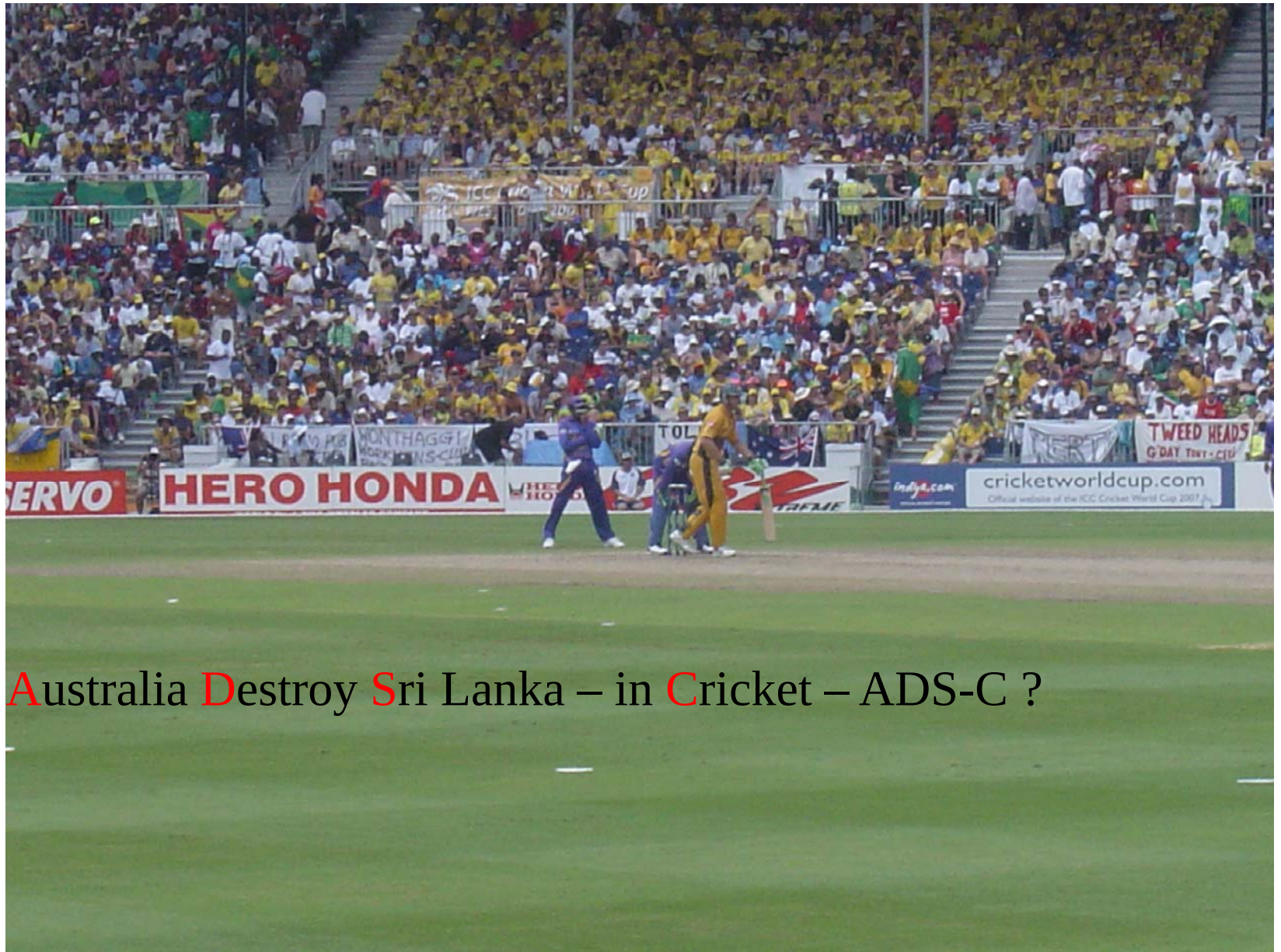
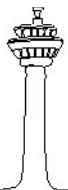




Australia Destroy Sri Lanka – in Cricket – ADS-C ?

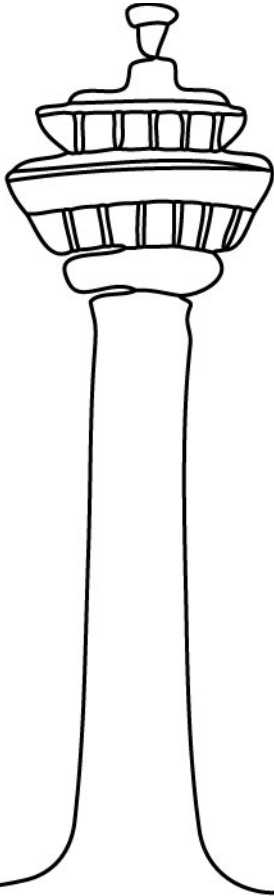


Overview of ADS-Contract

ICAO Surveillance Seminar

18 – 20th June 2007

Port of Spain



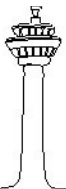
Akhil Sharma
Director, ATC AIRCOM Services
18th June 2007

Straightforward aircraft operations

SITA

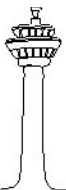
Overview

- Overview of SITA Data Link Infrastructure
- What is ADS-C ?
- Where is it implemented today ?
- Final Thoughts...

