

# ACARS and CPDLC

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Version 1.3.k

# Introduction

Aircraft Communication Addressing and Reporting System (ACARS) was first implemented in 1976 essentially as an automated reporting system for times spent in different phases of flight. The system accepts inputs from sensors on the wheels, doors, etc. to determine whether the flight is Out of the gate, Off the ground, On the ground, or In the gate (OOOI) and reports the data back to the airline operations.

The digital capabilities were soon expanded and the system can now be used to obtain additional information from airline operations such as weather reports at destination aerodromes, flight plans, amendments to flight plans, etc.

It can also communicate with other ground facilities including the airline maintenance department and the aircraft or engine manufacturer.

# ACARS Communication link

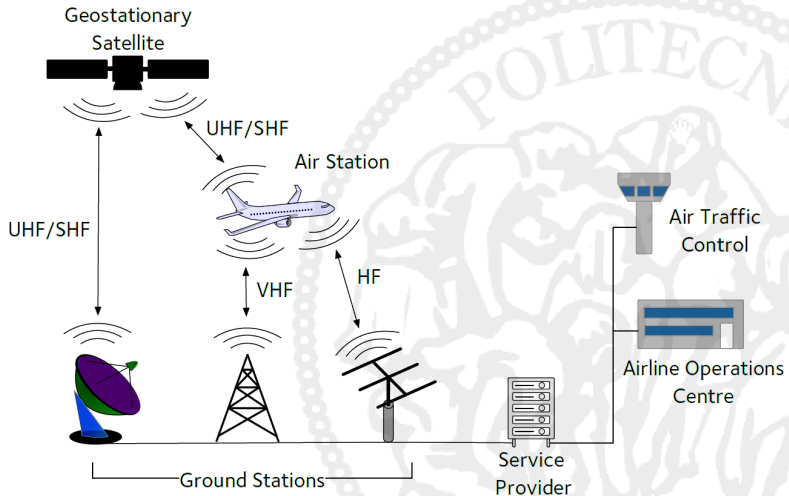
The communication is digital and uses whatever radio link is available. Typically:

- Very High Frequency (VHF) is used over populated land.
- Satellite Communications (SATCOM) extends coverage to oceanic and rural land areas.
- High Frequency (HF) provides (or tries to provide) coverage worldwide

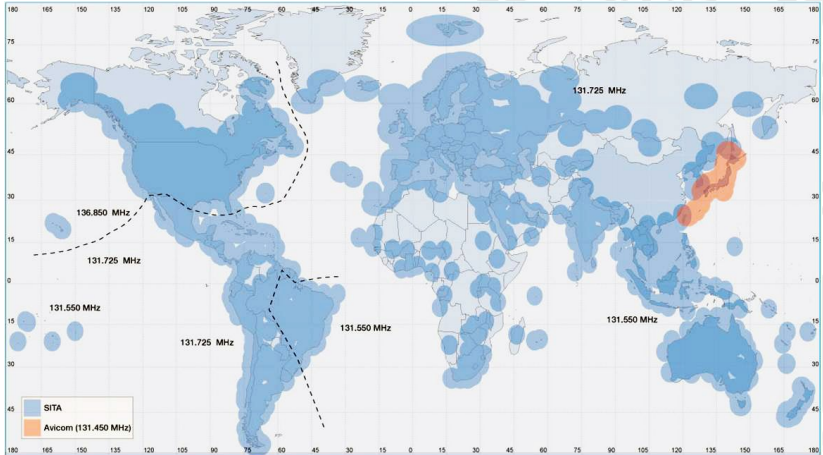
VHF is offered through a technology known as *Plain Old ACARS* and the newer *VHF Data Link mode 2* offering a higher data rate.

SATCOM provides several channel groups with different bit rates (typically, higher bit rate channels cost more to use), depending on the constellation used. Two main providers exist: *Inmarsat* and *Iridium*.

# ACARS Communication link



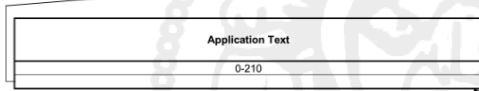
# ACARS VHF ground stations coverage



# Messages

ACARS messages are mainly composed of 210 character text field, with routing to an aircraft achieved via a flight ID (i.e. flight number).

