History of ARINC

- Incorporated in 1929
- Served as the airline industry’s single licensee and coordinator of radio communication
- Responsible for all ground-based, aeronautical radio stations and compliance with FRC rules and regulations
- Originally owned by airlines
- Revenue of $1 billion USD, with more than 3,000 employees worldwide
- Customers in over 102 countries
- Employees in 143 locations
Worldwide Products & Services

- Aerospace & Defense
- Commercial Aviation
- Airports
- Networks
- Public Safety
- Security
- Transportation

Video en Español: Aviación y Aeropuertos - Panorama Global

Mission-critical solutions for Communications, Engineering and Systems Integration
AGENDA

- GLOBALink Media and Coverage
- Applications
- Central and South American Trails and Implementation
Aircraft Communications And Reporting System

ACARS
GLOBALink/VHF Statistics: In the beginning…

- 1978: ARINC began offering ACARS Service in the USA
- Two Customers: TWA and Piedmont Airlines
- Primary Application: OOOI Messages
- Media: VHF for domestic coverage
- Data Rate: 2400 bps
What’s Needed to do Data Link?

1. Avionics

2. ARINC air/ground and ground/ground services
   - GLOBALink A/G Network
   - GLOBALink Message Processor
   - ARINC AviNet Ground Network

3. Host Processing Application
   - Host Processing
   - Value-Added Services
   - FAA/CAA Tower Systems
ACARS Airborne Architecture
Data Link Uses During Phases of Flight

- **Pre-flight to take-off**
  - Data link initialization
  - Link test / clock update
  - Flight plan
  - Weight & balance
  - Airport / runway analysis
  - Enroute weather
  - Load manifest
  - Crew information
  - PDC
  - Departure D-ATIS
  - OUT
  - Delay report
  - OFF
  - Fuel on board
  - Take-off engine data
  - Free-text messages from dispatch, maintenance, etc…

- **Enroute**
  - APU and engine operational data
  - ATC services (OCD, CPDLC, FANS)
  - Position reports
  - Arrival D-ATIS
  - Enroute weather / winds
  - Delay / ETA
  - Amended releases
  - Irregular operations messages (diversion, emergency situation)
  - Special requests, gate assignment, connecting gate info for passengers and crew
  - SELCAL
  - Free-text messages from dispatch, maintenance, etc…

- **Landing and post-flight**
  - ON
  - IN
  - Post-flight crew report
  - Post-flight engine and APU operational data
  - Fuel data
  - Free-text messages from dispatch, maintenance, etc…
ARINC Data Link Media
Truly Worldwide coverage

- VHF ACARS
- VDL Mode 2
- HF Data Link
- INMARSAT
- Iridium

- Delivering over 1.5 million messages per day
- Serving 200+ customers
ARINC HF/VHF Communications Media

- **VHF ACARS**
  - 1100 ground stations around the globe

- **VDL Mode 2**
  - 428 stations in 19 countries

- **HFDL**
  - 15 HF Ground stations using multiple frequencies
  - Double, even triple redundancy in geographic coverage, including polar regions
  - The FAA has accepted PARC CWG’s recommendations to approve FANS Over HFDL for RCP/400 Operations as defined in GOLD
ARINC Satellite Communications Media

- **Inmarsat**
  - Continuing to offer Classic Aero services over the I-3 and I-4 satellite networks
  - ARINC was named Distribution Partner (DP) by Inmarsat for SwiftBroadband service

- **Iridium**
  - 66 low-earth orbit (LEO) satellites providing global coverage
  - Iridium NEXT Service life extension to 2025 and beyond is planned
  - Currently supporting ~400 aircraft
Message Delivery in a Multi-Media Environment

[Diagram showing various communication systems and networks integrated into a seamless internetworking system, including Inmarsat, HFDL, VHF, DDLXCA, ARINC Global Network, Iridium, and ACARS Host System.]
ACARS Data Link Coverage
## GLOBALink Service Statistics

