

**C/AFT ATS Datalink Focus Group Meeting**  
**March 12, 1998**  
**Everett, WA**

Agenda

0900-0910 Welcome and Opening statements David Massy-Greene  
 0910-0940 ARINC Presentation Aloke Roy  
 0940-1010 SITA Presentation Vaughn Maiolla  
 1010-1030 Break  
 1030-1100 VDL Mode 2 Simulation Report Ken Clark  
 1100-1130 Mitre/CAASD Datalink Study Report Jim Simpkins  
 1130-1230 Lunch  
 1230-1500 General discussion  
 1500-1600 Develop plan for the April All Airline C/AFT meeting in Paris

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Summary

C/AFT has a core meeting in Washington DC on April 2nd, and an all-airline meeting in Paris on April 29th. David Massy-Greene will take a recommendation to the all-airline meeting for an interim step to ATN. This step will be ACARS over VDL Mode 2 using CLNP and something like TP4. C/AFT will also perform a benefit study to estimate the probability of long-term benefit of ATN.

### Action Items

Group: Send corroborating studies as well as any benefit studies that are out there.  
Group: Provide electronic copies of presentations to Kathleen  
Aloke: Send assumptions that were used for growth predictions  
Aloke: See if ARINC can do ACARS over VDL Mode 2 simulation in mixed environment  
Nigel: Find out what Eurocontrol is doing in regards to frequency management.  
Boeing: Determine if we can undertake simulation of ACARS over VDL mode 2  
Boeing: Begin development of long-term probabilistic benefit model  
Charlotte: Determine if we can publish FAA CPDLC R.D on the C/AFT web site.

### Introduction David Massy-Greene

We are embarking on an important activity to try to unhook nexus that's been occurring in various CAA's around world to get progress in CNS/ATM. Which way do we go in datalink – what flavor, and which one can we justify? C/AFT looked at what it takes to put ATN on airplane, we didn't understand what was pushing ATN, in its pure form, to airplane at this stage. What are benefits that would pay for investment? Some applications may require level-B router on airplane (current estimates ~ \$1/2 million per airplane). Started to look at what else was available to enable to go faster into datalink environment, but still leave progression path to ATN. SITA and ARINC have both made separate proposals to go to VDL Mode 2, allowing bandwidth for AOC and ATC.

What would I like to do today? Develop consensus on path for C/AFT datalink focus group – how should we be proceeding in future.

A full cost benefit analysis requires costs and benefits. We don't know benefits, have some idea of costs. We can't determine benefits until we have an operational concept. Free Flight TF3 provides ideas, but doesn't provide operational concept. We plan on doing a probabilistic cost/benefit analysis, it will take a while, and will be fairly undefined due to uncertainty in operational concept/benefits. Would like benefits ultimately in dollars. Datalink is an enabler.

### Aloke Roy ARINC proposal for transition to VDL/ATN

[Link to Aloke's presentation.](#)

**Situation:** VHF ACARS traffic is increasing. Multiple frequencies are required to handle current traffic. Today there are 10 million messages/month requiring 4-5 frequencies. As user demand increases, more frequencies will be required. Growth predictions indicate that up to 12 frequencies may be required by 2004. This is not a viable solution. Frequencies are not easy to find – we're not going to get 12 frequencies.

**Proposal:** Implement a VDL Mode 2 Network which:

- Complies with ICAO VDL and ATN SARPs
- Uses Connection Less Network Protocol (CLNP) address for end-to-end data delivery
- Supports direct delivery of user data to hosts using CLNP
- Supports optional X.25 Gateway for host connectivity
- Announces VDL service availability using ACARS squitter message
- Will allow simultaneous operation of interim VDL and full ATN based avionics

ARINC's proposal has the following objectives:

- Provide additional data-link capacity by Year 2000
- Provide backward compatibility with existing applications and minimize impact on avionics
- Provide clear transition path to ATN

