Integrating NextGen Capabilities
Program Overview

- Provides data communications services between pilots and air traffic controllers, supplementing existing voice communications capabilities.
- Provides a data link between ground automation systems and flight deck avionics for air traffic control (ATC) clearances, instructions, traffic flow management, and flight crew requests.
- Controllers will be able to deliver instructions with a push of a button and without the need to utilize voice frequencies.
- Enables the transmission of complex instructions to be quickly and correctly loaded into an aircraft’s flight management system, upon acceptance by the pilot.
- Enables NextGen Initiatives and Trajectory-Based Operations.
Global Data Link Deployments

Air Traffic Services (ATS) Data Link Map

Flight Information Region (FIR) boundaries are provided by ICAO. Nominal ATS data link service availability is depicted to the best of Boeing’s knowledge. Service is not necessarily available throughout an indicated FIR.
Program Background

- Air-ground digital communications has been an objective since 1960s
- Initial Mission Need Statement for Data Comm approved in 1991
- Controller Pilot Data Link Communications (CPDLC) Program – 1998-2004
  - Miami ARTCC deployment 2002-2003
  - Program terminated in October 2004/FFP2
- Restructured program
  - IARD 2006
  - IID 2008
- Segment 1 Phase 1 (S1P1) FID in 2012
  - Departure Clearance (DCL) Service in Tower domain
  - Delivers infrastructure to include air-ground network service (ERAM, TDLS, DCNS, FTI, Avionics)
  - Infrastructure provides foundation for S1P2 services
  - Completed all three Keysite IOCs and In-Service Decision (ISD)
- Segment 1 Phase 2 (S1P2) Initial En Route Services FID in 2014
  - Split the FIDs for Initial and Full En-route services due to budget constraints
  - Started software development for Initial services
Data Comm Benefits

- Reduce communication time between controllers & pilots
- Improve re-routing around weather and congestion
- Increase flexibility and accommodation of user requests
- Enable NextGen Initiatives & Trajectory-Based Operations

**Throughput/Efficiency**
- Delay
- Fuel Burn

**Controller Pilot/Efficiency**
- Communication Time
- Controller Workload

**Environmental**
- Emissions (CO₂)

**Safety**
- Read/hear back errors
- Loss of Comm events
Evolution of Services

• **Strategy is to deploy services incrementally**
  – Implements basic services at airport towers initially
  – Leverages existing equipage
  – Delivers ground system infrastructure for future services (i.e., En Route) with initial deployment

• **Program Phases**
  – Segment 1 Phase 1 (S1P1): Baselined May 2012
    • Initial Controller Pilot Data Link Communications (CPDLC) Departure Clearance (DCL) Tower Services (Baseline Waterfall 2016-2019, Challenge Waterfall 2015-2016)
  – Segment 1 Phase 2 (S1P2):
    • Initial En Route services - Baselined October 2014 (Baseline Waterfall 2019-2021)
    • Full En Route services - To be baselined in 2016 (subject to budget availability)
  – Segment 2 (S2)
    • Adds advanced trajectory services – still in concept development and Agency strategic planning

• **Program is aligned with industry expectations**
  – One of the four high priority NextGen/NAC focus capabilities (NIWG)
    • Report delivered to Congress in October 2014
    • Re-validated as a top four priority during Rolling Plan Update discussions - January 2016
  – NAC recommendation: Tower Service “DCL via Data Comm” (Tier 2) and En Route Service “CPDLC/Weather Reroutes” (Tier 1B) – September 2013
  – Included in RTCA Task Force 5 Operational Improvements – September 2009
Program Services Roadmap

Segment 1 Phase 1 - Tower Service

- Initial En Route Services
  - Transfer of Communications
  - Initial Check-In
  - Altimeter Settings
  - Altitudes
  - Speeds (Limited)
  - Crossing Restrictions (Limited)
  - Airborne Reroutes / Go Button
  - Controller Initiated Reroutes (Limited)
  - Direct-to-Fix (Limited)

Segment 1 Phase 2 - En Route Services

- Baseline May 2012
  - Baseline October 2014
  - To be Baseline FY2016

Full En Route Services

- IOC
- IOC
- IOC

Avionics

- FANS 1/A over VDL-2 transitioning to ATN

Ground System

- Future Air Navigation System (FANS)
- Aeronautical Telecommunications Network (ATN)

Segment 2 - Advanced Services

- 4D Trajectories
- Dynamic RNP
- Adv Flt Int Mgt with ATC winds
- D-TAXI
Data Comm Enterprise Components

• **En Route Automation Modernization (ERAM)**
  – Software enhancements to provide Data Comm functionality

• **Tower Data Link System (TDLS)**
  – Software enhancements to provide Data Comm functionality