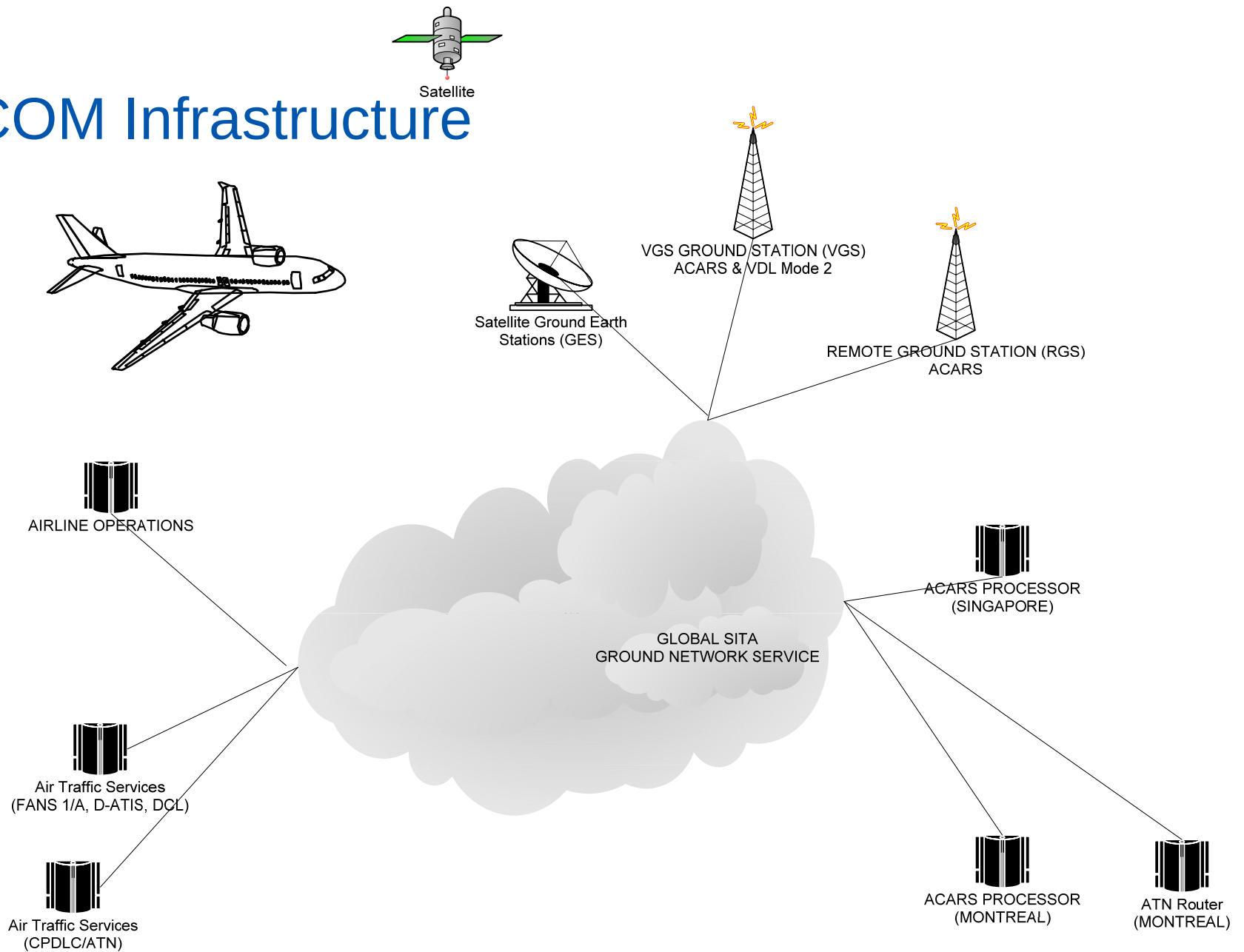


FANS and ATN Implementation Timeline

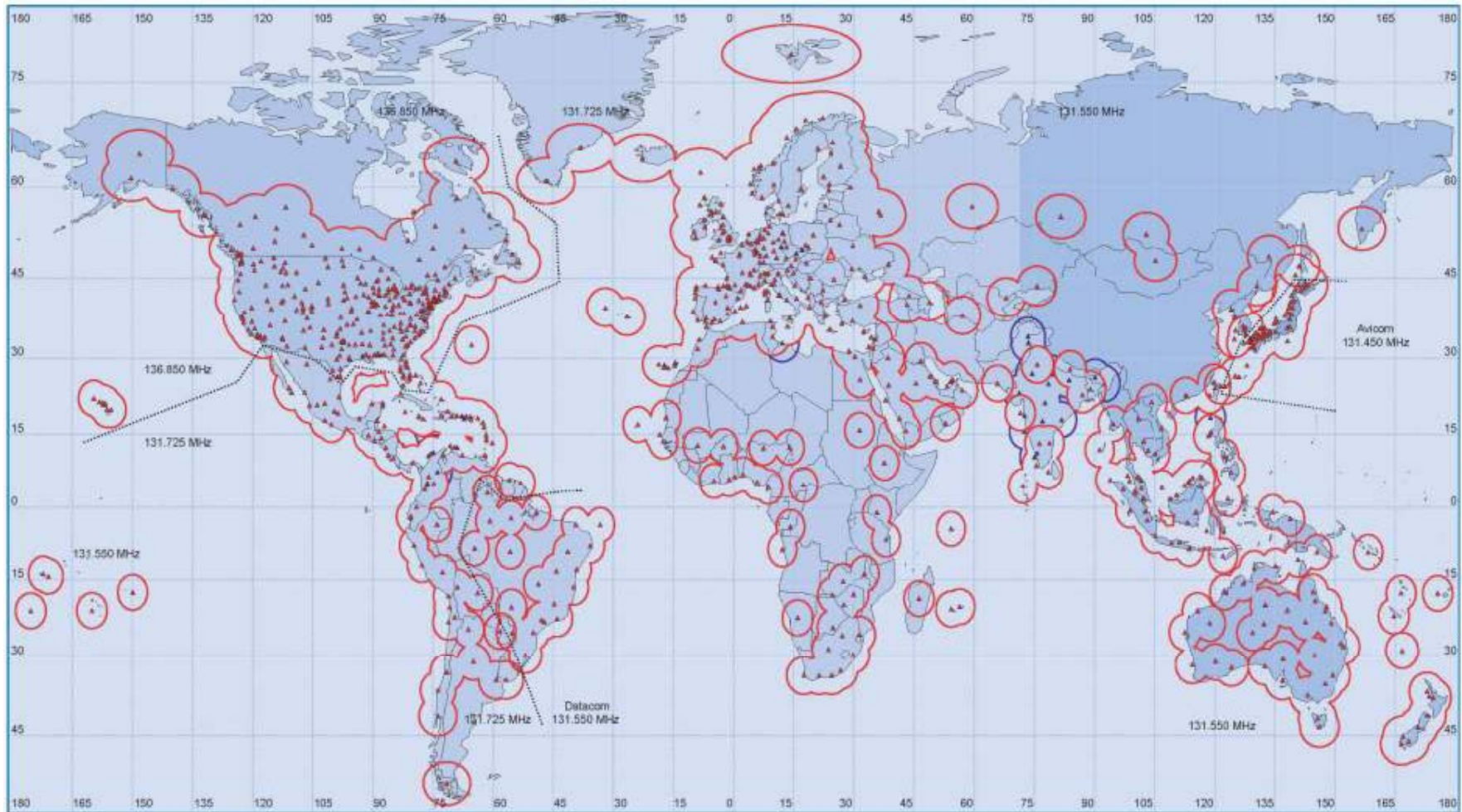
- 1988: ICAO FANS Committee 1988 Report
- 1995: First Boeing “FANS-1” Package Certified
- 1995: Initial Air Navigation Service Provider (ANSP) FANS Implementations
- 2000: First Airbus “FANS-A” Package Certified
- 2004: ATN-Based CPDLC Implemented in Maastricht UAC
- Today-Future: FANS-1/A implemented by ANSPs in many locations worldwide
ATN being implemented throughout EUROCONTROL Link2000+ airspace
ATN to be implemented in US commencing in 2012 timeframe.



