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Commentary on Data Link Server Paper Presented at Bordeaux by Eurocontrol

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SUMMARY

This paper comments on the Eurocontrol Data Link Applications Servers in Europe paper, which was originally presented in Rio and then again in Bordeaux.

1 Introduction

1.1 The Data Link Application Servers in Europe paper presented in Bordeaux had many interesting points. There are many considerations to take into account if a data link server approach is going to be used, and the paper did a good job at identifying many of them.

1.2 However, there was one area where the paper was slightly misleading. This had to do with CPDLC and DSC connections to a server, where the paper said that the SARPs as currently written constrain a server implementation. This is not the case.

2 Background

2.1 The following is an excerpt from the Eurocontrol paper, which briefly explains the data link application server concept:

> The concept explored in this document is that of a Data Link Application Server. In all the background material described in section 1.2 above, there is an underlying assumption that each application on board the aircraft communicates with a separate application for each ATSU through whose control it passes. This is illustrated in figure 1-1. The concept of a Data Link Application Server is that a single application may serve several ATSUs. This is illustrated in figure 1-2.

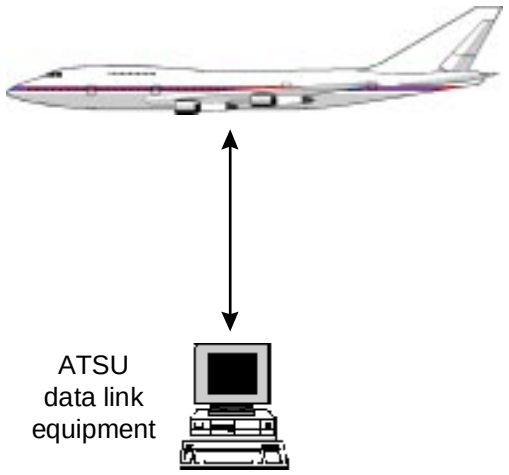

Figure 1-1: Normal view of a data link connection

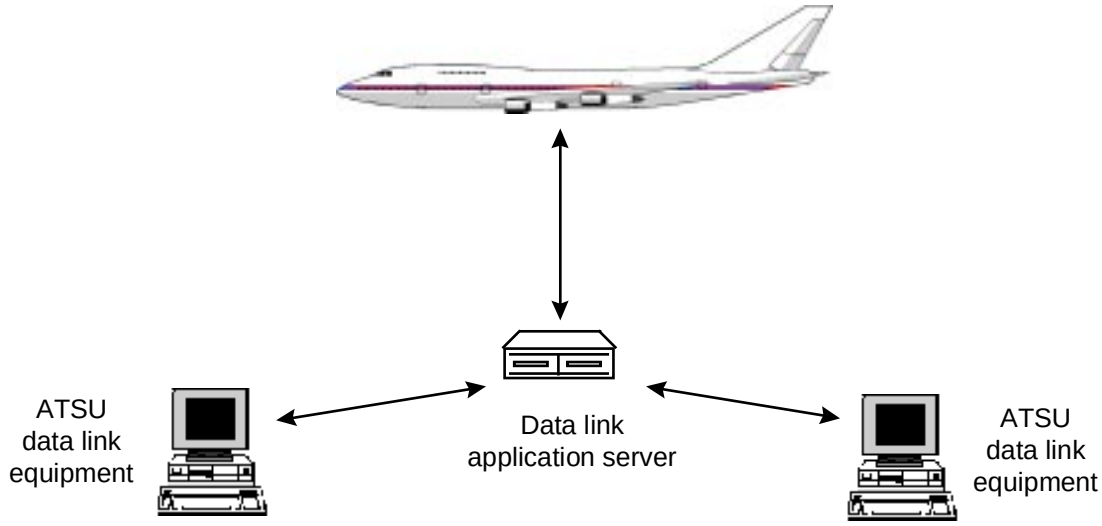

Figure 1-2: Concept of a data link application server

One view of this concept is that it is a technical issue only, and that from the users' perspective, the service should remain identical. In many ways this viewpoint is correct, however, there are many organisational, commercial, technical and state issues that arise that must be considered.

The data link application server may be operated by a number of different organisations:

- by a state's ATC organisation - providing a single server for all sectors within the state's airspace,
- by joint agreement between two or more states - providing a single server for all the collaborating states,
- by a service organisation - providing a service that can be used by one or more states' ATC organisations.

Where there is no data link application server, each ground end user must be equipped with the full application architecture. That is, it must contain:

- The user application (implementing the user interface and the services defined in the ORD)
- Context Management (CM) application software
- Automatic Dependant Surveillance (ADS) application software
- Controller Pilot Data Link Communications (CPDLC) application software
- The upper layers stack
- ATN transport and lower layers

Moreover, this set of functions must be present in each ATSU.

A data link application server would also have to contain this complete set of functionality. However, the ground end user equipment could have a very simple interface to the data link application server. For example, it could be implemented with a Remote Procedure Call (RPC) mechanism over another type of network infrastructure. This is illustrated in figure 2-2.

