director, Flight Operations Technical Support, Delta Air Lines</td>
</tr>
<tr>
<td>11:20 – 11:40 am</td>
<td>Transportation Network Topologies</td>
<td>Bruce Holmes, Associate Director, Airspace Systems Programs Office, NASA Langley Research Center and John Scott, Icosystems, Inc.</td>
</tr>
<tr>
<td>11:40 – 12:00 pm</td>
<td>Aviation Weather Roadmaps</td>
<td>Sadegh Kavoussi, President, AvMet Applications International, LLC</td>
</tr>
<tr>
<td>12:00 – 01:15 pm</td>
<td>LUNCH</td>
<td></td>
</tr>
<tr>
<td>01:15 – 01:45 pm</td>
<td>Pilot’s Perspective: The Road to Future I-CNS Applications</td>
<td>Rip Torn and Robert Wayne, Air Line Pilot Association, International</td>
</tr>
<tr>
<td>01:45 – 02:15 pm</td>
<td>The Next NAS – 2025 Demand Projections</td>
<td>Michael Harrison, Aviation Management Associates, Inc.</td>
</tr>
<tr>
<td>02:15 – 02:45 pm</td>
<td>Unmanned Aerial Vehicle (UAV) Cargo System Senior Design Capstone Project</td>
<td>Kevin Han, Angela Garcia, Indah Leo, Miguel Martin del Campo, Chnur Muhammad, Libni Ortiz and George Donohue, George Mason University</td>
</tr>
<tr>
<td>02:45 – 03:15 pm</td>
<td>Air and Ground ATM Systems Integration Need or Fashion....</td>
<td>Jean-Claude Richard, Air Traffic Alliance</td>
</tr>
<tr>
<td>03:15 – 03:30 pm</td>
<td>BREAK</td>
<td></td>
</tr>
<tr>
<td>03:30 – 04:00 pm</td>
<td>Global Communications, Navigation, and Surveillance Systems Program Progress and Plans</td>
<td>Chip Meserole, The Boeing Company and James Dieudonne, The MITRE Corporation</td>
</tr>
<tr>
<td>04:00 – 04:30 pm</td>
<td>Emergent Issues of Network Centric Architectures and Shared Infrastructures</td>
<td>Marie Stella, Federal Aviation Administration</td>
</tr>
<tr>
<td>04:30 – 05:00 pm</td>
<td>Air Transportation Infrastructure Concept for the 21st Century</td>
<td>Herman Rediess, Federal Aviation Administration</td>
</tr>
</tbody>
</table>
### Tuesday, April 27, 2004

#### Session A2 – Communications Datalink
**Session Chair:** Art Feinberg, Intelligent Automation Inc.

<table>
<thead>
<tr>
<th>Time</th>
<th>Title</th>
<th>Speakers</th>
</tr>
</thead>
<tbody>
<tr>
<td>01:15 – 01:45 pm</td>
<td>Seamless Integration of VDL into the NAS with the Multimode Digital Radio</td>
<td>Frank Jaworski, Jim McChesney and Chang Zhang, ITT Aerospace</td>
</tr>
<tr>
<td>01:45 – 02:15 pm</td>
<td>Operational Benefits of Transitioning the Traditional Voice-based Controller/Pilot COM Radio System to Digital Technology</td>
<td>Tom Davis and Steve Dougherty, Raytheon Company</td>
</tr>
<tr>
<td>02:15 – 02:45 pm</td>
<td>MMDA Qualification Issues</td>
<td>Michael Kocin, ViaSat, Inc.</td>
</tr>
<tr>
<td>02:45 – 03:15 pm</td>
<td>SITA ATS AIRCOM Data Link Services and What's Next</td>
<td>Kathleen Kearns, SITA</td>
</tr>
<tr>
<td>03:15 – 03:30 pm</td>
<td><strong>BREAK</strong></td>
<td></td>
</tr>
<tr>
<td>03:30 – 04:00 pm</td>
<td>Next Generation FANS over Inmarsat BGAN</td>
<td>Dave Morse and Karl Griep, Aviulant, and Rich Deininger, Tectura</td>
</tr>
<tr>
<td>04:00 – 04:30 pm</td>
<td>Protocol Support for a New Satellite-Based Airspace Communication Network</td>