AIRCOM Infrastructure

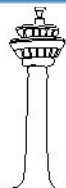


VHF coverage : Nov 2006

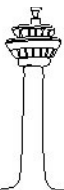
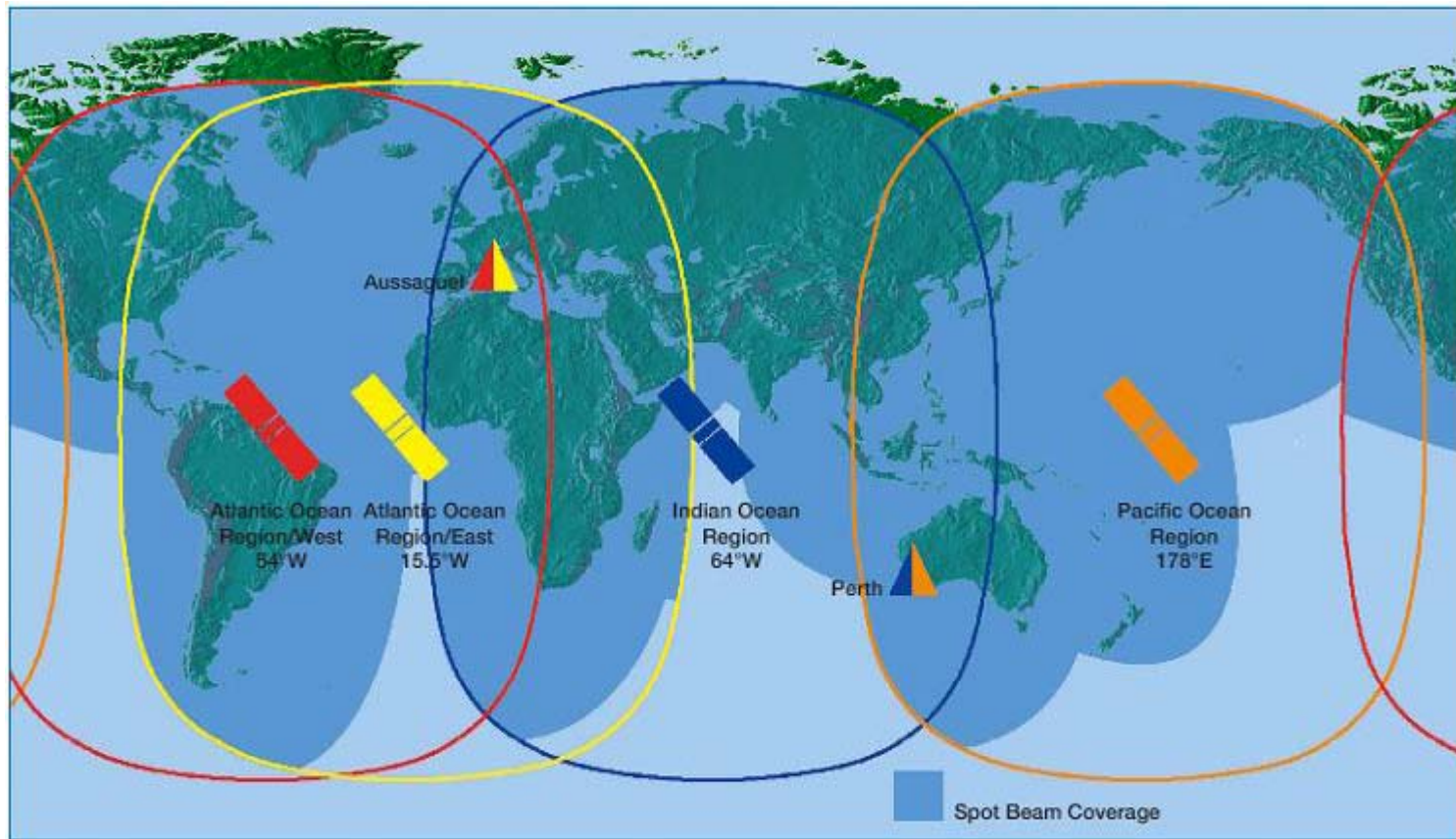


Nov 2006 : Over 1'100 radios

VDL coverage : Nov 2006



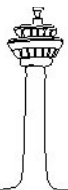
Worldwide Satellite AIRCOM Coverage



AIRCOM Datalink – An increasing Demand

	VHF ACARS	VDL AOA	Satellite ACARS
Number of users			
05Q1	6,377	112	1,795
06Q1	7,400	190	2,080
Variance	+16%	+70%	+16%
Daily traffic (kb)			
05Q1	527,000	13,000	125,000
06Q1	778,000	26,000	164,000
Variance	+48%	+100%	+31%
Daily traffic per aircraft (kb)			
05Q1	83	116	70
06Q1	105	137	79
Variance	+27%	+18%	+13%

AIRCOM Datalink service is used by over 180 airlines & 50 Air Navigation Service Providers



Regional equipped data link airlines



AEROLINEAS
ARGENTINAS



 **Copa Airlines**

TACA 

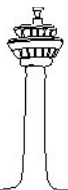
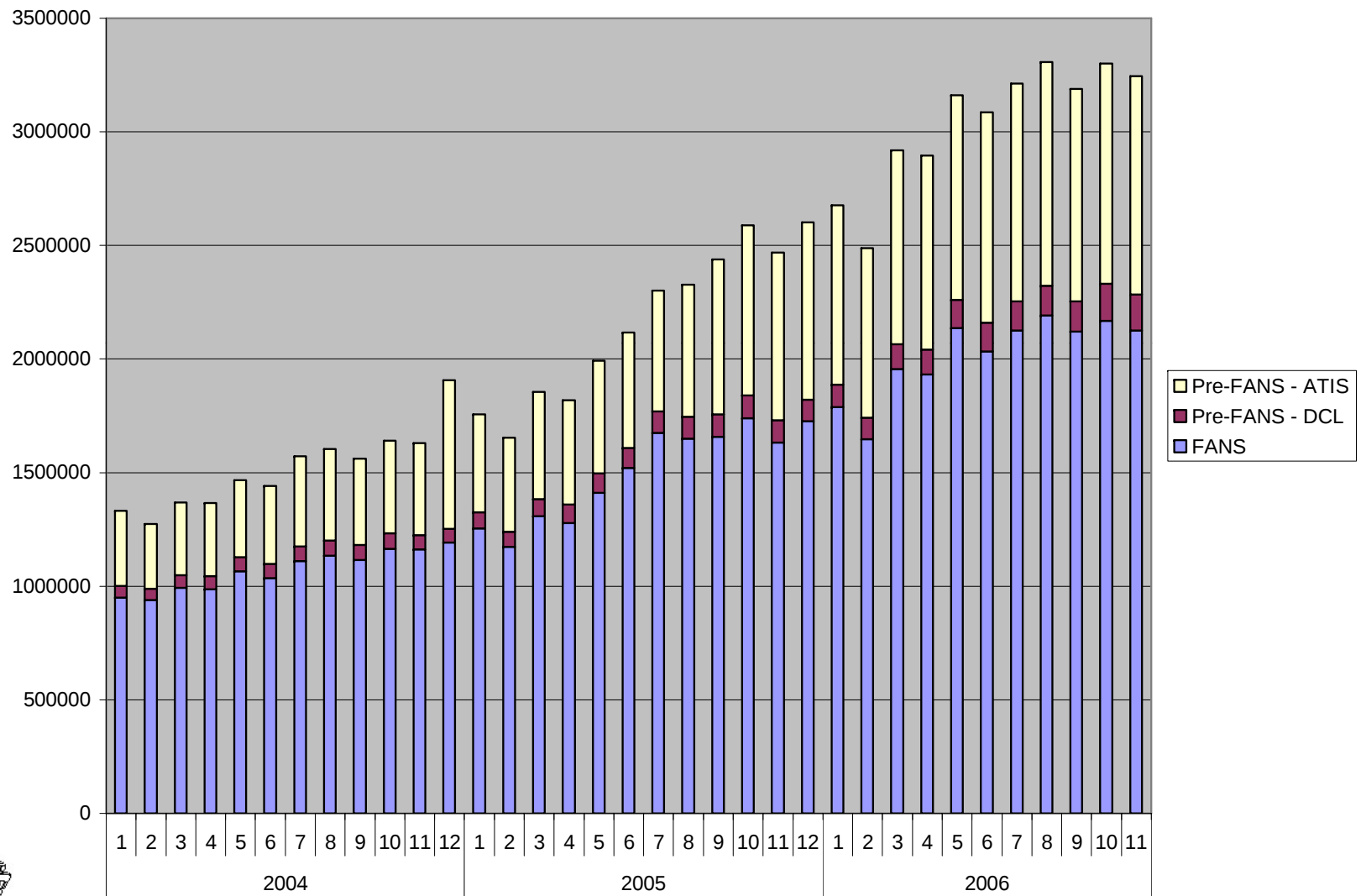
TAM


