2026/11/09



CPDLC, ADS-C & AIDC in the Caribbean

ICAO NACC Regional CPDLC ADS-C Workshop

Federal Aviation Administration

CPDLC & ADS-C Architectural Fundamentals

Controller-Pilot Data Link (CPDLC)

Two-way digital messaging application governed by ICAO Doc 4444. Allows controllers and pilots to exchange strategic clearances (altitudes, routes, speeds, frequency transfers) over data link, offloading voice frequencies and eliminating acoustic readback errors.

Surveillance-Contract (ADS-C)

Surveillance agreement established between ground ATM automation and aircraft FMS. Downlinks 4D position, vector, and meteorological telemetry via SatCom or VDL Mode 2 under periodic, event (deviation triggers), or demand contracts without flight crew intervention.

Est. 75%

Voice Congestion Reduction

Offloads routine frequency chatter during peak Caribbean transit banks.

0%

Acoustic Misinterpretation

Eliminates verbal readback/hearback errors from accents or radio distortion.

1-Touch

FMS Push-To-Load

Clearances load directly into aircraft navigation, eliminating waypoint typing errors.

Caribbean Regional Challenges & Route Mitigation

Fragmented Airspace & Small FIRs

Unlike vast single-ANSP oceanic sectors, the Caribbean consists of numerous compact FIRs (San Juan, Piarco, Havana, Santo Domingo, Kingston, Curaçao, COCESNA). Flights cross boundaries every 10–30 minutes, requiring frequent CDA/NDA handshakes.

Radar to Non-Radar Transition Mosaic

Airspace alternates between high-density coastal radar/ADS-B surveillance and procedural oceanic sectors over open water. Systems must cleanly handle the shift from tactical line-of-sight monitoring to strategic conformance monitoring.

Mixed Equipage & Dual-Medium Spikes

Commercial airliners feature FANS 1/A or ATN B1, while regional turboprops and general aviation operate voice-only. Managing mixed traffic on the same frequency causes controller workload spikes from constant voice/text switching.

Hybrid Communication Sub-networks

Ensuring continuous coverage across island geography demands a hybrid sub-network infrastructure combining ground-based VDL Mode 2 multi-frequency stations for continental routes with SatCom (Inmarsat/Iridium) over open water.

Mitigation Strategy: Airspace Segregation & Dedicated Data-Link Routes

10a : J2–J7 (CPDLC) & D1 (ADS-C) • PBCS: RCP 240 / RSP 180

Operational Factor	Without Dedicated Routes (Mixed Traffic)	With Dedicated Data-Link Routes (Segregated)
Controller Workload	HIGH: Juggling voice and text on identical sector frequencies.	**REDUCED: High-density corridors run on automated silent text.**
Frequency Congestion	VHF saturates during peak arrival and departure banks.	**PRESERVED: Voice kept open for terminal & unequipped aircraft.**
Airspace Capacity	Bottlenecks from conservative non-radar procedural spacing.	**EXPANDED: Equipped traffic flies reduced 30/30 NM separation.**
Incentive to Equip	LOW: Airlines see no tangible benefit for avionics costs.	**HIGH: Direct routing, UPRs, and priority climb clearances granted.**

Ground Automation System Workload & Surveillance Architecture

Automated DLIC Management

Processes Data Link Initiation Capability logons 15–25 min prior to FIR entry, correlating Field 07 call sign and registration.

Multi-Sensor Fusion & Predictors

Fuses radar, ADS-B, and ADS-C into single target icons. Smooth dead-reckoning algorithms prevent target jumping at coast-out.

Event-Contract Conformance

Arms FMS contracts (Lateral Dev >2 NM, Vertical Dev >300 ft, Waypoint Change) to immediately alert controllers of route deviations.

Overdue Timers & Safety Nets

Triggers visual alert if report is overdue by 3 min; prompts mandatory 6 min voice reversion.

Surveillance Refresh Benchmark & PBCS Criteria

Surveillance Layer	Update Frequency	Operating Medium	Control Philosophy	Applicable Separation
Primary / Secondary Radar	**4 to 12 Seconds**	Ground Line-of-Sight	Tactical Vectoring	3 to 5 NM Terminal / En-route
ADS-B Out (1090 MHz)	**1 Second**	Broadcast Line-of-Sight	Tactical Surveillance	3 to 5 NM Radar-like Spacing
ADS-C Telemetry	**Dynamic: ~10–30 Min**	SatCom or VDL Mode 2	Strategic Conformance	30/30 NM (10m) • 20 NM (192s)

RCP 240: Max transaction time 240s (99.9%), 210s (95%), 60s pilot response limit.