<td>Yadong Shang, Michael Hadjitheodosiou and John Baras, University of Maryland</td>
</tr>
<tr>
<td>04:30 – 05:00 pm</td>
<td>B-VHF – A Multi-Carrier Broadband Communications Concept for Air Traffic Management in the VHF Band</td>
<td>Bernhard Haindl, Miodrag Sajatovic, Christoph Rihacek, Johannes Prinz, Frequentis GmbH and Michael Schnell, DLR</td>
</tr>
</tbody>
</table>

#### Session A3 – Surface
**Session Chair:** Chris Daskalakis, DOT Volpe National Transportation Systems Center

<table>
<thead>
<tr>
<th>Time</th>
<th>Title</th>
<th>Speakers</th>
</tr>
</thead>
<tbody>
<tr>
<td>01:15 – 01:45 pm</td>
<td>Architecture and Interfaces for Runway Safety Systems</td>
<td>Eric Chartier, Architecture Technology Corporation and Dan Hicok, Federal Aviation Administration</td>
</tr>
<tr>
<td>01:45 – 02:15 pm</td>
<td>A Demonstration of the Final Approach Runway Occupancy Signal System</td>
<td>Jaime Figueroa, Federal Aviation Administration and Kirk Swanson, Architecture Technology Corporation</td>
</tr>
<tr>
<td>02:15 – 02:45 pm</td>
<td>Airport Surface Surveillance Service – An Alternate Approach</td>
<td>Kirk Swanson, Architecture Technology Corporation and Dan Hicok, Federal Aviation Administration</td>
</tr>
<tr>
<td>02:45 – 03:15 pm</td>
<td>Very Closely Spaced Parallel Approaches</td>
<td>Siroos Sekhavat Tafti, George Mason University</td>
</tr>
<tr>
<td>03:15 – 03:30 pm</td>
<td><strong>BREAK</strong></td>
<td></td>
</tr>
<tr>
<td>03:30 – 04:00 pm</td>
<td>Fleet Mixture and Arrival Rate Estimation at Memphis International Airport</td>
<td>Ben Levy, J. Legge, M. Romano, R. Collins, Sensis Corporation and Chris Daskalakis, DOT, Volpe National Transportation Systems Center</td>
</tr>
<tr>
<td>04:00 – 04:30 pm</td>
<td>Adaptive Channel Equalization for a Potential Airport Wireless Area Network</td>
<td>Minh Nguyen and Izabela Gheorghisor, The MITRE Corporation</td>
</tr>
<tr>
<td>04:30 – 05:00 pm</td>
<td>Determination of Controller Issued Taxi Clearances</td>
<td>Brent Midwood, US DOT, Volpe Center</td>
</tr>
<tr>
<td>Time</td>
<td>Event</td>
<td>Speaker(s)</td>
</tr>
<tr>
<td>---------------</td>
<td>-----------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>07:15 – 08:15 am</td>
<td>Registration/Continental Breakfast</td>
<td></td>
</tr>
<tr>
<td>08:15 – 08:45 am</td>
<td>Session B1 – Weather Information Communication, WINCOMM and Aviation Weather</td>
<td>Michael Jarrell, NASA Glenn Research Center and Thomas Tanger, Ohio Aerospace Institute</td>
</tr>
<tr>
<td>08:45 – 09:15 am</td>
<td>Weather Information Communications (WINCOMM) Project: Dissemination of Weather Information for the Reduction of Aviation Weather-Related Accident Casual Factors</td>
<td>Thomas Fraim, NOAA and Anthony Ramirez, Science and Technology Corporation</td>
</tr>
<tr>
<td>09:15 – 09:45 am</td>
<td>Weather Products for Airspace Management</td>
<td>Thomas Fraim, NOAA and Anthony Ramirez, Science and Technology Corporation</td>
</tr>
<tr>
<td>09:45 – 10:00 am</td>
<td>Pilot Weather Needs: Understanding, Quantification, Value</td>