MEXICANA



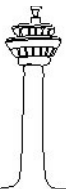
SITA

FANS/d-ATIS/DCL Traffic Evolution



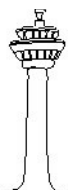
FANS 1/A

- Also referred to as:
 - FANS 1 – Boeing implementation
 - FANS A – AIRBUS implementation
- Operates over ACARS industry standard
- ICAO ATN SARPs also define version of ADS
 - Has not been implemented
- Generally equipped on long haul aircraft (B747, B77, A330/340)
- Implements
- Around 2,000 aircraft equipped today
- ADS-C (ADS-Contract) – previous ADS-A
- CPDLC (Controller Pilot Data Link Communications)
- AFN (ATS Facilities Notification)
- Operates over either VHF or SATCOM
- Intended to be used over remote/oceanic airspace



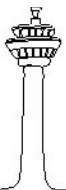
Equipped Airlines

Aeroflot	British Airways	Fedex	Saudi Arabian
Air Canada	Cargolux	Garuda	SAS
Air Charter	Cathay Pacific	JAL	Singapore
Air China	China Airlines	Korean	South African
Air France	China Southern	Kuwaiti	TAM
Air New Zealand	Continental	Lan Chile	Thai Airways
Air Pacific	Corsair	Lufthansa	TNT International
All Nippon	Delta	LTU - Gmbh	United Airlines
American	Egypt Air	Malaysian	US Air Force
AOM	El Al	QANTAS	Airbus
Asiana	Emirates	Polar Air Cargo	Boeing
Austrian	EVA Airways	RAAF Australia	



Key Standards

- RTCA DO-212 – Minimum Operational Performance Standards for Airborne ADS Equipment, October 1992
- ARINC 622-4, ATS Data Link Applications over ACARS Air/Ground Network
- RTCA 258, Interoperability Requirements for ATS Applications using ARINC 622 communications (FANS 1/A Interop Standard)
- FANS 1/A Operations Manual, V4, September 2006



Identifying Data Link Equipage

- Item 10 of ICAO Flight Plan “J” indicates Data Link capability
- Item 10 – “D” indicates ADS-C capability
- Item 18 – Letters “DAT/” followed by “SV” indicating Satellite and VHF data link capability

Example:

ICAO Item 10:J...../...D

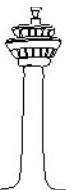
ICAO Item 18: REG/.....DAT/SV (for a satellite and VHF data link equipped aircraft)

Letter following DAT/	Type of data link
S	Satellite data link
H	HF data link
V	VHF data link
M	SSR Mode S data link



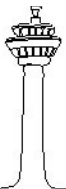
ADS C Description

- Three types of ADS contract can be established:
 - Periodic
 - Event
 - Demand
- Contracts initiated by the ground system
- Pilot has ability to cancel all ADS contracts by selecting “ADS-off”



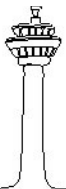
ADS-C Contracts

- Periodic Contract
 - Allows an ATSU to specify the reporting period
 - Controller should be able to vary reporting rate – context dependant
- Event Contract
 - Requires an ADS report is sent whenever a pre-defined event occurs
 - E.g. Vertical Change Rate, Lateral Deviation Change, Altitude Range, Waypoint Change
- Demand Contract
 - “One-off” request from Ground System for FMS to provide ADS report containing specific data as defined in request



ADS-C Reports

- Basic Report includes
 - Latitude
 - Longitude
 - Altitude
 - Time Stamp
 - Figure of Merit
- Optional data includes
 - True Track, Ground Speed, Vertical Rate
 - Heading, Mach Speed
 - Airframe ID (24 bit code), Flight ID
 - Wind Speed, True Wind Direction, Temperature
 - Lat, Long, Altitude, ETA and next and next+ 1 waypoint
- Figure of Merit
 - Value defines accuracy of ADS data (1 = < 30 miles, 7 = GPS)



ADS-C Connection Management

- FANS 1/A equipped aircraft can have up to 5 connections
- One is reserved for use by AOC
- Controlling ATSU may not be aware that aircraft is also contracted by another ATSU
- Procedural priority scheme has been established
 - Current Data Authority
 - Next Data Authority
 - Adjacent ATSU for monitoring operations close to its boundary
 - Airline AOC

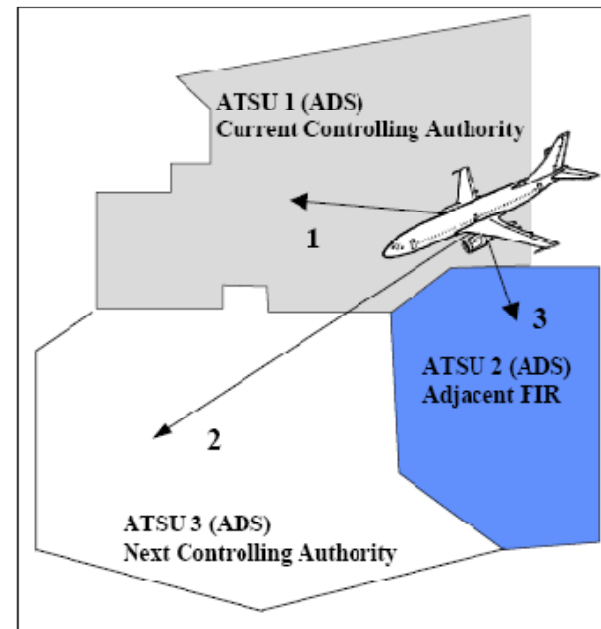
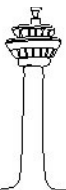
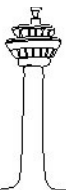


