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Session II
Collaborative Decision Making

Toward CDM Implementation

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Collaborative Decision Making

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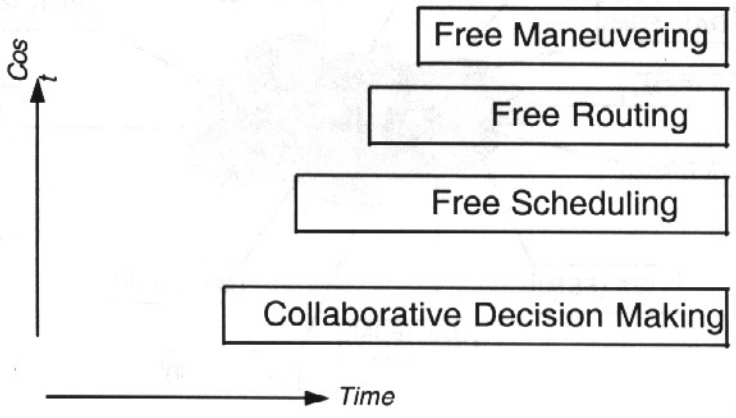
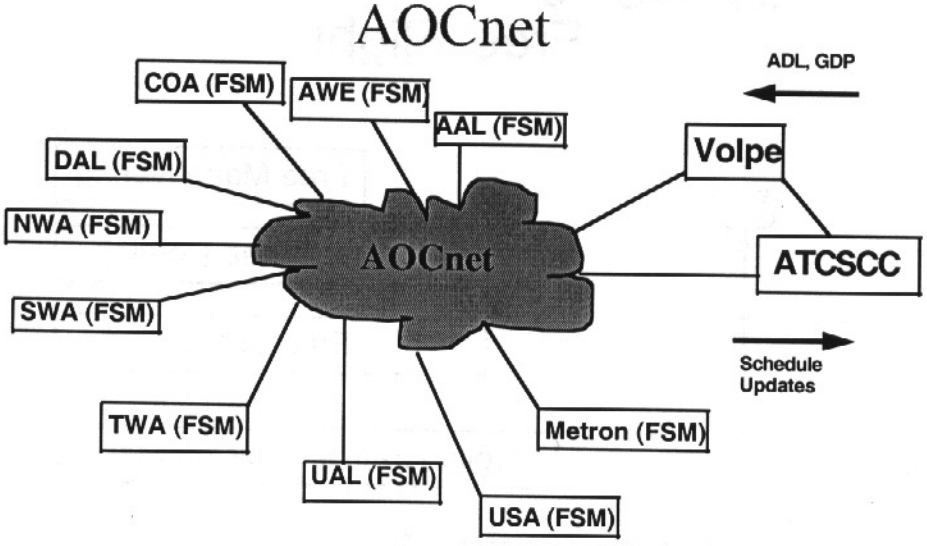
Managing the Evolution to Free Flight



Managing the Evolution through Collaboration

- Partnership for Joint Capability Development
  - Investment required at both ends
  - Coordination is key
- Information Exchange
  - Foster a common understanding
- Decision Making
  - Better information leads to better decisions



COLLABORATIVE DECISION MAKING (CDM)

"The FAA should seek collaborative opportunities with the private sector in order to accelerate the transition to a new NAS." *White House Commission on Aviation Safety and Security*

The Collaborative Decision Making (CDM) program is just the sort of effort between government and industry proposed by the White House Commission. CDM, which recently became RTCA Special Committee 191-Collaborative Air Traffic Management (ATM), has already implemented important elements which will allow for the transition to a new National Airspace System (NAS) as defined by the Free Flight Action Plan. CDM is based upon the premise that shared information on all sides will ensure a NAS beneficial to everyone. CDM is also a paradigm for industry, rather than government, bearing the burden of project funding. Already, airlines involved in CDM have collectively invested significantly more than the FAA in software development and training, as well as the creation of the AOCnet, the communications link which allows for two-way data exchange between ATCSCC and Airline Operational Control Centers (AOCs). Under the CDM Working Group, five other Working Groups have been established to examine and develop future collaborative elements essential to the evolution of Free Flight: Ground Delay Enhancements (GDE), Collaborative Routing, NAS Status Information, Data Integration and Analysis.