RSP 180: Max surveillance transit time 180s (99.9%), 90s (95%) FMS-to-ATSU.

Transfer of Control: Manual / Contingency vs. Automated AIDC

⚠ Manual Transfer of Control Pipeline (Non-AIDC / System Failure Contingency)

Direct Controller Interphone & Manual Workstation Entry Required

STEP 01
Voice Coordination
Sector A calls Sector B via interphone 30–45 min prior; delivers verbal estimate, level, and data link equipage.

STEP 02
Manual NDA Uplink
Sector A controller manually selects aircraft on console and uplinks NDA containing Sector B's 4-letter ICAO code.

STEP 03
Pilot Manual Logon
If NDA fails, Sector A instructs crew via voice/text to manually type Sector B's ICAO address into the MCDU.

STEP 04
Manual Contract Setup
Sector B manually initiates ADS-C contract; Sector A manually terminates their contract after handoff confirmation.

Automated Transfer of Control Pipeline (AIDC / NAM ICD Active)

Zero Controller/Pilot Intervention • Dual Active Contracts Across Boundary

STEP 01
Auto Pre-Notification
15–45 min prior to boundary, Sector A sends AIDC CPL/EST to Sector B with flight parameters and data link address.

STEP 02
Auto NDA Uplink
Sector A system uplinks NEXT DATA AUTHORITY (UM 160). Aircraft FMS executes background logon to Sector B.

STEP 03
Auto ADS-C Contract
Sector B initiates periodic contract in background. Aircraft holds dual active contracts with zero surveillance gap.

STEP 04
Auto CDA Switchover
At FIR boundary, Sector A sends END SERVICE (UM 161). Sector B automatically becomes active CDA.

Operational Domain	Manual / System Failure (Non-AIDC / Non-NAM)	Automated Handover (AIDC / NAM ICD Active)
Coordination Mechanism	Verbal interphone calls between controllers; manual flight strip/FDPS updates.	**Ground-to-ground digital messaging (CPL, EST, ACP, TOC, AOC) between FDPS.**
Controller Workload & Lead Time	HIGH (30–45 min lead time required for verbal calls and manual uplinks).	**MINIMAL (15–20 min lead time; system coordinates silently in background).**
Separation Standard Applied	INCREASED PROCEDURAL BUFFERS (50–80 NM) until data link is manually verified.	**REDUCED DATA LINK MINIMA (30/30 NM or 20 NM) with active ADS-C tracking.**

Operational Challenges: ADS-C & CPDLC in Oceanic & Offshore FIRs

Airborne FMS Logon Mismatches

Trailing spaces or zero omissions between FMS MCDU entries and Field 07 call signs trigger automatic DLIC logon rejections. Hardware tail-swap discrepancies block connection requests before oceanic entry.

Interfacility Handover Failures

FDPS or AIDC glitches (e.g., Santa Maria LPOO to New York KZNY) stall automated NDA commands. Aircraft cross FIR boundaries locked to the transferring unit, leaving the receiving ANSP unable to establish connection.

SatCom Latency & Coverage Drops

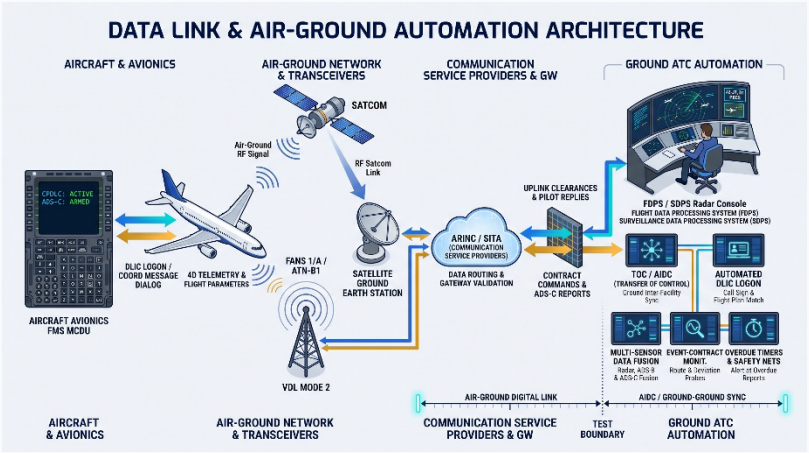
Space-segment buffer queues cause delayed clearance deliveries. Uplinks executed after tactical windows expire introduce separation hazards, while high-latitude flights face geostationary Inmarsat horizon loss.