<td>James Tauss and Gary Church, Aviation Management Associates, Inc.</td>
</tr>
<tr>
<td>10:00 – 10:30 am</td>
<td>A New Aviation Weather Technology that Forecasts NEXRAD Reflectivity Fields</td>
<td>Mike Cetinich, Jeppesen and Mike Eilts, Weather Decision Technologies</td>
</tr>
<tr>
<td>10:30 – 11:00 am</td>
<td>Oceanic Weather Product Development</td>
<td>Tenny Lindholm, The National Center for Atmospheric Research (presented by Gary Blackburn)</td>
</tr>
<tr>
<td>11:00 – 11:30 am</td>
<td>Flight Information Services Communication Architectures</td>
<td>Robert Nichols, Sunita Munjal, and Robert Pattay, The Johns Hopkins University Applied Physics Laboratory</td>
</tr>
<tr>
<td>11:30 – 12:00 pm</td>
<td>Communications Requirements and Architectures for Terminal Area Weather Distribution</td>
<td>Sunita Munjal, Robert S. Pattay, and Robert A. Nichols, The Johns Hopkins University Applied Physics Laboratory</td>
</tr>
<tr>
<td>12:00 – 01:00 pm</td>
<td>LUNCH</td>
<td></td>
</tr>
<tr>
<td>01:00 – 01:30 pm</td>
<td>Analysis of Candidate Communication Architectures for TAMDAR Implementation in 2007-2015</td>
<td>Michael Castle, The John Hopkins University Applied Physics Laboratory</td>
</tr>
<tr>
<td>01:30 – 02:00 pm</td>
<td>Flight Test of Weather Data Exchange Using the Universal Access Transceiver (UAT) Automatic Dependent Surveillance – Broadcast (ADS-B) Data Link</td>
<td>Lawrence Bachman, The John Hopkins University Applied Physics Laboratory</td>
</tr>
<tr>
<td>02:00 – 02:30 pm</td>
<td>Flight Test of Weather Data Exchange Using the 1090 Extended Squitter (1090ES) and VDL Mode 3 Data Links</td>
<td>James Griner, NASA Glenn Research Center</td>
</tr>
<tr>
<td>02:30 – 03:00 pm</td>
<td>Automated Handoff for VDL Mode 3</td>
<td>Ionut Cardei and Sabera Kazi, Honeywell</td>
</tr>
<tr>
<td>03:00 – 03:15 pm</td>
<td>BREAK</td>
<td></td>
</tr>
<tr>
<td>03:15 – 03:45 pm</td>
<td>A Low Cost Single Chip VDL Compatible Transceiver ASIC</td>
<td>Robert Becker, Honeywell</td>
</tr>
<tr>
<td>03:45 – 04:15 pm</td>
<td>Enhancing In-Flight Transoceanic Communications Using Swift-64 Packet Mode Service</td>
<td>Richard Slywczak, NASA Glenn Research Center</td>
</tr>
<tr>
<td>04:15 – 04:45 pm</td>
<td>ESCAN</td>
<td>Lisa Lust, Honeywell</td>
</tr>
</tbody>
</table>
**Wednesday, April 28, 2004 – Track 2**

<table>
<thead>
<tr>
<th>Time</th>
<th>Session Title</th>
<th>Chairs/Speakers</th>
</tr>
</thead>
<tbody>
<tr>
<td>07:15 – 08:15 am</td>
<td>Registration/Continental Breakfast</td>
<td></td>
</tr>
<tr>
<td>08:15 – 08:45 am</td>
<td>Aircraft Surveillance Applications (Extracts from ASA MASPS, DO-289)</td>
<td>Steve Koczo, Rockwell Collins and Jonathan Hammer, The MITRE Corporation</td>
</tr>
<tr>
<td>08:45 – 09:15 am</td>
<td>Determination of Requirements for Automatic Dependent Surveillance –Broadcast (ADS-B) to ADS-B Three Nautical Miles (nm) Separation Standard</td>
<td>Stan Jones, The MITRE Corporation (presented by Chris Moody)</td>
</tr>
<tr>
<td>09:15 – 09:45 am</td>
<td>General Aviation Use of ADSB – Effect on Near Mid-Air Collision Rates</td>