Figure 10: Priorities for ADS-C connections



ADS-C – Emergency Mode

- Can only be activated by the pilot
- Normally cancelled by pilot
- Ground system can be configured to control display of emergency mode status
- Activated automatically by sending CPDLC “MAYDAY” message
- Can also be set independently
- When emergency mode is set, aircraft sets emergency flag in all reports sent to ground systems that have contract established



FANS 1/A Operations Manual

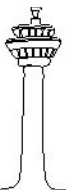
- Originally developed by South Pacific Group
- Now adopted by majority FANS regions
- Defines requirements and procedures for FANS 1/A operations
 - System performance criteria
 - System validation (safety, integration)
 - System monitoring (performance reports)
 - FANS Interoperability Team (FIT)
 - Central Reporting Agency (CRA)

<http://www.crasa.cra-japan.org> (the JCAB CRASA web page)

<http://www.faa.gov/ats/ato/130.htm> (the FAA's Oceanic Procedures Branch)

<http://www.faa.gov/ats/ato/ipacg.htm> (the IPACG web page)

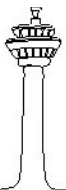
<http://www.faa.gov/ats/ato/ispacg.htm> (the ISPACG web site)



SITA

FOM System Performance Requirements

- End-to-end round trip time for uplinks
 - 2 minutes for 95% messages
 - 6 minutes for 99% messages
- End-to-end round trip time for downlinks
 - 1 minute for 95% messages
 - 3 minutes for 99% messages
- Message delivery
 - Less than 1% of all messages delivered
- Availability 99%



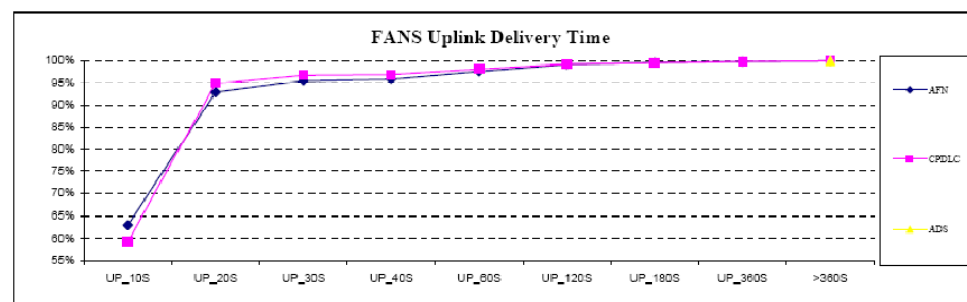
SITA FANS Performance Reporting

1.1 GLOBAL FANS DATALINK TRAFFIC

Customer	Ground Traffic (Uplink + Downlink)	Percentage Total	Air-Ground Traffic (Uplink + Downlink)	Percentage Total
ATS Provider	48 894	100%	50 917	100%
FANS Services				
AFN (Log-on)	16 320	33,38%	17 022	33,43%
CPDLC	32 574	66,62%	33 895	66,57%
ADS				

1.2 FANS SYSTEMS PERFORMANCE

Availability	Feb-05	Last 3 Months	Last 12 Months
VHF FANS AIRCOM Processor Availability	100,00%	100,00%	100,00%
Satellite FANS AIRCOM Processor Availability	100,00%	99,87%	99,93%
VHF Access Network Availability	99,99%	98,78%	99,38%
Satellite Access Network Availability	99,92%	99,87%	99,93%
FANS Service Availability via VHF	99,99%	98,78%	99,38%
FANS Service Availability via Satellite	99,92%	99,87%	99,93%

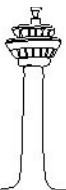


FANS BY AIRLINES			
ATS Provider	Feb-05	12-month average	Percentage Total
BAW	12 710	10 089	26,00%
AFR	8 660	9 421	17,71%
DLH	8 617	10 319	17,62%
AAL	6 976	4 232	14,27%

FANS BY MEDIA			
ATS Provider	Feb-05	12-month average	Percentage Total
VHF UP & DOWNLINK	8 974	9 080	18,40%
Satellite UP & DOWNLINK	39 801	33 892	81,59%

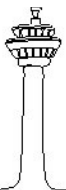
FANS Interoperability Teams - FIT

- **Primary certification of FANS 1 package on a QF flight was achieved in 1995**
- **ISPACG problem reporting system could not cope with problems that were identified post certification**
- **New approach was required**
 - **An implementation team “FIT” established**
 - **Address technical and procedural issues**



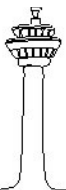
Central Reporting Agency - CRA

- However, ISPACG/FIT realised that the traditional “industry team” would require support to manage the daily issues and required in-depth research
- A FIT sub-team – CRA was established
 - Daily monitoring, co-ordination, testing and problem research as directed by the FIT
- The CRA for the South Pacific is today run by Boeing with funding from the FAA