Name	SOH	Mode	Aircraft Registration Number	T A K	Label	DBI	STX	MSN	Flight ID
Size	1	1	7	1	2	1	1	4	6
Example	<SOH>	2	.N123XX		5Z	2	<STX>	M01A	XX0000



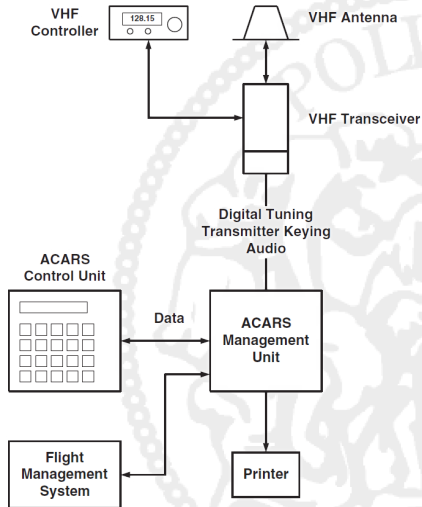
Suffix	BCS	BCS Suffix
1	2	1
<ETX>		<DEL>

Messages have a label, used by a Communications Management Unit (CMU), to send the content to the correct on-board system, and are structured according to the ARINC 620-8 standard.

# Messages examples

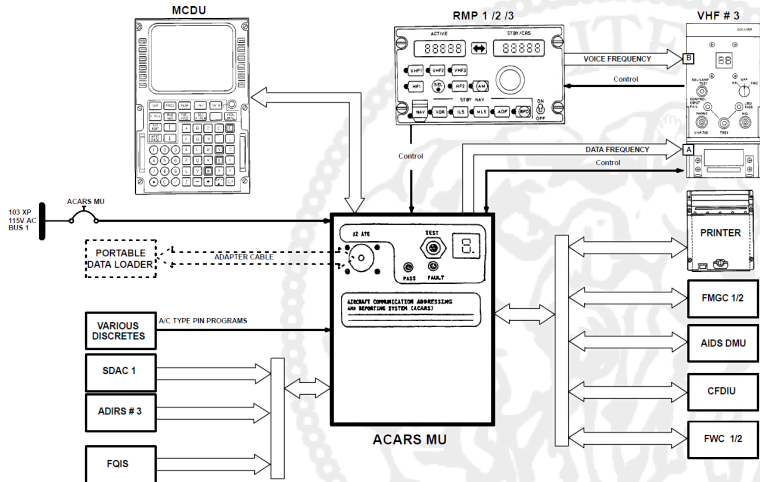
- **Information Services.** In order to handle changes en route due to weather or local restrictions which occur in-flight, ACARS can be used to retrieve up-to-date information via data link.
- **Flight Plans.** Airlines will often transfer flight plans including routes, destination and loading information to aircraft ahead of departure.
- **Positional Reports.** Although ACARS is not primarily intended for position reporting some aircraft do use it.
- **Diagnostic Feeds.** To track required maintenance on aircraft systems, some components such as engines automatically report their status to the manufacturer. This is primarily used by commercial aircraft, so we do not consider it further.
- **Free-text Messages.** Often, the staff needs to communicate outside of the constraints of structured ACARS messages, from requests for medical aid to sports scores.

# ACARS generic installation





# On board system architecture (Airbus A320 series)



The diagram illustrates the ACARS system architecture, showing the flow of data between the Ground to Air, ON to IN Status, and Air to Ground channels, and the four menu types: ACARS INFLT MENU 2/2->, ACARS PREFLT MENU 2/2->, ACARS POSTFLT MENU 2/2->, and ACARS INFLT MENU 1/2->.