<td>Steve Hampton and Richard Theokas, Embry-Riddle Aeronautical University</td>
</tr>
<tr>
<td>09:45 – 10:00 am</td>
<td>BREAK</td>
<td></td>
</tr>
<tr>
<td>10:00 – 10:30 am</td>
<td>Terminal Area Surveillance at Innsbruck Airport</td>
<td>Werner Langhans, Austro Control</td>
</tr>
<tr>
<td>10:30 – 11:00 am</td>
<td>Safe Flight 21 and Two Advanced Automatic Dependent Surveillance-Broadcast (ADS-B) Applications</td>
<td>Randall Bone and James Reagan, The MITRE Corporation</td>
</tr>
<tr>
<td>11:00 – 11:30 am</td>
<td>Alternative Surveillance Technology for the Gulf of Mexico</td>
<td>Chris Daskalakis and Patrick Martone, DOT Volpe Center</td>
</tr>
<tr>
<td>11:30 – 12:00 pm</td>
<td>East Coast Broadcast Services Implementation</td>
<td>Robert Strain, The MITRE Corporation</td>
</tr>
<tr>
<td>12:00 – 01:00 pm</td>
<td>LUNCH</td>
<td></td>
</tr>
<tr>
<td>01:00 – 01:30 pm</td>
<td>Collaborative Decision Making (CDM) – An Integral Component of Air Traffic Management</td>
<td>Carol Huegel, Sensis Corporation</td>
</tr>
<tr>
<td>01:30 – 02:00 pm</td>
<td>ADS-B Performance in the TRACON for DAG-TM Concept Element 11</td>
<td>Rajesh Raghaven, Analex Corporation</td>
</tr>
<tr>
<td>02:00 – 02:30 pm</td>
<td>The Road to Free-Flight: Delivery of Trajectory Intent Information to the Flight Deck</td>
<td>Rajesh Raghaven, Analex Corporation</td>
</tr>
<tr>
<td>02:30 – 03:00 pm</td>
<td>Assigning Time Slot Resources for Uplink Broadcast Services</td>
<td>Chris Moody, Warrant Wilson and Izabela Gheorghisor, The MITRE Corporation</td>
</tr>
<tr>
<td>03:00 – 03:15 pm</td>
<td>BREAK</td>
<td></td>
</tr>
<tr>
<td>03:15 – 03:45 pm</td>
<td>Implementation of the Surveillance Data Network Through the FAA Telecommunications Infrastructure</td>
<td>Scott Remillard, Sensis Corporation and Robert Coulson, Harris Corporation</td>
</tr>
<tr>
<td>03:45 – 04:15 pm</td>
<td>Provision of Distributed Integrated Air Traffic Management Displays for the Global Satellite Communication, Navigation and Surveillance System (GCNSS)</td>
<td>Ian Wilson and John Pesce, Embry-Riddle Aeronautical University</td>
</tr>
<tr>
<td>04:15 – 04:45 pm</td>
<td>Implementation of New Technologies in Radar Systems</td>
<td>Michael Coluzzi, Larry Carlin, Makoto Igawa and Bernard Ross, ITT Gilfillan</td>
</tr>
<tr>
<td>04:45 – 05:15 pm</td>
<td>Antistealth ISAR Technology for Target Detection and Identification by Linear Frequency Modulated Signal</td>
<td>Andon Dimitrov Lazarov, Bourgas Free University and Chavdar Nikolaev Minchev, National Military Academy (Cancelled)</td>
</tr>
</tbody>
</table>
### Wednesday, April 28, 2004 – Track 3

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>Presenter(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>07:15 – 08:15 am</td>
<td>Registration/Continental Breakfast</td>
<td></td>
</tr>
</tbody>
</table>
| 08:15 – 08:45 am | Session B3 – Simulation & Modeling | The Processing of Airspace Concept Evaluation Using FASTE-CNS as a Pre- or Post-Simulation CNS Analysis Tool  
Thanh Nguyen, Analex Corporation and Brian Hung, The MITRE Corporation  