• **FAA Telecommunications Infrastructure (FTI)**
  – Circuits to provide connectivity between interfacing NAS systems over a private IP network
  – Provides NAS Enterprise Security Gateway (NESG) as a secure interface access point for data exchange between systems inside and outside the NAS

• **Data Comm Network Service (DCNS)**
  – Air/ground network to provide connectivity between the ground system and the aircraft
  – Leverages existing networks of Communication Service Providers (CSP) - ARINC and SITA

• **Avionics**
  – Aircraft equipped with Future Air Navigation System (FANS) 1/A avionics and VHF Data Link (VDL) radios
System-of-Systems Architecture

Air Carrier Operations

FAA Ground Automation

Network Services
Data Comm CPDLC Message Data Flow

- Flight data update
- Logon/session status
- Logon request/response
- CPDLC Session message/response
- Dispatch Copy

ERAM

National ERAM

Parent ERAM

DCNS

AOC

FANS Equipped A/C

TDLS
# S1P1 Tower Service

## Acquisition Program Baseline (APB) Milestones

<table>
<thead>
<tr>
<th>Acquisition Program Baseline (APB) Milestones</th>
<th>APB Date</th>
<th>Actual Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓ ERAM Preliminary Design Review (PDR)</td>
<td>September 2011</td>
<td>September 2011</td>
</tr>
<tr>
<td>✓ FID: Final Investment Decision for ERAM &amp; TDLS</td>
<td>May 2012</td>
<td>May 2012</td>
</tr>
<tr>
<td>✓ DCIS Contract Award</td>
<td>July 2012</td>
<td>September 2012</td>
</tr>
<tr>
<td>✓ TDLS Preliminary Design Review (PDR)</td>
<td>December 2012</td>
<td>October 2012</td>
</tr>
<tr>
<td>✓ TDLS Critical Design Review (CDR)</td>
<td>August 2013</td>
<td>July 2013</td>
</tr>
<tr>
<td>✓ ERAM Initial Test Release (ITR)</td>
<td>June 2014</td>
<td>April 2014</td>
</tr>
<tr>
<td>✓ Operational Test (OT&amp;E)</td>
<td>November 2015</td>
<td>March 2015</td>
</tr>
<tr>
<td>✓ First-Site Initial Operational Capability (IOC)</td>
<td>March 2016</td>
<td>August 2015</td>
</tr>
<tr>
<td>✓ In-Service Decision (ISD)</td>
<td>December 2016</td>
<td>December 2015</td>
</tr>
<tr>
<td>✓ Operational Readiness Decisions (ORD)</td>
<td>April 2017</td>
<td>September 2015</td>
</tr>
<tr>
<td>Last-Site IOC</td>
<td>May 2019</td>
<td></td>
</tr>
</tbody>
</table>

**Key:**
- Complete
- On Track
- May Be Missed
- Missed
S1P1 Tower Service - Operational Readiness

- Completed Independent Operational Assessment (IOA) and received In-Service Decision (ISD) in 2015

- Achieved Initial Operating Capability (IOC) at all three Key Sites and have started the waterfall
  - Salt Lake City (SLC), key site – August 7, 2015
  - Houston Intercontinental (IAH), key site – September 3, 2015
  - Houston Hobby (HOU), key site – September 10, 2015
  - New Orleans (MSY), first site in the waterfall – January 21, 2016
  - Austin (AUS) – February 4, 2016
  - Louisville (SDF) – February 10, 2016
  - Newark (EWR) – February 12, 2016
  - San Antonio (SAT) – February 19, 2016
  - Kennedy (JFK) – February 25, 2016
  - Indianapolis (IND) – March 7, 2016
  - Los Angeles (LAX) – March 10, 2016
  - Sites have been on continuous operations since their IOCs

- Continuing coordination with industry and field sites to support waterfall activities
  - Conducting Air Traffic and Tech Ops training
  - Operators conducting flight crew training
# S1P1 Tower Service Implementation Challenge Waterfall

## TDLS Sites Color Key

<table>
<thead>
<tr>
<th>Key Sites</th>
<th>Planned CPDLC DCL Site</th>
<th>Site Operational</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Planned CPDLC DCL Site</strong></td>
<td><strong>Site Operational</strong></td>
</tr>
<tr>
<td></td>
<td>Waterfall reflects challenge schedule dates (calendar year)</td>
<td>Baseline schedule Tower deployment dates dates are 2016-2019</td>
</tr>
</tbody>
</table>
The Data Comm Stakeholder Cloud

Airspace Users
- American Airlines
- Delta Air Lines
- Alaska Airlines
- Southwest
- JetBlue
- United
- FedEx
- UPS
- U.S. Air Force
- Army Aviation

Unions
- APA
- alpa
- NATCA
- SEIU
- Airlines for America
- GAO
- United States Department of Transportation