- Allow interim avionics and full ATN compatible avionics to operate over same ground infrastructure thereby reducing industry costs
- Allow local routing and delivery of user data
- Provide the capability to add new applications without changing basic communications stack
- Gain operational experience with new architecture

**ARINC Roadmap to ATN:** Mode 1 trials were performed in 1997. GLASTAR VDL Mode 2 demo will fly next month (FAA). European trials next year. Propose industry interoperability team, even though SARPS are well defined there are a lot of options. Interoperability problems could arise, depending on options chosen. Will have full VDL Mode 2 operational end of 1999 (150 - 200 ground stations per year). ACARS service will live its own life for at least 10 years. Would like to see all new airplanes equipped with VDL in 2000 (Airbus and Boeing). FAA automation in 2005 will allow airlines to take full advantage of ATN end-to-end.

Vaughn Maiolla SITA proposal for Migration to VDL Mode-2

[Link to Vaughn's presentation.](#)

**Situation:** SITA agrees with ARINC's assessment of the current situation. SITA's philosophy turns around realizable benefits. To get funding for new investments, we need almost immediate payback. Most of the benefits of CNS/ATM are in the future, and are dependent on new applications. No one has looked at a proper Concept of Operations for CPDLC and ADS. SITA operates 3 frequencies in Europe and that's not enough. These clogged arteries keep people from using datalink.

**Proposal:** VDL Mode 2 is here today and provides an intermediate step supporting existing ACARS-based AOC applications during the upgrade of aircraft fleet and airline ground system. X.25 over VDL is the preferred solution because it is extremely simple and will eliminate many of today's problems due to poor ACARS protocol implementation. Other reasons are:

- ICAO VDL standard was developed to provide an ATN compatible VHF datalink but the VDL ISO8208/X.25 protocol can transport data in any format
- Allows same conversion between VDL or VHF ACARS air-ground connections and user ground system interface
- Avionics can easily switch between VHF ACARS and VDL ground stations during the VDL deployment phase.

SITA's proposal has the following objectives:

- To provide performance improvements without an immediate replacement or upgrade of the existing ACARS datalink applications, on the aircraft or at the airline host
- To provide a migration path from ACARS protocol for air-ground datalink communications to protocols specified in the ICAO VDL Mode 2 and AMSS Data-3 standards
- To provide ICAO-compliant datalink services which can support any future ATS internetworking protocols.

SITA believes CLNP/TP4 add complexity and risk with no performance benefit, and that CLNP/TP4 should be validated (on the ground) before going "live" with operational traffic. CLNP/TP4 validation is already a part of ATN validation and is task that is better left to ATNSI and EURATN.

VDL Mode 2 Simulation Report Ken Clark

[Link to Ken's presentation](#)

A CRDA between the FAA and ARINC was established in June 1996 to develop an integrated end-to-end VDL/ATN simulation. The simulation explored the performance and capacity characteristics of VDL Mode 2 system under various ATS and AOC traffic conditions. The intent of the simulation was to determine the maximum number of aircraft that could be serviced within each domain on a single frequency and meet the performance requirements.

The ATS requirements for message delivery times were based on operational requirements for the Aeronautical Data Link System prepared by the FAA Data Link Operational Requirements Team (DLORT) in January 1995. The ATS message traffic model was based on the message types and message frequency as recorded during the controller pilot data link communications benefits studies for terminal airspace conducted by the FAA Technical Center.

ARINC developed an AOC message traffic profile to be used for the simulation including PDC and D-ATIS messages, as well as standard OOOI messages, and are based on actual ACARS traffic measurements. AOC performance was required to meet current AOC data link performance levels.

The study consisted of three steps, each representing various phases of flight. For each Step a message set was defined. All aircraft in the system transmitted the same message set. The number of aircraft were then increased to determine the maximum capacity of the system, and still meet the performance standards of DLORT. The model represented Y2000 level traffic.