Steven Mainger, NASA Glenn Research Center  
Simulation of Controller Pilot Data Link Communications over VHF Digital Link Mode 3  
Steven Bretmersky, Robert Murawski, Cleveland State University, Thanh Nguyen and Rajesh Raghavan, Analex Corporation  
Steven Mainger, NASA Glenn Research Center |
| 08:45 – 09:15 am |                          | Proposed Development of NASA Glenn Research Center's Aeronautical Networks Research Simulator  
Steven Mainger, NASA Glenn Research Center |
| 09:15 – 09:45 am |                          | Data Communications Performance of AOCDL and AUTOMET over a VDL Mode 2 Link  
Steven Bretmersky, Robert Murawski, Vijay Konangi, Cleveland State University and Robert Kerczewski, NASA Glenn Research Center  
Steven Bretmersky, Robert Murawski, Vijay Konangi, Cleveland State University and Robert Kerczewski, NASA Glenn Research Center |
| 09:45 – 10:00 am |                          | Break                                                                         |
| 10:00 – 10:30 am |                          | Data Communications Performance of AOCDL and AUTOMET over a VDL Mode 2 Link  
Steven Bretmersky, Robert Murawski, Vijay Konangi, Cleveland State University and Robert Kerczewski, NASA Glenn Research Center  
Steven Bretmersky, Robert Murawski, Vijay Konangi, Cleveland State University and Robert Kerczewski, NASA Glenn Research Center |
| 10:30 – 11:00 am |                          | A Performance Study of the VDL Mode 3 Subnetwork Aircraft MAC Sublayer Random Access Algorithm  
Brian Hung, The MITRE Corporation |
| 11:00 – 11:30 am |                          | ERLANG B/C Link Availability/Blockage for Data and Voice Over VDL Mode 3  
Mohammed Shamma, Analex Corporation |
| 11:30 – 12:00 pm |                          | Investigation of Party Line Voice over Inmarsat’s Mobile Packet Data Service  
Richard Deininger, Tectura Corporation (presented by Bob Stephens) |
| 12:00 – 01:00 pm |                          | Lunch                                                                         |
| 01:00 – 01:30 pm |                          | Aviation Communications Emulation Testbed  
Charles Sheehe, NASA Glenn Research Center and Thomas Mulkerin, Mulkerin Associates Inc. |
| 01:30 – 02:00 pm |                          | Agent Infrastructures for Modeling and Simulation of CNS in the NAS  
Goutam Satapathy and Vikram Manikonda, Intelligent Automation, Inc. |
| 02:00 – 02:30 pm |                          | Oceanic Situational Awareness for the North Atlantic Corridor  
Bryan Welch and Israel Greenfeld, NASA Glenn Research Center |
| 02:30 – 03:00 pm |                          | Transmission Protocols and Information Reachability for Ad Hoc Airborne Networks  
Yiyuan Zhao, University of Minnesota and Maggie Cheng, University of Missouri |
| 03:00 – 03:15 pm |                          | Break                                                                         |
| 03:15 – 03:35 pm |                          | Can Current Security Policies Meet NAS Security and Safety Needs?  