<table>
<thead>
<tr>
<th>Category</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Messages per Month:</td>
<td>47 Million</td>
</tr>
<tr>
<td></td>
<td>&gt;1 Billion VHF Kbits in 2011</td>
</tr>
<tr>
<td>Monthly Aircraft</td>
<td>17,000+ globally</td>
</tr>
<tr>
<td>Classic VHF Stations</td>
<td>1,100+ stations</td>
</tr>
<tr>
<td>VDL Mode2 Stations</td>
<td>400+ stations</td>
</tr>
<tr>
<td>2012 YTD Uplink Message Success:</td>
<td>98.9% (POA) / 99.0 (AOA)</td>
</tr>
<tr>
<td>VDL Block End-to-End Transit (Ave):</td>
<td>1.9 seconds</td>
</tr>
<tr>
<td>Major Growth Areas:</td>
<td>Latin America; South Pacific; India, Malaysia;</td>
</tr>
<tr>
<td></td>
<td>Eastern-Europe/Middle-East</td>
</tr>
<tr>
<td></td>
<td>162 Stations in South/Central America</td>
</tr>
<tr>
<td></td>
<td>Adding 40+ VDL RGSs in Europe in 2012</td>
</tr>
</tbody>
</table>
GLOBALink/VHF Coverage Map – North/Central America
GLOBALink/VHF Coverage Map – Caribbean
GLOBALink VHF Coverage
Iridium Coverage

Iridium complements HFDL in GLOBALink coverage
HFDL General Overview

- ARINC launched the world’s only High Frequency Data Link (HFDL) system in 1998
- 73 worldwide customers
- Over 1600 equipped aircraft with 3.6 million transmissions per month
  - 2011 traffic up 22.92% over 2010
Long-range, beyond the line-of-sight communications take place in the HF radio spectrum from 2-30 MHz
- Over 167 frequencies used by the HFDL system worldwide
- Over 31 different frequencies operating at any one time

- Air-ground message transmission speed varies depending on radio wave propagation conditions
  - 300, 600, 1200, 1800 bps
Architecture

Ground End Systems
- Airline host processing
- DSP services
- CAA systems
- Tower systems

ARINC Global Network

VHF (POA)
VDL
SATCOM

ARINC’s Central Processing System (CPS)

HFDL Ground Station (HGS)

Then serve pretzels.

We ran out of peanuts!
Airborne Architecture

- ACARS
- MU/CMU/ATSU
- HF Data Radio (x2)
- HF Coupler (x2)
- Multi-functional Cockpit Display Unit
- Flight Management System
HFDL Ground Stations

- San Francisco, CA, U.S.A (H01)
- Molokai, HI, U.S.A. (H02)
- Reykjavik, Iceland (H03)
- Riverhead, NY, U.S.A. (H04)
- Auckland, New Zealand (H05)
- Hat Yai, Thailand (H06)
- Shannon, Ireland (H07)
- Johannesburg, South Africa (H08)
- Barrow, AK, U.S.A. (H09)
- Panama City, Panama (H11)
- Santa Cruz, Bolivia (H13)
- Krasnoyarsk, Russia (H14)
- Al Muharraq, Bahrain (H15)
- Yona, Guam (H16)
- Telde, Canary Islands (H17)
Worldwide Coverage

HF Ground Stations
- Alaska
- Bahrain
- Bolivia
- California
- Canary Islands
- Guam
- Hawaii
- Iceland
- Ireland
- New York
- New Zealand
- Panama
- Russia
- South Africa
- Thailand

Legend
- HFDL ground station

Areas of Primary coverage
Areas of Secondary coverage
First United Polar Flight
Flight UA895 (N107UA) Chicago-Hong Kong =
Jan 20, 1999
VDL Mode 2 - AOA/ATN
Comparing VHF ACARS and VDL Mode 2 AOA

<table>
<thead>
<tr>
<th></th>
<th>ACARS</th>
<th>AOA</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Standards</strong></td>
<td>AEEC standard</td>
<td>ICAO standard</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AEEC derivative</td>
</tr>
<tr>
<td><strong>Bit or Character</strong></td>
<td>Character</td>
<td>Bit</td>
</tr>
<tr>
<td><strong>Data Rate over RF</strong></td>
<td>2.4 kbps</td>
<td>31.5 kbps</td>
</tr>
<tr>
<td><strong>Frequencies for equivalent RF capacity</strong></td>
<td>8-10</td>
<td>1</td>
</tr>
<tr>
<td><strong>Avionics</strong></td>
<td>ARINC 716/724</td>
<td>ARINC 750/758</td>
</tr>
<tr>
<td><strong>Host ACARS</strong></td>
<td>ACARS</td>
<td></td>
</tr>
<tr>
<td><strong>Messages</strong></td>
<td>ARINC 618/620</td>
<td>ARINC 618/620</td>
</tr>
<tr>
<td><strong>Availability</strong></td>
<td>Now</td>
<td>Now</td>
</tr>
</tbody>
</table>
# Comparing VHF ACARS and VDL Mode 2 AOA