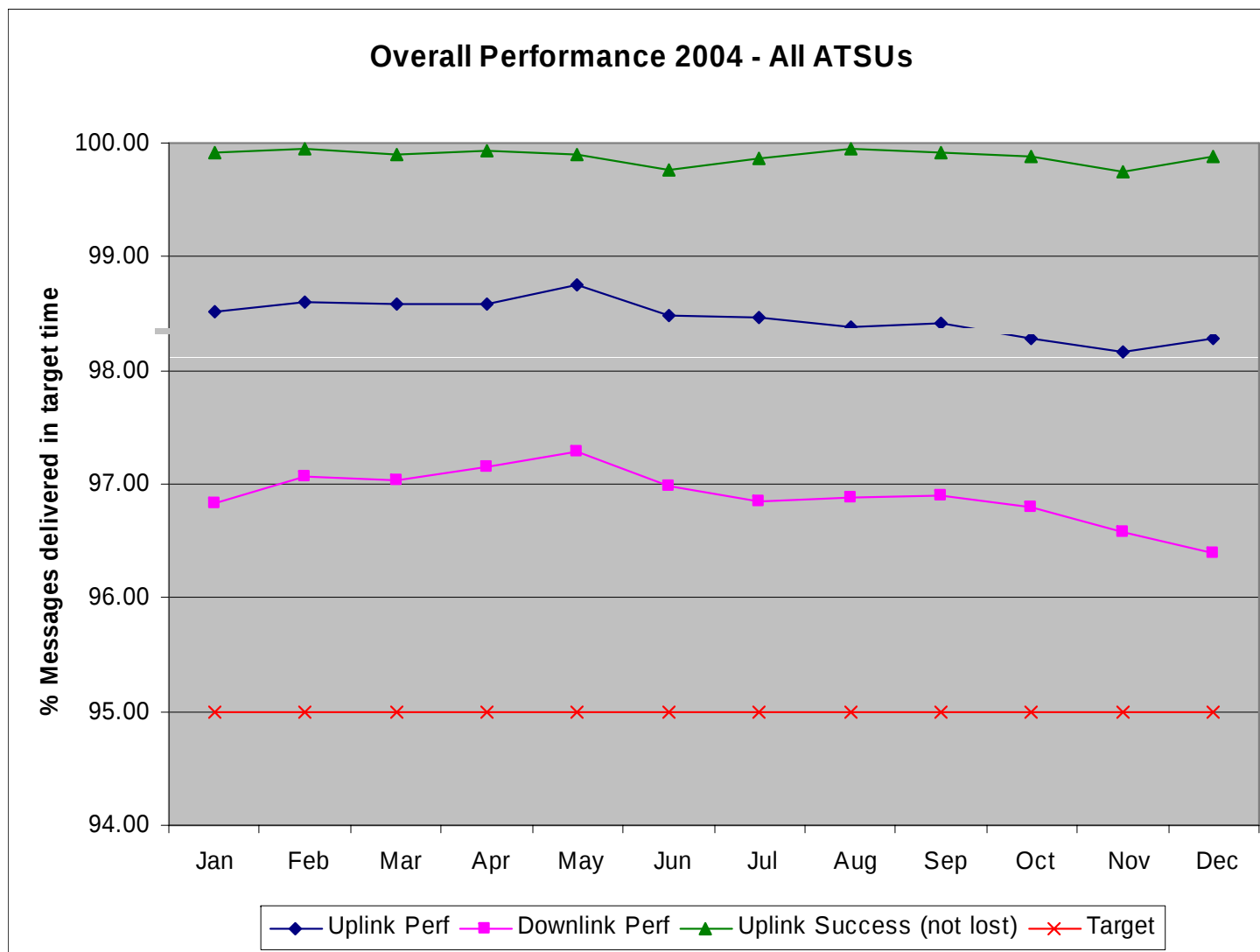


The Result.....

- **System Performance Targets**
- **Monthly System Performance Monitoring**
- **Message sending data**
- **Increased overall system stability**
- **Standardised procedures across multiple FIRs**
- **Network of various experts at hand**

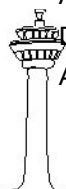


Functions – System Performance Monitoring



Functions – System Performance Monitoring

Uplink Msg Element	Msg#	Bris	Melb	Oakl	Auck	Total	% Used
UNABLE	0	5478	1985	51185	1095	59743	2.823
STANDBY	1	13514	4736	1964	205	20419	0.965
REQUEST_DEFERRED	2	1086	284	31870	20	33260	1.571
ROGER	3	1098	510	786	116	2510	0.119
AFFIRM	4	172	229	552	13	966	0.046
NEGATIVE	5	160	171	140	3	474	0.022
EXPECT_level	6	68	3	13	0	84	0.004
EXPECT_CLIMB_AT_time	7	480	18	29	0	527	0.025
EXPECT_CLIMB_AT_position	8	332	5	491	0	828	0.039
EXPECT_DESCENT_AT_time	9	14	2	0	0	16	0.001
EXPECT_DESCENT_AT_position	10	3	0	4	0	7	0.000
EXPECT_CRUISE_CLIMB_AT_time	11	3	1	1	0	5	0.000
EXPECT_CRUISE_CLIMB_AT_position	12	1	0	77	0	78	0.004
AT_time_EXPECT_CLIMB_TO_level	13	47	4	20	0	71	0.003
AT_position_EXPECT_CLIMB_TO_level	14	55	8	12	0	75	0.004
AT_time_EXPECT_DESCENT_TO_level	15	6	0	0	0	6	0.000
AT_position_EXPECT_DESCENT_TO_level	16	5	0	0	0	5	0.000
AT_time_EXPECT_CRUISE_CLIMB_TO_level	17	1	1	0	0	2	0.000
AT_position_EXPECT_CRUISE_CLIMB_TO_level	18	2	0	0	0	2	0.000
MAINTAIN_level	19	1197	1145	7164	1180	10686	0.505
CLIMB_TO_AND_MAINTAIN_level	20	27317	14173	240604	11935	294029	13.892
AT_time_CLIMB_TO_AND_MAINTAIN_level	21	159	25	32	145	361	0.017
AT_position_CLIMB_TO_AND_MAINTAIN_level	22	512	312	265	31	1120	0.053
DESCEND_TO_AND_MAINTAIN_level	23	1292	626	4458	493	6869	0.325
AT_TIME_DESCEND_TO_AND_MAINTAIN_level	24	9	0	0	16	25	0.001