Marie Stella, Federal Aviation Administration  
Kelly Mesveskas, Vic Patel, Federal Aviation Administration and Simon Blake-Wilson, BCI |
| 03:35 – 03:55 pm |                          | Link Security for Aeronautical Wireless Networks  
Marie Stella, Federal Aviation Administration |
| 03:55 – 04:15 pm |                          | Security Architecture for Aeronautical Networks  
Robert Stephens, Boeing Air Traffic Management, Tectura Corporation |
| 04:15 – 05:15 pm |                          | Audience Discussion – NAS Security Requirements 2020  
Marie Stella, Federal Aviation Administration |
<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>Chairs/Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>07:15 – 08:15 am</td>
<td>Registration/Continental Breakfast</td>
<td></td>
</tr>
<tr>
<td>08:15 – 08:45 am</td>
<td><strong>Session C1 – Navigation</strong>&lt;br&gt;Sessions Chairs: Rafael Apaza, Federal Aviation Administration and James Budinger, NASA Glenn Research Center</td>
<td>S. Vince Massimini and Frederick Niles, The MITRE Corporation</td>
</tr>
<tr>
<td>09:15 – 09:45 am</td>
<td>Extending Wide Area Augmentation System Service into Central and South America&lt;br&gt;Roxaneh Chamlou, The MITRE Corporation</td>
<td>Roxaneh Chamlou, The MITRE Corporation</td>
</tr>
<tr>
<td>09:45 – 10:00 am</td>
<td><strong>BREAK</strong></td>
<td></td>
</tr>
<tr>
<td>10:00 – 10:30 am</td>
<td>Integrated GPS/Loran Prototypes for Aviation Applications&lt;br&gt;G. Linn Roth, Locus, Inc. and Mitchell Narins, Federal Aviation Administration</td>
<td>G. Linn Roth, Locus, Inc. and Mitchell Narins, Federal Aviation Administration</td>
</tr>
<tr>
<td>10:30 – 11:00 am</td>
<td>Development of Global Positioning System Prediction Tools to Support Flight Planning&lt;br&gt;Karen Van Dyke, Jon Parment and Jayne Rossetti, DOT Volpe Center</td>
<td>Karen Van Dyke, Jon Parment and Jayne Rossetti, DOT Volpe Center</td>
</tr>
<tr>
<td>11:00 – 11:30 am</td>
<td>INS/GPS/Odometer Integrated Navigation System and Adaptive Federated Filter&lt;br&gt;Bing-Fang Chen and Bin Wu, Beijing Institute of Tracking &amp; Telecommunications Technology</td>
<td>Bing-Fang Chen and Bin Wu, Beijing Institute of Tracking &amp; Telecommunications Technology</td>
</tr>
<tr>
<td>12:00 – 01:00 pm</td>
<td><strong>LUNCH</strong></td>
<td></td>
</tr>
<tr>
<td>01:00 – 01:30 pm</td>
<td>Effectiveness of the Automatic Dependent Surveillance – Broadcast (ADS-B) Ground Based Transceiver (GBT) Parrot System in Alaska&lt;br&gt;Young Lee, Chris Moody and James Reagan, The MITRE Corporation</td>
<td>Young Lee, Chris Moody and James Reagan, The MITRE Corporation</td>
</tr>
<tr>
<td>01:30 – 02:00 pm</td>
<td>Short Baseline Interferometry for Precision Landing&lt;br&gt;Leonard Schuchman and Richard Orr, Satel</td>
<td>Leonard Schuchman and Richard Orr, Satel</td>
</tr>
<tr>
<td>02:00 – 02:45 pm</td>
<td><strong>BREAK</strong></td>
<td></td>
</tr>
<tr>
<td>02:45 – 03:15 pm</td>
<td>A Survey of Possible Methods for Mitigating the Impact of Radio Frequency Interference on Satellite Navigation Systems Used for Precision Approach&lt;br&gt;James Carroll, U.S. Department of Transportation/Volpe Center</td>
<td>James Carroll, U.S. Department of Transportation/Volpe Center</td>
</tr>
<tr>
<td>03:15 – 03:45 pm</td>
<td>Test Plan: Measurements of the Effects of UWB Devices on Aircraft Avionics&lt;br&gt;James Hollansworth, NASA Glenn Research Center and Jay Ely, NASA Langley Research Center</td>