**ACARS INFLT MENU 2/2->**

- CREW ROT
- <REQUEST
- CONN GATE
- <REQUEST
- PIL
- <REQUEST
- <TELEX
- <MISC

**ACARS PREFLT MENU 2/2->**

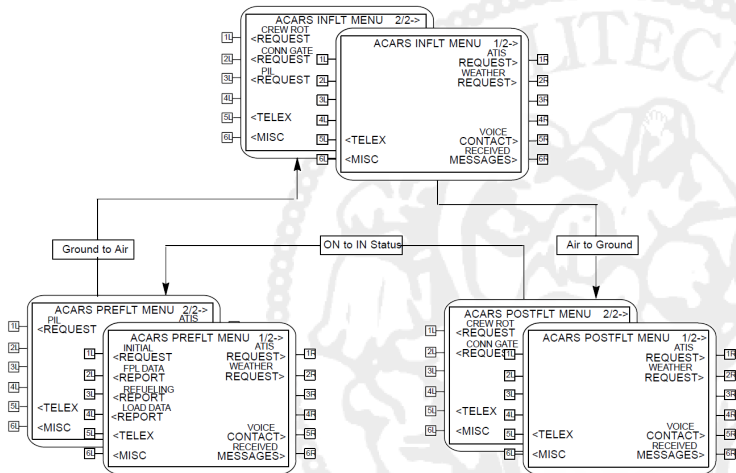
- PIL
- <REQUEST
- INITIAL
- <REQUEST
- FPL DATA
- <REPORT
- REFUELING
- <REPORT
- LOAD DATA
- <REPORT
- <TELEX
- <MISC

**ACARS POSTFLT MENU 2/2->**

- CREW ROT
- <REQUEST
- CONN GATE
- <REQUEST
- <TELEX
- <MISC

**ACARS INFLT MENU 1/2->**

- ATIS
- REQUEST
- WEATHER
- REQUEST
- VOICE
- CONTACT
- RECEIVED
- MESSAGES



# ACARS Human Machine Interface (HMI)



# Controller-Pilot Data Link Communications

ACARS also communicates with Air Traffic Control (ATC) and is used to implement a new mode of communication between pilots and ATC:

## **Controller-Pilot Data Link Communications (CPDLC).**

The CPDLC system uses a data link with ATC to pass on clearances and other instructions to pilots and for pilots to request level changes, etc.

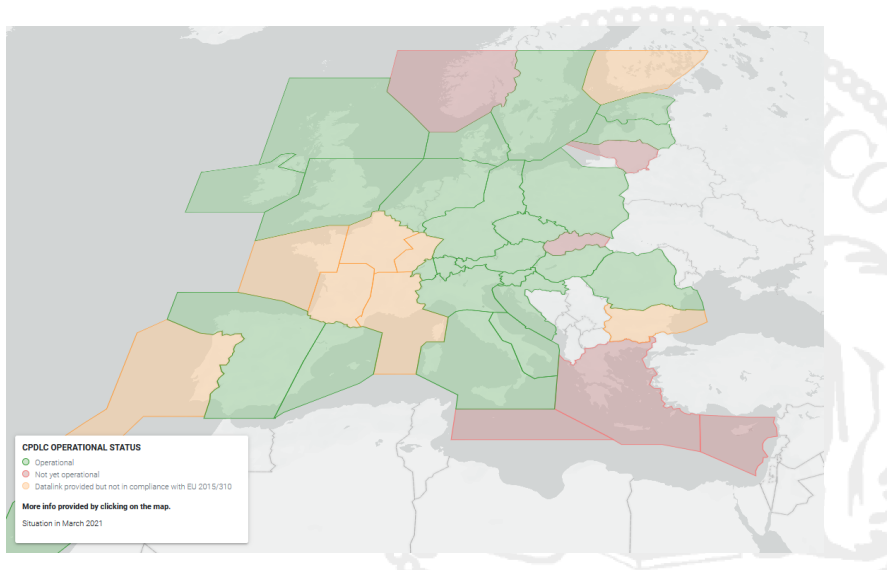
This relieves some of the stress on flight crews as they do not have to concentrate on picking out their call sign from almost continuous ATC talk and the text information that appears on the screen cannot be misheard.

ACARS controllers are also interfaced to a printer so that a hard copy of important information can be obtained

# CPDLC HMI



# CPDLC coverage under EROCONTROL



# List of Acronyms

<b>ACARS</b>	Aircraft Communication Addressing and Reporting System
<b>ATC</b>	Air Traffic Control
<b>CPDLC</b>	Controller-Pilot Data Link Communications
<b>HF</b>	High Frequency
<b>HMI</b>	Human Machine Interface
<b>OOOI</b>	Out of the gate, Off the ground, On the ground, or In the gate
<b>SATCOM</b>	Satellite Communications
<b>VHF</b>	Very High Frequency