**Step 1.** Airport domain. All aircraft located on the ground. There was a single ground station.

**Step 2.** Terminal domain. All aircraft airborne. The traffic profile used included terminal domain messages from the AOC traffic set and ATS messages used in the FAA Technical Center study. There were 6 ground stations located in the New York City area.

#### **Results for Steps 1 and 2.**

Performance Requirement

- 95% of all messages are required to be delivered within 3 seconds with 150 aircraft.

Result

- Shared ATS/AOC. Performance requirements met with 160 aircraft.
- Dedicated ATS Datalink. Performance requirements met with 250 aircraft.

**Step 3.** En-route domain. Northeastern United States.

#### **Results for Step 3**

Performance Requirement

- 95% of all messages are required to be delivered within 5 seconds with 400 aircraft.

Result

- Shared ATS/AOC. Performance requirements not met (simulation could handle 150 aircraft)
- Dedicated ATS Datalink. Performance requirements met with 640 aircraft.

#### **Conclusion**

- Simulation shows VDL Mode 2 meets expected performance and capacity requirements using a shared ATS/AOC data link system in terminal and airport domains.
- VDL Mode 2 data link system dedicated for ATS applications can support more than 640 aircraft in the en-route domain, which is well beyond the DLORT requirements.

### [Link to Jim's presentation](#)

Jim Simpkins presented the results of a data link simulation study that looked at domestic en route operations for sectors that enforce restrictions due to communication volume saturation for 1994 traffic levels. The premise was that if the frequency problems could be reduced, controllers could accept more communications and reduce the miles-in-trail restrictions. Controller teamwork/delegation of tasks, with the additional communication capacity, led to more efficient and higher capacity use of the existing airspace. Results showed that with data link there was a reduction of the 20 miles-in-trail restriction to minimum (5 miles) and it resulted in 62% delay reduction for all 48 aircraft. In the arrival sector, average flight time was reduced by 4 minutes and 22 miles. Controllers were able to achieve no holding with a 40% increase in traffic. Voice occupancy time was reduced between 78 to 84%. TOC (transfer of communications) accounted for 30% of the messages. The follow-on study performed by CSSI did not have a manned simulation.

### General Discussion

**Aloke Roy:** The SITA proposal is a subset of ARINC's, and SITA will have to go to what ARINC proposes for ATN. SITA's proposal will solve today's problem, but it is not flexible for the future.

**David Massy-Greene:** What about message assurance? This is an important issue for NATCA and IFALPA.

**Vaughn Maiolla:** Message assurance is not embedded in the SITA solution, but it could be added at the application layer.

**Aloke:** ARINC's proposal has message assurance in the CLNP.

**David:** We must be careful in implementing a near-term solution only. Is it worth implementing a near-term solution that will take us to 2005 but won't be fully implemented until 2003?

**David:** What thought has been given to frequency management, and how to accomplish?

**Aloke:** All I can say is that ARINC intends to field 2 frequencies from the get-go. It's easier to put hardware in the field right away, rather than update later. There is capability within VDL that allows service providers to detect problems and change frequency. We can implement on-ground frequency vs. en-route frequency. We can synchronize frequency changeover based on TOC, using input provided by FAA computers. VDL system is being designed to work with external systems like that.

**David:** Is Eurocontrol dealing with frequency management?

**Nigel Makins:** I don't know but I'll find out.

**David:** Latency numbers in the VDL Mode 2 simulation report -- were they transmission latencies or end-end?

**Aloke:** Latency from CMU through RF through ground station, through route exiting ARINC network. May need to add FAA / airlines network delay and application delay to get total time budget. According to Ron Jones published at ATN Panel meeting total 3 ½ seconds for terminal, and around 6 seconds for en-route. This is how we came to latency requirement.

**Al Burgemeister:** Doesn't account for latencies within airplane avionics. Jones people allocated 1 sec to avionics, but that is optimistic.

**David:** Vaughn, how difficult would it be for SITA to implement TP4 and additional addressing capability.

**Vaughn:** It wouldn't be that difficult. We don't favor it because of risk at this point, we'd rather do it incrementally.