<table>
<thead>
<tr>
<th></th>
<th>AOA</th>
<th>ATN</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Standards</strong></td>
<td>AEEC standard</td>
<td>ICAO standard</td>
</tr>
<tr>
<td></td>
<td>ICAO standard</td>
<td></td>
</tr>
<tr>
<td><strong>Designed for CPDLC</strong></td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Data Rate over RF</strong></td>
<td>31.5 kbps</td>
<td>31.5 kbps</td>
</tr>
<tr>
<td><strong>Host ACARS</strong></td>
<td>ATN for bit</td>
<td>Applications</td>
</tr>
<tr>
<td><strong>Messages</strong></td>
<td>ARINC 618/620</td>
<td>ATN &amp; ARINC 618/620</td>
</tr>
<tr>
<td><strong>Availability</strong></td>
<td>Now</td>
<td>Now</td>
</tr>
</tbody>
</table>
GLOBALink/VHF VDLM2/AOA Message Traffic

- Number of Aircraft
- Number of Messages
- UPLINKS
- DOWNLINKS
- NUMBER OF AIRCRAFT
Ratio of POA and AOA Message Traffic

![Bar chart showing the ratio of POA and AOA message traffic over time. The x-axis represents different months from January 2008 to August 2011, and the y-axis represents total traffic from 0 to 50,000,000 messages. The chart includes bars for POA and AOA, with POA in blue and AOA in red. The traffic peaks in certain months, particularly in the later years.]
VDL Mode 2 Deployment in Asia:
VDL Mode 2 Deployment in South Pacific:
VDL Mode 2 AOA/ATN Coverage in Europe
GLOBALink ATS Services
CNS/ATM Functions

- AFN – ATS Facility Notification
- CPDLC – Controller Pilot Data Link Communications
- ADS-C – Automatic Dependent Surveillance – Contract
- CADS/CFRS – Data link position reporting in the North Atlantic
- PDC – Pre-Departure Clearance in U.S. and Canada
- DCL – ARINC 623 Departure Clearance, Worldwide
- D-ATIS – Digital Automatic Terminal Information Service
ARINC FANS Connections

- FANS Messaging
  - ATS Facility Notifications
  - CPDLC
  - ADS-C
  - (Departure Clearance)

- Currently Connected through ARINC
  - FAA Oakland
  - NavCanada
  - New Zealand
  - UKNATS
  - Magadan (Russia)
  - Trinidad & Tobago (pending)

- Requires AGN connection and routing to ARINC ATC Gateway
CNS/ATM Functions with non-FANS ATC Centers - CADS

- Centralized ADS – CADS

- Is a service provided by the Data Link service Provides
  - CADS translates FANS/ADS POS and MET for CAA’s non equipped with CNS/ATM capable system
  - Message is converted to free text and send it via AFTN
  - Message applications
    - ATS facilities notification (AFN)
    - Automatic dependent surveillance (ADS)
    - Meteorological messages
  - Same information can be provided to airlines flight operations centers
CNS/ATM Functions with non FANS aircrafts - CFRS

- Centralized Flight Management Computer (FMC) Waypoint Reporting Service (CFRS)
  - Allows non-FANS-equipped aircraft to send position reports in a manner similar to CADS
  - Position Reports from aircraft that have FMC WPR (Flight Management Computer Way Point Reporting) capability
  - Honeywell PIP (Product Improvement Package) or Pegasus avionics required
    - Boeing 757-200, Boeing 767-300, Airbus 310, Airbus 319
Departure Clearance (DCL)

- Request for Departure Clearance over data link
- Departure Clearance service enables the flight crew to communicate directly with the airport tower via data link to obtain clearances
- DCL replace the voice communications between pilots and controllers, thereby reducing the number of voice messages sent over congested VHF frequencies
- The main benefits are fewer ATC delays at busy airports, a safety improvement from having fewer communication errors between pilot and controller, and a reduced controller workload
D-ATIS: Digital Automatic Terminal Information System

- Contains weather observation, runway information, Notices to Airmen (NOTAMs), and airport advisories
- Request/Response
- 620 Format – Bit oriented messages, user defined labels
- 623 Format – Character Oriented ATS Messages – B9 label
- Updated by CAA approximately every hour (sometimes we poll for data)
- Expire after 80 minutes in U.S. (can vary by country)