Trade Associations
- IATA
- NBAA
- AEEC
- RTCA
- EUROCAE
- EASA
- NATS
- SESAR
- EUROCONTROL
- BAE Systems
- Boeing
- Gulfstream
- Airbus
- Embraer
- Boeing
- Honeywell
- Thales
- Rockwell Collins
- SITA
- Harris
- Lockheed Martin
- AirTel
- ATN
- Altys Technologies

Standards Groups
- Aeronautical Radio
- ARINC
- RTCA
- NATO
- ICAO
- ITU

Global ANSPs
- NAV CANADA
- NATS
- EUROCONTROL
- BOMBARDIER
- Gulfstream
- AIRBUS
- Embraer

Aircraft OEMs
- Boeing
- Airbus
- Embraer

Avionics Suppliers
- Honeywell
- Thales
- Rockwell Collins
- SITA
- Harris

Ground System Providers
- AirTel
- ATN
- Altys Technologies

Federal Aviation Administration
S1P1 Tower Service – Operator Coordination

- FedEx, UPS, United, Southwest, Delta, American, USAF, British Airways, Air New Zealand, Cargolux, Emirates, Air India, SAS, Etihad, and Austrian Airlines all conducting operations with Data Comm
  - Additional domestic and international operators will participate as Data Comm services are activated at more airports

- Coordinating with air carriers to support the waterfall
  - Scheduling aircraft to support waterfall deployment
  - Aircrew training
  - Interface testing with Airline Operation Centers (AOC) dispatch automation systems
S1P1 Tower Service - Ground Automation and Network Services

• Completed En Route Automation Modernization (ERAM) hardware installation and integration at parent Air Route ARTCCs (ZLC, ZTL, ZHU, ZID, and ZNY) to support the waterfall
  – Completed NAP to NAP Integration of National ARTCCs (ZLC/ZTL) – September 2015
  – Additional releases planned as necessary to support PTR fixes throughout implementation

• Completed Tower Data Link Services (TDLS) software modifications to support the implementation waterfall
  – Additional releases planned as necessary to support PTR fixes throughout implementation

• Data Comm Network Service (DCNS) providing air-ground VHF Data Link Mode 2 (VDL-2) communications
  – Service volumes being ordered at airports ‘just-in-time’ as program progresses through the waterfall

• FAA Telecommunications Infrastructure (FTI) will be used to provide ground-ground communications
  – All required services have been ordered and cutover
Data Comm Equipage

• 1,494 Data Comm equipped aircraft operating in the NAS as of February 25, 2016
  ○ Includes FANS/VDL-2, FANS/POA, business jets, and international aircraft

• 674 aircraft have been equipped through the Data Comm equipage initiative
# Data Comm Operational Metrics

<table>
<thead>
<tr>
<th>Operational Metrics</th>
<th>Industry</th>
<th>FAA</th>
<th>Metric Measured</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enhanced safety by reduced communication errors</td>
<td>Industry</td>
<td>FAA</td>
<td>Probable Reduction in Pilot Readback Error</td>
</tr>
<tr>
<td>Reduced communication time between controllers and pilots which increases controller productivity</td>
<td>FAA</td>
<td>Pilot/Controller Efficiency</td>
<td>Minutes of Comm Time Saved</td>
</tr>
<tr>
<td>Increased airspace capacity and efficiency</td>
<td>FAA</td>
<td>Flight Throughput</td>
<td>Max Departures per 15 Min Periods during Revision Events</td>
</tr>
</tbody>
</table>
| Reduced delays, fuel burn, and carbon emissions | FAA | Flight Efficiency and Environment | **Flight Efficiency**  
Average Arrival Delay,  
Delayed Arrival Aircraft,  
Average Gate Departure Delay,  
Gate Departure Delayed Aircraft,  
Average Taxi-Out Delay, and  
Taxi-Out Delayed Aircraft  
**Environment**  
Calculated CO₂ Emissions from Estimated Taxi Fuel Burn by Aircraft Type |
| Improved re-routing around weather and congestion | FAA | Flight Efficiency | Qualitative Analysis with Controllers and Operators |
| Increased flexibility and accommodation of user requests | FAA | Pilot/Controller Efficiency | Qualitative Analysis with Controllers and Operators |
# Data Comm Operational Metrics