The Ground Delay Enhancements Working Group has been established to determine what changes are needed in policies and procedures, as well as modifications and enhancements to the actual infrastructure (i.e. FSM, ETMS database, AOCnet). Part of this infrastructure, the Flight Schedule Monitor (FSM), enables NAS users to view operational constraints in the same format as Air Traffic Control System Command Center (ATCSCC). Developed primarily as a tool for ATCSCC, it benefits the airlines as well. If everyone is able to view the same data in the same format, collaboration can be used to everyone's benefit to increase NAS efficiency. For example, when a Ground Delay Program (GDP) is proposed by ATCSCC, FSM allows AOCs to perform "what if" analyses, examine alternatives, allocate resources and change their allocations in a matter of seconds. If airlines cancel or delay enough of their own flights, the necessity for a GDP may be eliminated, saving airlines and passengers time and money.

A Collaborative Routing Working Group has also been established by CDM. This group has two primary goals: (1) create a system allowing ATC and the users to negotiate routes which avoid congestion and delays in the NAS and (2) allow users and ATC to negotiate routes that avoid adverse weather while minimizing negative impacts on the NAS. Collaborative Routing seeks to give ATC and the NAS users the same picture of adverse weather conditions so as to avoid confusion and confrontation, while allowing all users to meet their flight routing needs. This group will examine what technology is needed to facilitate collaborative routing as well as determine procedures to be used by all involved parties. Collaborative negotiation both before departure and en route will allow the user's regulatory and safety needs to be met in a way which does not compromise ATC's needs and constraints.

The NAS Status Information Working Group is exploring data which should be sent over the AOCnet. Their mission is to identify data critical to safety or efficiency which exists somewhere in the NAS, but is not currently distributed to all the users who need it. Examples are: airport configuration data, braking action reports, RVR and NOTAMS information. CDM's Data Integration Working Group will then determine which data items specified by NAS Status Information are candidates for distribution via the AOCnet. This group will examine whether or not the data is currently available or will be available in digitized format compatible to the AOCnet. Data Integration will also explore relationships with other data exchange programs (e.g. SMA, CTAS). The best way to make the data accessible will be determined according to its status as a benefit to NAS safety and efficiency.

Finally, the Analysis Working Group has been established to verify the benefits of the various elements of CDM. Their overall goal is to measure the effects of CDM changes on the NAS. The Analysis group has agreed on several metrics upon which to base the benefits of CDM. For the airlines, these revolve around time and cost savings. Benefits to the FAA will be determined by analyzing the value of dynamic scheduling information and measuring increased controller productivity due to better decision support tools.

The White House Commission on Aviation Safety and Security advocates "a strong government-industry partnership" in order "to support the aviation system of the future." CDM is that partnership. It is not only an element of Free Flight, but represents a new philosophy in aviation: collaboration between government and industry will lead to the creation of a safer and more efficient NAS beneficial to all involved.

Collaborative Decision Making (CDM)

Benefit Summary
(Ground Delay Programs)

An FAA organization, ASD-400, independent of the IPT which manages the CDM program, has been tasked with conducting the benefits analysis of FAA programs. The results of the various CDM exercises, statistical and simulation analyses were provided to ASD-400 to conduct their own analysis, using several formulas to reduce most of the benefits and ensure a conservative calculation. Using projections in demand growth, the benefits were then computed over an eight-year time frame. The ASD-400 concluded that the CDM elements comprise a potential of $2.6 billion reduction in costs to the airline industry through the year 2016. When the value of passenger time is taken into account, this number becomes $8.9 billion.