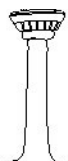


FANS Problem Report

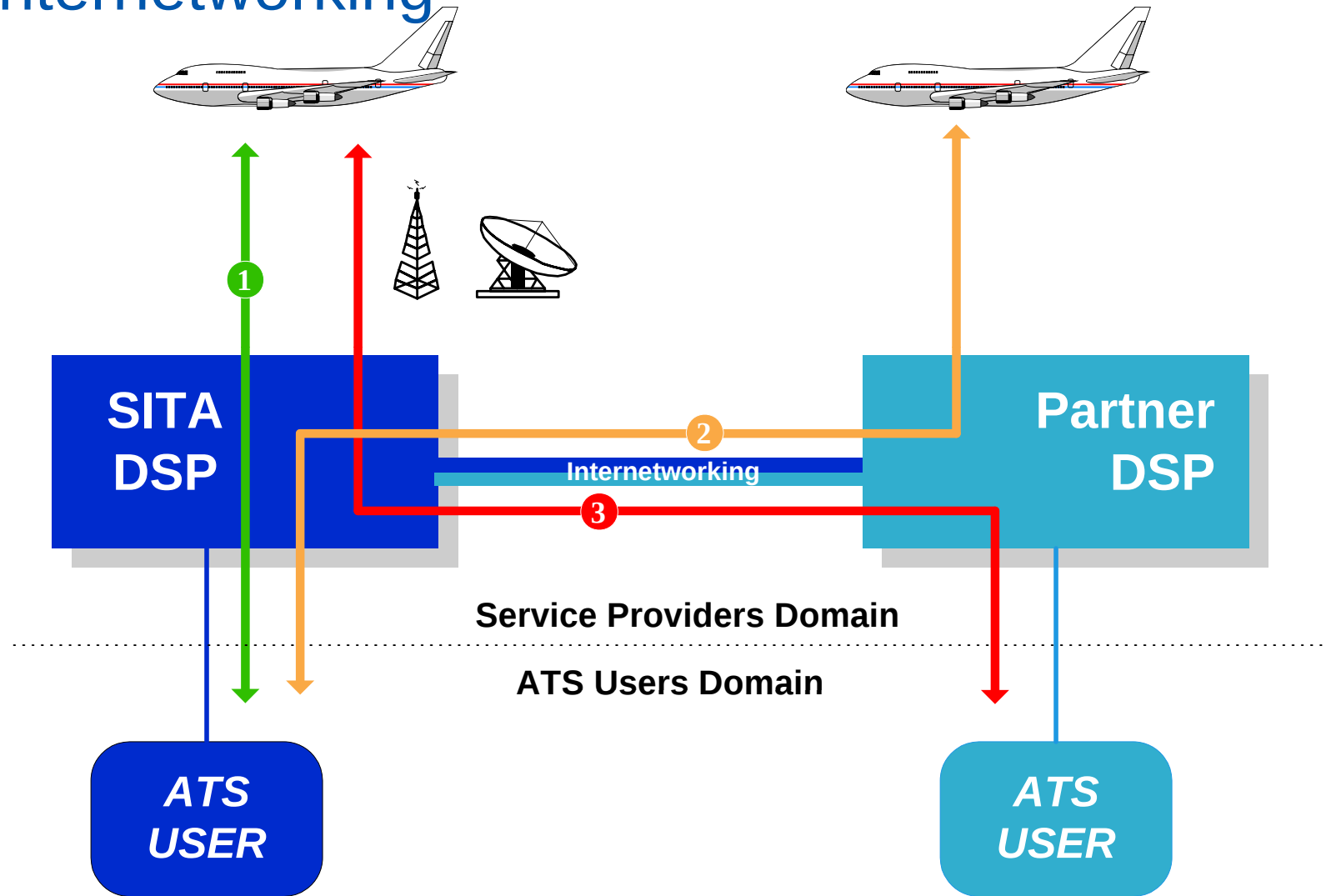
3.10 FANS-1/A Problem Report

Number

Date UTC		Time UTC	
Registration		Flight Number	
Sector			
Originator		Aircraft Type	
Organization			
Active Center		Next Center	
Position			
Description			

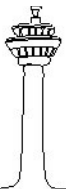


ATS Internetworking



FANS Expansion

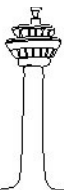
- First introduced in South Pacific on routes between Australia/New Zealand and USA
- Has since expanded to:
 - North Pacific
 - North Atlantic
 - Bay of Bengal (AAI)
 - Arabian Sea (AAI)
- Other regions have trialled and plan to introduce operational service in the next year or so:
 - Middle East & North Africa
 - Africa (ASECNA)
 - South Atlantic
- Some Air Navigation Service Providers in Europe plan to accommodate FANS aircraft – but focus is on the implementation of ICAO compliant systems



Regional Coordinating Groups with Associated FANS-1/A Interoperability Teams or Similar*

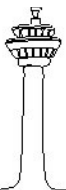
Region or Control Area	Associated Coordinating Group or ANSP	
SouthPac	ISPACG	-Informal Pacific ATS Coordinating Group
Cen/NoPac	IPACG	-Informal Pacific ATC Coordinating Group
NAT	FIG	-North Atlantic FANS Implementation Group
SAT	SAT	-South Atlantic
Europe	Eurocontrol	-Link2000+ Program
Middle East & North Africa	AFIG	-Arab Civil Aviation Commission (ACAC) FANS Implementation Group
Bay of Bengal	BBACG	-Bay of Bengal ATS Coordination Group
SouthEast Asia	SEACG	-South-East Asia ATS Coordination Group

* FANS is in either trial or operational implementation status for many locations in each of these regions. Additional details on FANS implementations can be found in the backup slides.



NAT Data Link Operations: Data Link Services*

- CPDLC
 - Gander
 - Shanwick
 - Santa Maria
 - Reykjavik
 - New York
- ADS
 - All NAT OCAs
- FMC WPR
 - All NAT OCAs with exception of New York
- OCL
 - Gander & Shanwick



See <http://www.nat-pco.org/DataLink.htm> for more information.

NAT Data Link Operations: Gander and Shanwick Usage

Gander¹

- ADS and FMC WPR Position Reporting: 50%
- CPDLC (excluding Position Reporting): 42%

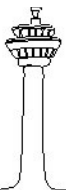
Shanwick²

- ADS WPR aircraft: 35.81%
- FMC WPR aircraft: 6.18%
- OCLs: ~60%
- CPDLC³: ~35%

¹ NAV CANADA, NAT and Northern Canada Operations presentation to the Feb 1-2, 2006 AEEC Data Link Users Forum.

² UK NATS, NAT Operations & new Shanwick FDP System presentation to the Feb 7-8, 2007 AEEC Data Link Users Forum.

³ UK NATS, NAT Operations presentation to the Jun 14-15, 2006 AEEC Data Link Users Forum.

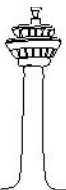


GREPECAS 12

The Twelfth Meeting of the CAR/SAM Regional Planning and Implementation Group was held in Havana, from June 7 to 11, and registered some important decisions/conclusions on ATS Data Link:

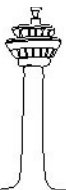
Conclusion 12/42: REGIONAL USE OF ACARS AND FANS 1/A EQUIPMENT DURING THE TRANSITION PHASE

“That CAR/SAM States/territories/international organizations and users, based on ICAO existing recommendations, and to the cost/benefit considerations and taking into account the existence of technology installed in ground and on board aircraft, continue with the implementation of the applications feasible to be used with ACARS data and FANS 1/A during the transition towards the implementation of ATN.”



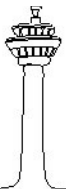
SAT FANS-1/A Operations

- Atlântico (Trial)
- Canarias (Trial)
- Johannesburg
- Cape Town
- More planned (e.g. ASECNA, Argentina, Angola, Cape Verde)
- SAT FANS Interoperability Team formed in 2006 and has had two meetings to date.



DGCA Chile – Case Study

- DGCA Chile wished to acquire some initial experience with FANS 1/A for their South Pacific airspace
- Wanted to limit investment involved in integrating FANS 1/A capability in existing ATM automation
- Decided to implement stand alone FANS Workstation
- Started trials in August 2006
- Next Step – upgrade FANS workstation to support operational service



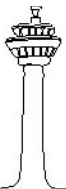
DGCA Chile - Quote

Ayer 03 de agosto, hemos hecho el primer ensayo CPDLC con una aeronave en vuelo, un A340 de LAN de Santiago a Buenos Aires al que monitoreamos su ruta hasta el aterrizaje con el ADS. En mi opinión, lo de ayer es un hito para nuestro servicio, solo comparable con la instalación de nuestro primer RADAR en 1973.