**David:** I think TP4 will become a requirement.

**Vaughn:** TP4 should be transparent to us. I'm not a fan of TP4 myself. What does it buy you, look at CPDLC – just add pilot acknowledgment.

**David:** Adding this to our systems would be expensive.

**Kent Loving:** So would TP4.

**AI:** I understood that advantage of CNLP is to address and point particular data stream to gateway AFEPs or ATC/Airline host. X.25 doesn't have equivalent addressing.

**Vaughn:** The issue you're raising would only be of concern in ATN environment where you're totally bit-oriented from end-end.

**Aloke:** Tentative yes, you can do networking with X.25 just like with most other protocols. Advantage of CNLP is that it makes X.25 addressing plan transparent. In X.25 every terminal belongs to the same subnetworking system. Each subnetwork will have to do its own address translations. X.25 can do it, but CNLP is already defined. Industry spent 10 years defining this standard, why throw it away?

**David:** With CNLP and TP4 it would be on path to ATN.

**Kent:** you mentioned datalink users forum. Wouldn't this be a good place to bring up the SITA vs. ARINC proposals?

**Aloke:** Basically yes, there is a split between two options, so we'll do both on paper, and we'll see what gets implemented. That's as far as it is being planned on being taken so far.

**David:** ACARS over VDL M2 simulation is becoming very necessary. How long would it take Boeing to do ACARS over VDL Mode 2?

**Kent:** Don't know.

**Kathleen Pirotte:** Boeing will take action item to investigate this.

**David:** We need to have that answer.

**Kent:** We would need a lot of information from ARINC and SITA to do a good simulation. Can I count on you to give us information?

**Vaughn:** Yes, that should be OK.

**Aloke:** Yes, don't see a problem. Maybe we can give you Opnet model, but I'll have to check that out.

**David:** Question for Charlotte. Is there a way we can get around prioritization of messages?

**Charlotte Long:** I don't know. It seems reasonable that with correct latency prioritization should not be necessary.

**Aloke:** Priority becomes a concern when you're talking about tactical vs. strategic messages. We won't start out using tactical messages.

**Charlotte:** We have tried to separate into tactical and strategic sets. Best we could do is Build 1 is strategic and later is tactical. We're thinking about prioritization, but we don't have an answer yet.

**David:** Message integrity is not built into the system (Mode 2 or ATN). We should retain CRC for message integrity (even if 622 convergence function is stripped out). If we take FANS-1 implementation, it is bit-oriented, even though it comes out in characters. C/AFT would recommend that CRC remains in there.

**Aloke:** I agree.

**Greg Saylor:** If you need to go to increased number of frequencies, can you get them?

**Aloke:** No. if we don't go to VDL we will have problems. In some areas we have 5, but can't get them everywhere. It's going to be harder and harder.

**Vaughn:** Likewise for Europe. We operate 3 frequencies but they aren't available across Europe. If demand drives us to 5 frequencies we'd be in real trouble. We do have a VDL frequency for Europe, so we're OK in that regard.

**David:** Where do we go from here?

C/AFT has a core meeting in Washington DC on April 2nd, and an all-airline meeting in Paris on April 29th. I'd like to take a recommendation to the all-airline meeting for an interim step to ATN.

This step will be ACARS over VDL Mode 2 using CLNP and something like TP4. This is the way I would suggest we go as an interim step.

**Greg:** Is there any cost in taking the intermediate step that would be in excess of what we would need to take a longer term step.

**David:** This would require ARINC 758 CMU, possibly at different certification level than short-term implementation. We are still trying to find out what it will cost to get to level B CMU, even though we don't know what the actual requirement will be. I've spoken with both major CMU suppliers, who say that they are planning to certify to level C, but building to level B. They've done all they think they need to do to go to level B certification if necessary. Software tracing has been done, software verification has not.

**Aloke:** Given what we know today, 90-95% will be reusable