The overall benefits of CDM include figures not part of the ASD-400 analysis. For example, the numbers do not account for improved planning on the part of the users (airlines) that may result from the return flow of information. Nor do they account for delay propagation. Delay propagation studies have been unable to ascertain a metric for additional delays from one delayed flight because of variations in airline scheduling practices. It is not uncommon for one delayed flight to cause the delay of 2 to 5 other flights. It is the economic cost of these additional delayed flights that is not included in the benefits analysis. As well, they do not consider qualitative benefits, such as the improved scheduling flexibility associated with the simplified substitution process. Even considering airline investment costs that are needed, a rough estimate of the cost of implementing the full CDM functionality is in the $5 million range; a rather incredible benefit to the cost ratio.

The greatest benefit of the CDM is that it is a clear, first step toward greater collaboration and information exchange. Strong individuals in the FAA and the airline industry are working together to bring in a new era of teamwork and cooperation. As one CDM representative once put it, "it's us, the government and industry together against the weather".

COLLABORATIVE DECISION MAKING (CDM) EVOLUTION

1993

September - **FADE Experiments with AAL, UAL, USA**
FADE, or FAA/Airline Data Exchange, is intended to be a short experiment focusing on whether updated schedule information provided by the NAS users could affect Traffic Flow Management's decision making.

1994

August - **ATCSCC exercises the CDM concept in preparation for operational exercises**
An extensive 3-week human-in-the-loop exercise is conducted, with ATCSCC specifically focusing on whether updated schedule information can influence their decision making. The exercise results in a total reduction of 10-40% of assigned airline delay.

December - **Operational exercises take place and prove potential for User Benefits**
A joint airline/ATCSCC exercise is conducted at Metron, Inc in Reston, Virginia to measure the combined effects of improved decision making and the new compression process. Compression allows airlines to take advantage of arrival slot times available due to cancelled flights. The total delay reduction is fairly consistent with the exercises held at ATCSCC in August, about 10-35% depending upon the airport and scenario.

1995

Spring - **Rules of engagement crafted by the airlines and signed by the FAA. The collaboration process is recognized and continues to this day.**
The cornerstone of CDM, its "Roles and Responsibilities" guideline, is agreed to by the ATCSCC and NAS users and signed by both the development and air traffic entities of the FAA. Air Traffic Control-Traffic Flow Management will:

1) Monitor the NAS for constraints that produce capacity and demand problems
2) Make these constraints known to the users of the NAS
3) In cooperation with the users, develop a base line solution to the problem created by the constraint

In turn, Airline Operational Control (AOC) will:

1) Keep ATC-TFM informed of current operational demand and intent
2) Provide airline business need plans and designs within the general baseline solution provided by ATC-TFM

CDM is given its name and the CDM working Group is formed.

Summer - **RTCA Free Flight Task Force 3 takes place. CDM initiatives are captured in many of the committee's recommendations, as well as the Free Flight Action Plan**

1996

March - **Communications and Collaborative Routing Groups are established**
The Communications Sub-group is established to determine the link over which real time data will be exchanged

A Collaborative Routing Sub-group is formed to explore effective means of negotiating flight routes between AOCs and ATC before departure and en route in order to maximize efficiency and safety in the NAS.

October - **Operational exercises take place.**
Major airlines test the CDM concept and applications by using FSM to run "what if" scenarios.

1997

February - **AOCnet designed by Communications Sub-group**
The AOCnet is designed to be a two-way data exchange communications link which will allow members to exchange current information. The design minimizes point-to-point interconnetivity and increases the bandwidth.

May - **RTCA Special Committee 191 holds its first plenary session. CDM begins its transition to RTCA**

July - **AOCnet goes operational**
Seven airlines provide the communications architecture to enable data exchange and collaboration. Pre-operational testing exercises successfully disseminates aggregate demand lists, so all airlines have an accurate picture of airport and flight demand. Aircraft Situational Display is provided through the AOCnet.