<td>James Hollansworth, NASA Glenn Research Center and Jay Ely, NASA Langley Research Center</td>
</tr>
<tr>
<td>03:45 – 04:15 pm</td>
<td>Frequency Spectrum for New Aviation Data Links: Initial Study Results&lt;br&gt;David Matolak, Ohio University and James Branstetter, Federal Aviation Administration</td>
<td>David Matolak, Ohio University and James Branstetter, Federal Aviation Administration</td>
</tr>
<tr>
<td>04:15 – 04:45 pm</td>
<td>Minimizing Interference in Dense Packaging Environments&lt;br&gt;Michael Violette and Steve Ferguson, Washington Laboratories, Ltd</td>
<td>Michael Violette and Steve Ferguson, Washington Laboratories, Ltd</td>
</tr>
<tr>
<td>04:45 – 05:15 pm</td>
<td>Nationwide Capacity of a Digital Air/Ground Radio System for Air Traffic Services&lt;br&gt;Frank Box, Philip Long and Richard Snow, The MITRE Corporation</td>
<td>Frank Box, Philip Long and Richard Snow, The MITRE Corporation</td>
</tr>
<tr>
<td>Time</td>
<td>Session C3 – IP Based Transition for Aviation</td>
<td>Chair</td>
</tr>
<tr>
<td>--------------</td>
<td>-----------------------------------------------</td>
<td>------------------------</td>
</tr>
<tr>
<td>07:15 – 08:15 am</td>
<td>Registration/Continental Breakfast</td>
<td></td>
</tr>
<tr>
<td>08:15 – 08:45 am</td>
<td>Status of IPv6 in Industry</td>
<td>Waseem Naqvi, Raytheon</td>
</tr>
<tr>
<td>09:15 – 09:45 am</td>
<td>Aviation and IPv6</td>
<td>Sachin Lal, Anil Kumar, Computer Networks &amp; Software, Inc. and Manu Khanna, Comptel, Inc.</td>
</tr>
<tr>
<td>09:45 – 10:00 am</td>
<td>BREAK</td>
<td></td>
</tr>
<tr>
<td>10:00 – 10:30 am</td>
<td>IPv6, Mobile IP, and Ad Hoc Technologies in Aeronautical Telecommunications Network: Putting the Pieces Together</td>
<td></td>
</tr>
<tr>
<td>10:30 – 11:00 am</td>
<td>Architectural Issues with the Use of IPSec</td>
<td>Ruben Bigio, Federal Aviation Administration, Jamie Chappell, Luoping Liu, BCI, Vic Patel, William J. Hughes FAA Technical Center, Jim Simpkins and Simon Blake-Wilson, BCI</td>
</tr>
<tr>
<td>11:00 – 11:30 am</td>
<td>IP Based Air-Ground Datalinks</td>
<td></td>
</tr>
<tr>
<td>11:30 – 12:00 pm</td>
<td>IMT-2000 Satellite Standards with Applications to Mobile Air Traffic Communications Networks</td>
<td></td>
</tr>
<tr>
<td>12:00 – 01:00 pm</td>
<td>LUNCH</td>
<td></td>
</tr>
<tr>
<td>01:00 – 01:30 pm</td>
<td>Keeping Air Traffic Services Safe in a COTS Communications Environment</td>
<td></td>
</tr>
<tr>
<td>01:30 – 02:00 pm</td>
<td>Communication and the Future of Air Traffic Management</td>
<td></td>
</tr>
<tr>
<td>02:00 – 02:30 pm</td>
<td>Next Generation Datalink Applications</td>
<td>Peter Grogan, ARINC</td>
</tr>
<tr>
<td>02:30 – 02:45 pm</td>
<td>BREAK</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Time</th>
<th>Session C4 – SWIM</th>
<th>Chair</th>
<th>Speaker(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>02:45 – 03:15 pm</td>
<td>Net-Centric Strategy</td>
<td></td>
<td>Tim Wallace, Federal Aviation Administration</td>
</tr>
<tr>
<td>03:15 – 03:45 pm</td>
<td>System Wide Information Management (SWIM) Architecture Development</td>
<td></td>
<td>Zhenyi Jin, Tricia Gilbert, Stephen Henriksen, ITT Industries and Joshua Hung, Federal Aviation Administration</td>
</tr>
<tr>
<td>03:45 – 04:15 pm</td>
<td>System Wide Information Management Prototyping Activities</td>
<td></td>