TWIP – Terminal Weather Information for Pilots
- Now known as Integrated Terminal Weather System
- Provided by Doppler Weather Radar in Terminal Area
- Wind Shear, Microburst, Gust Fronts, Tornado, Moderate to Heavy Precipitation
D-ATIS Message Flow

ATS Server

Library of about 150 stations – U.S., Canada, Australia, Germany, Thailand, China, Mexico
Can handle both 620 and 623 requests
Also contains TWIP (U.S. only)

GLOBALink Message Processor

SITA

Mexico City

StarCaster

623 to airport

GLOBALink

623 to airport
ARINC DCL and D-ATIS Messaging
Caribbean, Central and South America

### Departure Clearance
- Colombia
  - Bogota (BOG)
- Mexico
  - Mexico City (MEX)
- Panama
  - Panama City (PTY)

### D-ATIS
- Argentina
  - Buenos Aires (EZE)
  - Cordoba (COR)
- Aruba
  - Aruba (AUA)
- Mexico
  - Mexico City (MEX)
GLOBALink FAA/Airline Operation Center Communications

- Air/Ground International HF Voice Service
- New York and San Francisco Long-Distance Operational Control Facilities
- Atlantic, Caribbean, Central and South America, Pacific Oceanic Canadian and Arctic Region, Gulf of Mexico
- Airline Operations Centers messaging
GLOBALink FAA/AOC HF/VHF Voice Coverage (NYC/SFO)
Technical Support Services

- FANS and ATN Test Support
  - Customer Support for OEMs conducting rollout testing on avionics
  - Can mimic ATS facility for pre-flight or in-flight verification of FANS equipment, SATCOM links, etc.
Our ANSP Partnerships
First ADS/CPDLC - Latin America FANS Trials in Cooperation with CORPAC and United Airlines

MIA - SCL
First ADS/CPDLC - Latin America FANS Trials in Cooperation with CORPAC and United Airlines
MIA - EZE

Flight UA984 (N785UA) Jun 19, 1998

Flight UA984 (N785UA) Jun 19, 1998

00:18:61 - FREETEX [AT THIS ALT...5000 FT]
00:18:69 - FREETEX [SO WHATS YOUR ALT AROUND THE GROUND WHILE FLYING OVER THE ANDES -- TEST]
00:19:58 - FREETEX [COCOACOCHOCO]
00:19:57 - FREETEX [MY UNOFFICIAL 4 LETTER NAME FOR LIMA]
00:23:19 - FREETEX WHERE IS MIXED MODE REPORT PASSING [LIMA]
00:24:20 - FREETEX [HELPFUL NICE CARDS NOT HARD TO GET, ALL NICE CARDS MUST BE CHECKED]
00:25:16 - FREETEX [I AM NOW CONNECTED TO FLIGHT UA986 AS WELL -- PHIL BRUM -- TEST]
00:25:22 - FREETEX [CAN TALK ACTUALLY I HAVE BEEN TOLD TO CUT THE TEST SHORT --]
00:25:30 - FREETEX [I AM NOT ABLE TO TALK TO ANYONE CLASS 2]
00:25:36 - FREETEX [HELPFUL NICE CARDS NOT HARD TO GET, ALL NICE CARDS MUST BE CHECKED]
00:25:45 - FREETEX [THANKS FOR SENDING SEVERAL MESSAGES TOGETHER BUT NOT NOW -- TEST]
00:28:03 - FREETEX [REQUEST DEFERRAL]
00:28:17 - FREETEX [REQUEST DEFERRAL]
00:30:14 - FREETEX [WHAT IS THE SYSTEM IS WORKING -- TEST]
00:30:47 - FREETEX [WHAT IS THE SYSTEM IS WORKING -- TEST]
00:31:10 - FREETEX [WHAT IS THE SYSTEM IS WORKING -- TEST]
00:32:45 - FREETEX [WHAT IS THE SYSTEM IS WORKING -- TEST]
00:34:45 - FREETEX [WHAT IS THE SYSTEM IS WORKING -- TEST]
00:36:20 - FREETEX [WHAT IS THE SYSTEM IS WORKING -- TEST]
00:38:00 - FREETEX [WHAT IS THE SYSTEM IS WORKING -- TEST]
00:39:40 - FREETEX [WHAT IS THE SYSTEM IS WORKING -- TEST]
00:41:20 - FREETEX [WHAT IS THE SYSTEM IS WORKING -- TEST]
00:43:00 - FREETEX [WHAT IS THE SYSTEM IS WORKING -- TEST]
00:45:40 - FREETEX [WHAT IS THE SYSTEM IS WORKING -- TEST]
00:47:20 - FREETEX [WHAT IS THE SYSTEM IS WORKING -- TEST]
00:49:00 - FREETEX [WHAT IS THE SYSTEM IS WORKING -- TEST]
00:50:40 - FREETEX [WHAT IS THE SYSTEM IS WORKING -- TEST]
00:52:20 - FREETEX [WHAT IS THE SYSTEM IS WORKING -- TEST]
00:54:00 - FREETEX [WHAT IS THE SYSTEM IS WORKING -- TEST]
00:55:40 - FREETEX [WHAT IS THE SYSTEM IS WORKING -- TEST]
00:57:20 - FREETEX [WHAT IS THE SYSTEM IS WORKING -- TEST]
00:59:00 - FREETEX [WHAT IS THE SYSTEM IS WORKING -- TEST]
01:00:40 - FREETEX [WHAT IS THE SYSTEM IS WORKING -- TEST]
01:02:20 - FREETEX [WHAT IS THE SYSTEM IS WORKING -- TEST]
01:04:00 - FREETEX [WHAT IS THE SYSTEM IS WORKING -- TEST]
01:05:40 - FREETEX [WHAT IS THE SYSTEM IS WORKING -- TEST]
01:07:20 - FREETEX [WHAT IS THE SYSTEM IS WORKING -- TEST]
01:09:00 - FREETEX [WHAT IS THE SYSTEM IS WORKING -- TEST]
01:10:40 - FREETEX [WHAT IS THE SYSTEM IS WORKING -- TEST]
01:12:20 - FREETEX [WHAT IS THE SYSTEM IS WORKING -- TEST]
01:14:00 - FREETEX [WHAT IS THE SYSTEM IS WORKING -- TEST]
01:15:40 - FREETEX [WHAT IS THE SYSTEM IS WORKING -- TEST]
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01:59:00 - FREETEX [WHAT IS THE SYSTEM IS WORKING -- TEST]
ARINC and ATN: Review and Work-in-Progress