Fall - **Prototype Operations begin. CDM GDP will go to San Francisco as the test site**

October - **NAS Status Information priorities are established. Data Integration group begins work to place NAS Status data items on AOCnet**

December - **Collaborative Routing prototype to be developed and initiated**

1998

TBD - **Collaborative Routing operational testing**

TBD - **Collaborative Routing data elements needed on AOCnet are identified based on operational testing**

TBD - **NAS Status safety and efficiency information available on AOCnet to all users**

TBD - **Collaborative Routing concepts to be implemented**

CDM PARTICIPANTS

GOVERNMENT:

▲Federal Aviation Administration (FAA)
▲Dept. Of Air Force/Air Mobility Command (HQ AMC/SCTA)
▲Eurocontrol
▲NASA/Ames Research Center
▲National Center for Atmospheric Research
▲Naval Research Laboratory (NRL)
▲Volpe National Transportation Systems Center (Volpe Center)

PRIVATE INDUSTRY:

✦ARINC, Inc.
✦Aviation Management Assoc., Inc.
✦BLR Group of America, Inc.
✦Center of Excellence (NEXTOR)
✦David R. Borneman Associates
✦Dimensions International, Inc.
✦GFB & Associates, Inc.
✦Lockheed Martin Corporation
✦Metron, Inc.
✦Mitre Corporation/CAASD
✦SoHaR Incorporated

AIRLINES:

✈Air Transport Association (ATA)
✈Airline Dispatchers Federation (ADF)
✈America West
✈American
✈Continental
✈Delta
✈FedEx
✈Kiwi
✈Midwest Express
✈Northwest
✈Reno Air
✈Southwest
✈Trans States
✈Trans World
✈United
✈UPS
✈US Airways
✈USAir Express

ACADEMIC INSTITUTIONS:

❖Embry-Riddle Aeronautical University
❖Massachusetts Institute of Technology (MIT)
❖Ohio State University
❖University of Maryland

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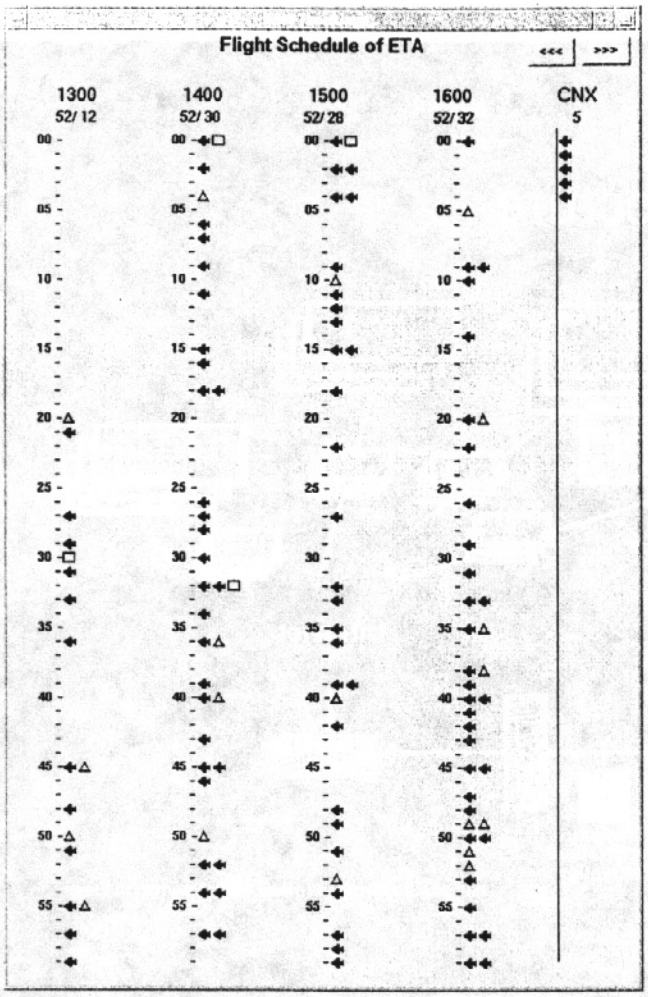
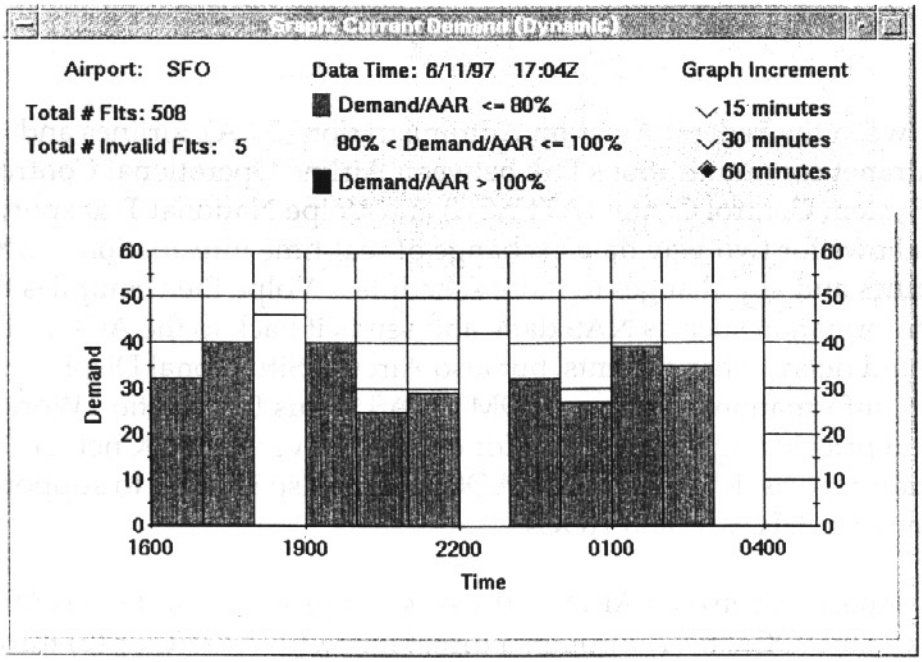
FSM