<td>Duane Harkness, Avialiant LLC and Paul Comitz, Boeing Air Traffic Management</td>
</tr>
<tr>
<td>04:15 – 04:45 pm</td>
<td>System-Wide Information Management for Aeronautical Communications</td>
<td></td>
<td>Mark Taylor, The Boeing Company</td>
</tr>
<tr>
<td>04:45 – 05:15 pm</td>
<td>System Wide Information Management (SWIM) for Global Air Traffic Management (ATM)</td>
<td></td>
<td>Leon Sayadian and Eric Weil, Federal Aviation Administration</td>
</tr>
</tbody>
</table>
| Time        | Session C5 – Airborne Internet  
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>07:15 – 08:15 am</td>
<td>Registration/Continental Breakfast</td>
</tr>
<tr>
<td>08:15 – 08:45 am</td>
<td>Airborne Internet/Collaborative Information Environment: Societal Trends Make NOW the Right Time to Create the “Network In The Sky” Ralph Yost, William J. Hughes Technical Center</td>
</tr>
<tr>
<td>08:45 – 09:15 am</td>
<td>A Data Communications Concept for a SATS Scenario James Hurlburt and Thomas Mulkerin, Mulkerin Associates Inc.</td>
</tr>
<tr>
<td>09:15 – 09:45 am</td>
<td>Transformational Cost Reduction for Airborne Broadband William McNary, Aerosat</td>
</tr>
<tr>
<td>09:45 – 10:00 am</td>
<td>BREAK</td>
</tr>
<tr>
<td>10:00 – 10:30 am</td>
<td>Next Generation Datalink for General Aviation James Branstetter, Federal Aviation Administration</td>
</tr>
<tr>
<td>10:30 – 11:00 am</td>
<td>Electronic Flight Bags Joe Burns, United Airlines</td>
</tr>
<tr>
<td>11:00 – 11:30 am</td>
<td>Mobi-Web: Bandwidth Management for a Mobile Collaborative Information Environment Noel Schmidt, ATC Corporation</td>
</tr>
<tr>
<td>11:30 – 12:00 pm</td>
<td>Airborne Internet Consortium Developments Jim Meer, Microflight and Paul Masson, STARNet, LLC</td>
</tr>
<tr>
<td>12:00 – 01:00 pm</td>
<td>LUNCH</td>
</tr>
</tbody>
</table>

| Time        | Session C6 – Demonstrations  
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>01:00 – 01:30 pm</td>
<td>Global Communications, Navigation and Surveillance System (GCNSS) Flight Demonstrations Robert Oxborrow, Boeing Company (presented by Robert Struth)</td>
</tr>
<tr>
<td>01:30 – 02:00 pm</td>
<td>Mobile Router Testing with Diverse RF Communications Links David Brooks, Infinite Global Infrastructures, Doug Hoder, NASA Glenn Research Center and Ryan Wilkins, Infinite Global Infrastructures</td>
</tr>
<tr>
<td>02:00 – 02:30 pm</td>
<td>Passive Wake Acoustics Measurements at Denver International Airport Frank Wang, Hadi Wassaf, John A. Volpe National Transportation Systems Center, Robert Dougherty, OptiNav, Inc., Kevin Clark, Andrew Gulsrud, John A. Volpe National Transportation Systems Center, Neil Fenichel, Microstar Laboratories, and Wayne Bryant, NASA Langley Research Center</td>
</tr>
<tr>
<td>02:30 – 02:45 pm</td>
<td>BREAK</td>
</tr>
<tr>
<td>02:45 – 03:15 pm</td>
<td>Alaska’s Capstone Program - Systems Engineering for Communication, Navigation and Surveillance Daniel Stapleton and James Cieplak, The MITRE Corporation</td>
</tr>
<tr>
<td>03:15 – 03:30 pm</td>
<td>Aircraft in the Future ATM System Pierre Depape, Airbus</td>
</tr>
<tr>
<td>03:30 – 04:00 pm</td>
<td>Overview of NASA Glenn Aero/Mobile Communication Demonstrations David Brooks, Infinite Global Infrastructures, Doug Hoder, NASA Glenn Research Center and Ryan Wilkins, Infinite Global Infrastructures</td>
</tr>
<tr>
<td>04:00 – 04:30 pm</td>
<td>Mobile IP Demonstration William Ivancic, NASA Glenn Research Center</td>
</tr>
</tbody>
</table>