CSP Infrastructure Outages

Airlines contracted exclusively to single service providers (SITA or ARINC) face simultaneous multi-aircraft disconnects during ground gateway outages, triggering provider aborts across entire sectors.

Validation Testing Framework & Regional Action Plan

4-Stage Validation Testing Framework



Stage 1: Offline Shadow Testing

Stream live ADS-C/CPDLC data into non-operational test bench to verify FDPS stability, message parsing, and latency without controlling live traffic.

Stage 2: Ground-to-Ground CSP Integration

End-to-end verification across Communication Service Providers (ARINC/SITA) and adjacent ANSP AIDC/NAM ICD links.

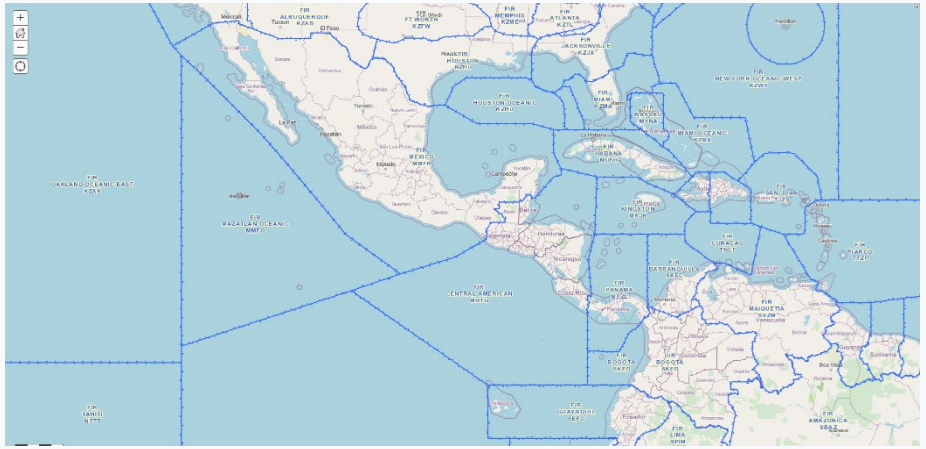
Stage 3: Airline & Avionics Pre-Validation

FAA Tech Center model: joint testing between ATM vendors (Thales, Indra, Leonardo) and airframes (Airbus, Boeing) to eliminate message rejection loops.

Stage 4: Phased Live Traffic Trials

New York Center model: initial live trials during low-density midnight shifts before full 24/7 commissioning.

Regional Implementation plan for CAR-SAM ANSPs



Determine Entry Point:

Deployment of Pre-Departure Clearances (DCL/PDC) at major hub airports first to resolve CPDLC flight plan correlation bugs in a low-risk ground environment.

Harmonize Bilateral LOAs:

Update interfacility Letters of Agreement with adjacent FIRs/TMA's defining automated transfer of control, and voice fallback protocols.

Regional Technical Missions:

Participate in ICAO (Oakland Technical Mission) to leverage FAA lessons learned.

Recap: MMFO / ZAK Visit (May 20, 2026) & Planning Next Regional Workshops

LESSONS LEARNED & TAILORING

Recap: Oakland Oceanic (ZAK) Best Practices Workshop with SENEAM / AFAC (May 20, 2026)

1. Technical & Operational Briefings

ATOP infrastructure, DataComm requirements, CPDLC implementation & outage contingencies, pilot-controller comm standards, safety/contingency protocols, and AIDC integration.

2. Live Observation & Simulation

Live floor observation of oceanic controller workflows in real-time operations, followed by a hands-on DYSM Lab simulation session.

3. Round Table Harmonization

Facilitated discussions on cross-boundary coordination, transition planning from voice to data link, and harmonized operational procedures between MMFO and Oakland Oceanic airspace.

4. Collins Aerospace (ARINC) Demo

Demonstration of Communication Service Provider (CSP) network gateways, VDL ground stations, Sat/Com routing, and SITA/ARINC cross-provider failure modes.



Discussion : Tailoring Upcoming Visits for TTCAA, Curaçao, and COCESNA

Customizing Agenda by ANSP Capability & Architecture

Questions?