About FSM:

Flight Schedule Monitor (FSM) is a decision support tool that allows Airline Operational Control (AOC) to view the information sent over the AOCnet in the same format as ATCSCC. The three essential components of FSM are: (1) a graphical and timeline presentation of demand, (2) information extraction capabilities and (3) ground delay utilities. These allow users to react quickly to NAS constraints. FSM permits airlines to monitor specified airports as well as view flights arriving at and departing from those airports. Airlines can view specific flight information about their own flights, airport arrival rates, open arrival slots and other information pertinent to their operations. FSM also allows operators to view the consequences of any action taken on specific flights (i.e. delays and cancellations).

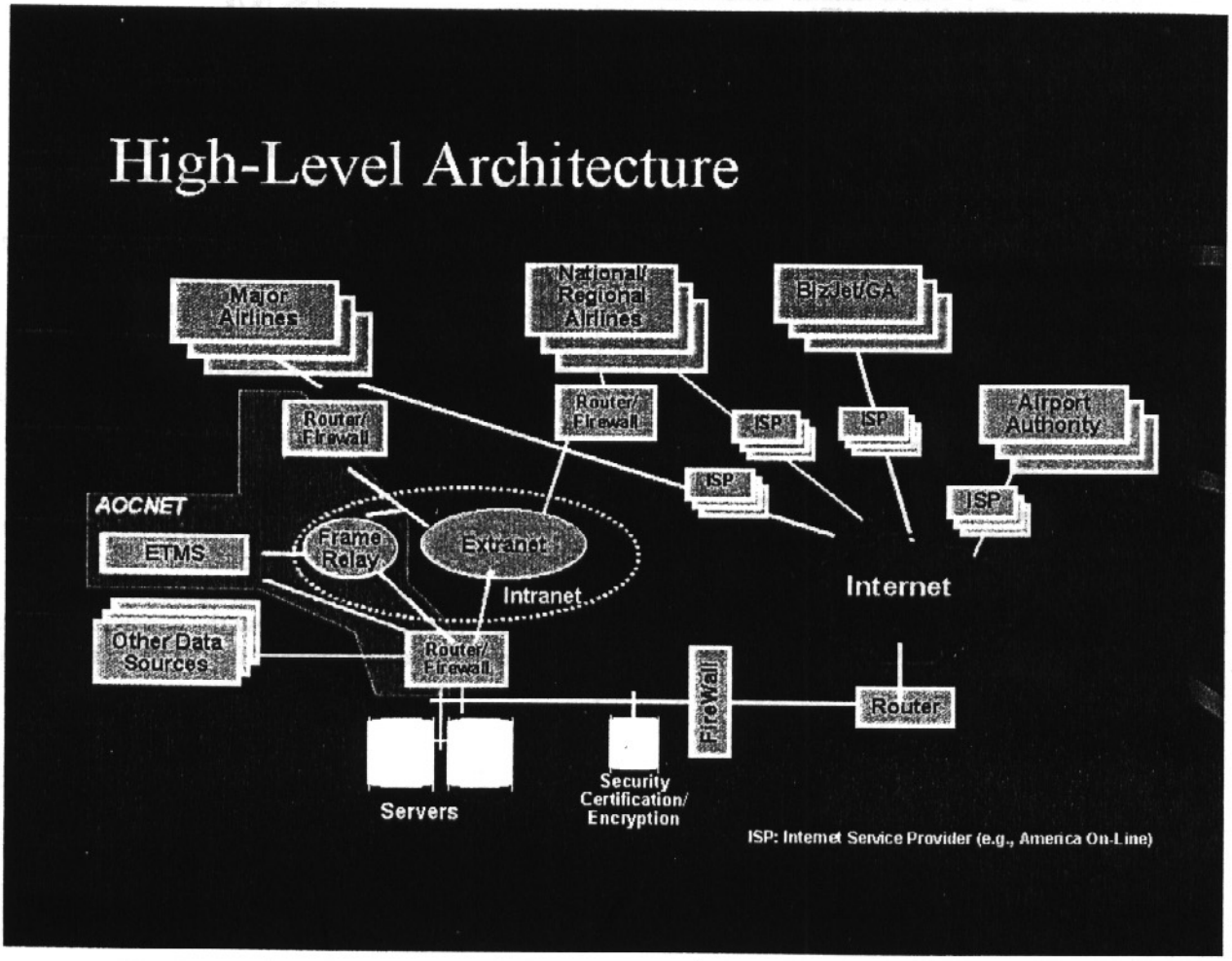
◗ FSM Display: Flights Colored According to Arrival Status



FSM is primarily used to aid ATCSCC in traffic management decision making. By monitoring airports, ATC can get a complete picture of NAS demand and constraints. They can quickly determine what action to take and what the consequences of those actions will be. FSM is currently available as freeware to any operator who signs a memorandum of agreement with the FAA.

◗Graph Display of Airport Capacity vs. Demand

AOCnet



About the AOCnet:

The AOCnet is a joint effort between the Federal Aviation Administration (FAA), airlines and ARINC, Inc. It serves as the intranet communications link between Airline Operational Control (AOC), Air Traffic Command System Control Center (ATCSCC) and Volpe National Transportation Systems Center. The AOCnet allows for two-way data exchange of real-time information. AOCs send in their operational schedules and any changes to those schedules. Volpe then compiles this information, along with other information such as NAS data, and sends it back to the AOCs. The AOCnet supports not only ground delay enhancements, but also Aircraft Situational Display (ASD) to industry and the expansion of information exchange. CDM's NAS Status Information Working Group is currently exploring and prioritizing data suitable for exchange over the AOCnet (i.e. airport configuration data, braking action reports, RVR, etc.). The AOCnet will also be used to support Collaborative routing efforts between ATCSCC and AOCs.

The graph above displays the connection between ARINC, the AOCnet provider, and the NAS users. There are two ways to connect to the AOCnet: (1) through a direct link with ARINC or (2) through an internet link with ARINC.