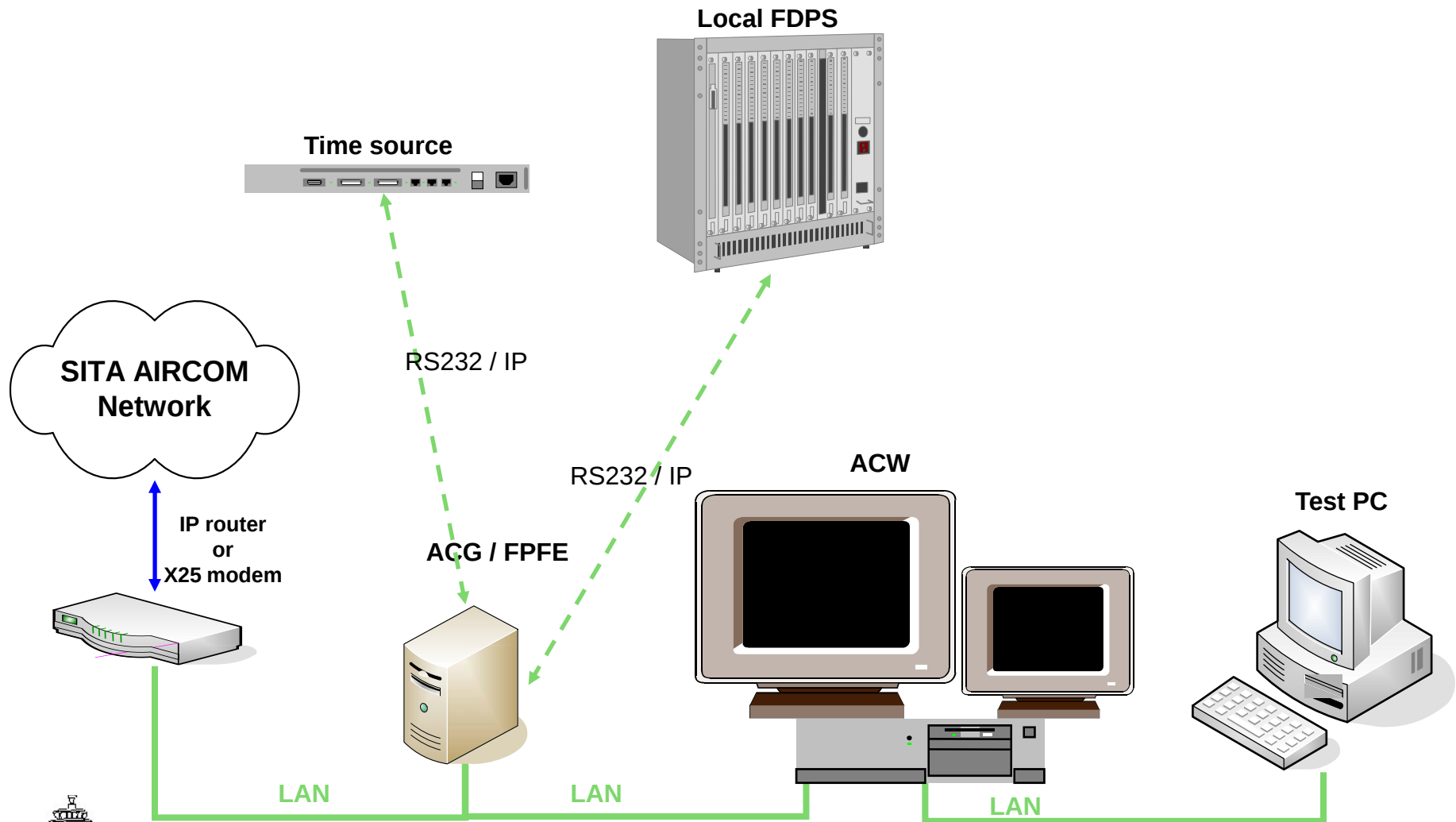
Hemos trabajado muy bien con la gente de SITA, Iñaqui y Damian,

Un abrazo,

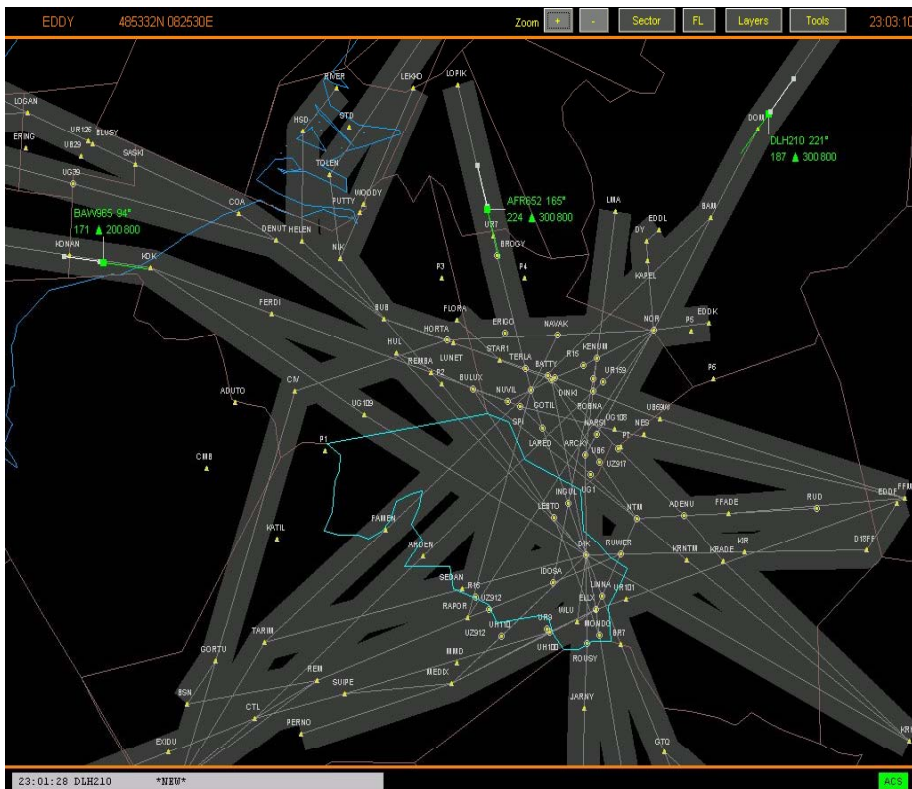
Alberto Fernández D
afernandez@dgac.cl



ADS-CPDLC Workstation (ACW) architecture



ADS-CPDLC Workstation



COCBIT v1.0 (demo)

File

Flights

Messages

Sound

Help

EDYY

COCBIT

21/01/2002

14:52:31

Flights

5

Aircraft ID

CM Status

CPDLC Status

ADS Status

ANZ4326

CONNECTED

CONNECTED

P(0) E(4) D(2)

SIA1244

CONNECTED

ABORTED

P(1) E(1) D(3)

AAL6868

CONNECTED

CONNECTED

P(5) E(2) D(3)

DLH2675

IN PROGRESS

CONNECTED

ABORTED

ACA9540

IN PROGRESS

NOT CONNECTED

CANCELLED

Received Downlink

5

Y

14:52:03

ANZ4326

DESCENDING TO FL270

N

Y

14:52:07

SIA1244

MONITORING EDYY 126.55

U

Y

14:52:09

AAL6868

MAYDAY MAYDAY MAYDAY

D

RSP

Y

14:52:12

DLH2675

WHEN CAN WE EXPECT M.70

L

RSP

Y

14:52:16

ACA9540

FTX <Hello there >

N

Downlink Dialog

0

Message Log

0

Uplink Dialog

0

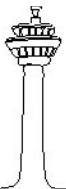
System Log

DATALINK

FAIS SERVER

Final Thoughts....

- FANS 1/A has been around for a long time
- It works !
 - Ground Systems
 - Avionics
- Trials should be limited in time otherwise airlines lose interest
- Advanced regions are reliant on the availability of the service
 - SITA has made multi million \$\$ investments in maintaining the Ground Earth Stations
- SITA is committed to working with ANSPs to introduce the technology around the globe





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