- ARINC’s European ATN/VDL Mode 2 network:
  - In operation since 2004; proven: 99.99% service availability
  - *Most European ATN flights handled by ARINC’s ATN network*

- ARINC ATN service contract with Maastricht since 2004

- ARINC/ENAV partnership agreement covering POA, AOA and ATN services

- ARINC partnership agreements for POA with NavPortugal, AENA, Skyguide, DFS and AustroControl.

- Meetings with ANSPs to extend the POA partnerships and include ATN-VDL Mode 2

- Supporting avionics ATN certification activities with Boeing, Airbus, Rockwell Collins, Honeywell, Garmin, Spectralux, Dassault, Bombardier, Embraer, Cesna…

- Eurocontrol awarded ARINC the VDL Multi-frequency test bed to be deployed in Bretigny
Next Country to Implement ATN: Italy

- ENAV and ARINC are deploying 15+ VHF/VDL stations in Italy
- SELEX and ARINC have designed a brand new integrated Ground Stations
- ARINC A/G and G/G ATN routers already installed
- CIA is the first ENAV station operational from now
- D-ATIS and DCL services over ACARS will also be implemented
Asia / Pacific Region

- ARINC continues its partnership with Aeronautical Radio of Thailand (AEROTHAI) and Aviation Data Communications Corporation (ADCC) to provide VHF ACARS in the Asia / Pacific region

- ADCC provides coverage within mainland China
  - VDLM2/AOA Stations now operational in Hong Kong and Beijing

- AEROTHAI provides coverage throughout most of Asia / Pacific region
  - VDLM2 AOA operational in Bangkok & Singapore
  - Continued ACARS deployments in Australia, New Zealand, Malaysia, & India

- AVICOM provides coverage within Japan
  - Long standing internetworking arrangement with ARINC
  - ARINC provided AVICOM with a replacement ACARS network
  - Deployment completed in 3rd QTR 2011 – System performance excellent.

- ADCC, AEROTHAI, ARINC, and AVICOM Operate Separate CPS systems
Fueling the Future

- Embarking on our next 80 years, with a commitment to…
  - Exceed our customers’ expectations
  - Continue to innovate
  - Retain our leadership in communications