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<th>FAA</th>
<th>Metric Measured</th>
</tr>
</thead>
<tbody>
<tr>
<td>DataComm Usage - This category of metric tracks whether the system is being used operationally and therefore whether the system and procedures are operationally suitable and performing as designed.</td>
<td></td>
<td>System Utilization</td>
<td>Eligible Flights, Participating Flights, Flights w/ Successful Logons, Flights w/ Successful Session Establishments, Flights w/ Initial Clearance Requests, Flights w/ Initial Clearance Received, Percent of Flights Using CPDLC DCL, Flights w/ Revised Route Clearance Received, Percent of Total Flights Receiving Revised CPDLC DCL, Percent of Revised Flights Receiving Revised CPDLC DCL, Percent of Revisions Delivered Using CPDLC DCL, Flights w/ Revised EDCT Clearance Received, Flights w/ Revised Altitude Clearance Received, Flights w/ Revised Expected Altitude Clearance Received, Flights w/ Revised Departure Frequency Received, Flights w/ Revised Departure Contact, Flights w/ Revised Departure Local Info, Flights w/ Revised Squawk Code, Flights w/ Revised Departure Procedure</td>
</tr>
<tr>
<td>Minutes of Comm Time Saved - This category of metric tracks how many controller/pilot communications minutes have been saved by the implemented DataComm functions. The metric is broadly covered by comparing known voice communication times with the communication times observed during DataComm exchanges.</td>
<td></td>
<td>Pilot/Controller Efficiency</td>
<td>Minutes of Comm Time Saved</td>
</tr>
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</table>
## Data Comm Operational Metrics

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</thead>
<tbody>
<tr>
<td>Airspace Throughput</td>
<td>- This category of metric tracks the impact on peak departure rates, by airport, for both routine operations and weather or other disruption events.</td>
<td>Flight Throughput</td>
<td>Max Departures per 15 Min Periods during Revision Events</td>
</tr>
<tr>
<td>Ground Delays - This category of metric tracks the impact on taxi time changes, on taxi-time variability, and airport recovery which translates into schedule predictability for aircraft operators.</td>
<td></td>
<td>Taxi Time Savings and Time to Zero Delay</td>
<td></td>
</tr>
<tr>
<td>Efficiency - This category of metric tracks the impact on taxi-time, gate delay and number of cancelled flights.</td>
<td>Flight Efficiency</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fuel Burn - This category of metric tracks the impact on the amount of fuel burned during ground operations and during the departure phase of flight.</td>
<td></td>
<td>Taxi Fuel Burn</td>
<td></td>
</tr>
<tr>
<td>Implementation - Industry will jointly track with the FAA the operational milestones published by the program.</td>
<td>Program Status</td>
<td>Airport and Aircraft Equipage</td>
<td></td>
</tr>
</tbody>
</table>
S1P2 Initial En Route Services - Status

• Developed En Route Initial Services execution strategy
  – Initial Services use cases complete and coordinated with NATCA
    ➢ Initial Services Computer Human Interface (CHI) approved by CHI User Team and ERAM National User Team
  – Initial Services deployment strategy briefed to external stakeholders
    ➢ Validated strategy with industry through the joint FAA-industry Data Comm Implementation Team (DCIT) and the NextGen Implementation Working Group (NIWG)
    ➢ Working planning details with industry through DCIT

• Started development of ERAM software enhancements to support Data Comm Initial En Route Services
  – Completed prototype code in November 2014
  – Completed S1P2 En Route Services CHI Demo with En Route Controllers from multiple facilities
  – Initial En Route services on track to be delivered starting in CY2019
Program Challenges

- The commitments to the NAC for deployment of Tower services reflect program challenge dates and not program baseline dates
  - Challenge dates assume more risk in the coordination and field implementation of Controller Pilot Data Link Communications (CPDLC) service to the towers

- Training
  - Development and acceptance of training materials
  - Timing of training to support initial operations at a site
  - Operator flight crew training to support waterfall

- Operator commitment /coordination and support of the Tower Services waterfall
  - Equipped aircraft and operations to support Data Comm services
  - Support to FAA site testing and air-to-ground interoperability

- Coordination of the delivery and integration of the component subsystems
  - ERAM/TDLS/DCNS/FTI

- Site coordination
  - Coordinating across multiple facilities and operators to transition to Data Comm
Program Summary

• Started Tower Service Implementation Waterfall
  – Received In-Service Decision (ISD) and completed IOCs for Tower Services at Salt Lake City (SLC), Houston Intercontinental (IAH), Houston Hobby (HOU), New Orleans (MSY), Austin (AUS), Louisville (SDF), Newark (EWR), San Antonio (SAT), Kennedy (JFK), Indianapolis (IND), and Los Angeles (LAX)

• Coordinating with field personnel to meet accelerated dates from industry and NextGen
  – Conducting Air Traffic and Tech Ops Training

• Coordinating with industry to support test and turn-up
  – Positive Feedback from stakeholder community

• Proceeding with En Route Service development and planning for Advanced Services
  – Industry and controller buy-in on Initial Services deployment strategy
  – Re-planning Full En Route Services due to FAA budget constraints, still targeting FID in 2016