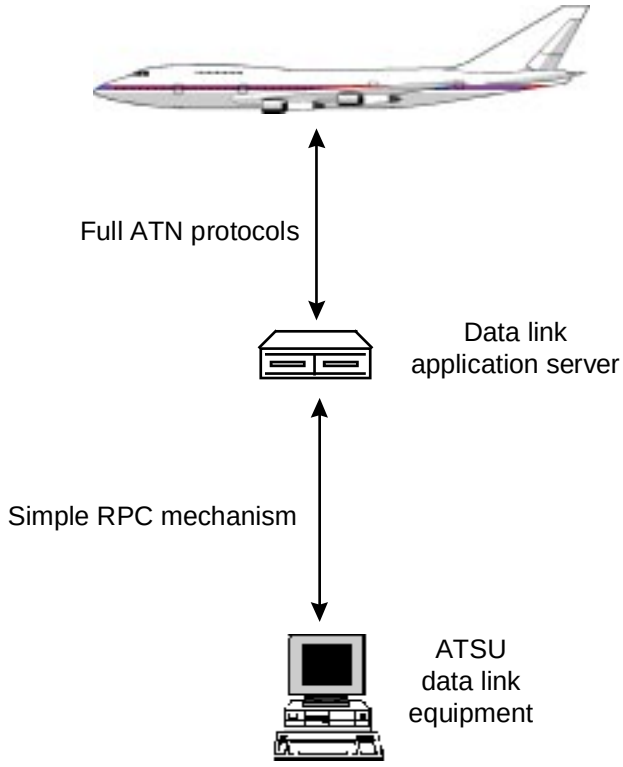

Figure 2-2: Use of simple protocols in the ATSU data link equipment

Clearly, the advantage here is a much simpler system architecture in the ATSU itself. This will therefore be cheaper to implement and simpler to validate. The commercial advantages grow with the number of ATSUs served by the data link application server.

2.2 In addition, the following table discusses issues with air-initiated data link applications:

Application	Function	Analysis
CM	CM-logon	The data link application server must act as the CM server, and therefore there is no issue concerning routing.
CPDLC	CPDLC-start initiated from the aircraft	In the CPDLC start request PDU there is an indication of the destination for the message in the CPDLC-start parameter "called peer identifier". This parameter must be passed to the ground system through A-ASSOCIATE AE-Title parameter. This is not done under the current specification. Even if the called peer identifier were passed to the ground system, the CPDLC SARPs do not state any use for this parameter in the ground system, and it is not passed to the CPDLC-ground-user in the CPDLC-start indication. Thus the information to route the CPDLC-start is not available in the ground system.
	DSC-start	The same issue exists for a DSC-start request.
FIS	Contract request	The ATIS contract request (the only one defined so far) contains an indication of the airport for which information is sought. This can be used as the basis for routing.

Table 9-1: Analysis of functions that result in an air initiated connection request

3 Discussion

3.1 In a data link server implementation, there will be only one end system from an aircraft's ATN application point of view, which is the server. The aircraft's applications will not have knowledge of applications beyond the data link server (at least not through the SARPs). One of the issues raised by the Eurocontrol paper is a perceived problem with CPDLC. Specifically, the paper says that there is no way for CPDLC to indicate to the server its intended recipient. As to why, the paper mentions that the Called Peer Identifier parameter of the CPDLC-start primitive is not indicated to the CPDLC-ground-user, nor passed to the CPDLC-ground-ASE.

3.2 This was not done for a purpose. The Called Peer Identifier parameter is not meant to be used as a user-level indication of a facility beyond an ATN end system. The real purpose of the Called Peer Identifier parameter is to provide the dialogue service with the necessary peer end system information to make a connection. This is a physical connection, not a virtual operational connection. Therefore, in the case of a data link server, the Called Peer Identifier parameter would have to be the facility designation of

the data link server (with which the physical connection is established), not the intended ground user that the aircraft wishes to ultimately perform CPDLC operational services with. In fact, putting a facility designation which does not correspond to an actual ATN end system in the Called Peer Identifier parameter will result in a connection error.

3.3 The CPDLC SARPs as currently written do provide other means to accomplish identifying an intended recipient outside of the ATN domain. One way would be to include a CPDLC message element in the CPDLC-start request that specifies the facility designation. This could be done by use of a free text message which has a tightly-controlled, agreed-to format (e.g., a four to eight character string). Upon receipt of the CPDLC-start request, the server would extract the intended facility designation from the free text. The server would then forward the CPDLC information to the specified ground system. There would be some issues that have to be dealt with. Keep in mind that the server would be the facility that actually had the physical connection to the aircraft, so the server would have to keep track of which aircraft is assigned to which facility. Also, detailed procedures would have to be developed, such as what to do if a requested facility is not available, if no facility is requested in the CPDLC-start request, etc.

3.4 Another way to accomplish identifying an intended recipient outside of the ATN domain would be to make the data link server smart enough to know where to forward the aircraft's information based on the aircraft's position or flight plan information. The data link server could then respond to the aircraft with uplink message UM 163 (which is FacilityDesignation), containing the facility designation of the controlling facility.

3.5 There are some drawbacks to the data link server approach, however. Performance issues will have to be closely examined, since characteristics like end-to-end integrity are compromised, and others (e.g. response times) may also be jeopardized. Also, new user-level procedures will need to be put in place, since there may a perfectly fine connection between an aircraft and a data link server but no operational connection between the server and the controlling facility.

4 Conclusion

4.1 The data link application server is a good concept, and will almost surely be implemented in some fashion. As the Eurocontrol paper correctly pointed out, there are many considerations that need careful study before the actual implementation of a data link application server. However, it should be noted that the ATN SARPs as currently written support the concept of data link application servers, and do not need to be modified to operate in that fashion.