SITAONAIR’s SATCOM Voice
Ground-to-Air

SITAONAIR
23th October 2019
Diego Albert (SITAONAIR),
Lionel Lin Hongyi (CAAS),
Agenda of topics

1- SITAONAIR SATCOM voice solution. What is SATCOM and why is it important for ANSPs?
(by Diego Albert, ATC Business Development Senior Manager, Asia Pacific)

2- CAAS Singapore – SATCOM Voice trial. Results and conclusions
(by Lionel Lin Hongyi, Aeronautical Telecommunications & Engineering (ATE) Division, CAAS Singapore)
SITAONAIR

Our customers include:

Supporting 6,000+ commercial air transport and business aviation aircraft

Serving over 150 airline and Air Navigation Service Providers customers worldwide

Seamlessly connecting multiple satellite networks
SATCOM Voice Integrated aircraft communication

- Provides access to both Air Traffic Services & Airline Operational / Administrative Communications
- Enables ATC to instantly contact Pilots through secure and high quality satellite communication
- Allows communications with Inmarsat and Iridium satellite networks – Fleet Agnostic (any Aircraft connected, anywhere)
- Can be integrated within Voice Communication Systems suppliers in the ATC market with standard interfaces
- Greatly alleviates workload and enhances efficiency
- HF replacement, VHF backup, relies on dependable and resilient infrastructure
- DCPC Logs usage for reducing aircraft separation

What is SATCOM and why is it important?
GTA calling procedures
AIRCOM® Satcom Voice

2-stage dial
• Available for all customers
• To setup a call, the ground user dials one of the SITAONAIR access numbers, then enters the PIN and AESid
• For Iridium, the ground user may dial directly the Iridium access number, and enter the Iridium userid, PIN, priority, and AESid

1-stage dial
• Available today for ANSP customers via private IPVPN and VoIP only
• To setup a call, the ATC ground system shall send one SIP INVITE message to the SITAONAIR voice gateway, with the called party set to the AESid and the calling party set to the full PSTN number of the ATC center

Average time to setup call via Inmarsat:
≈ 30 seconds

Average time to setup call via Inmarsat:
≈ 10 seconds
Service Overview
AIRCOM® Satcom Voice

Provides secure and high-quality voice communications as a substitute of HF in Oceanic airspace and backup of VHF traditional communications.

Available via satellite networks:
• Inmarsat I4 (Classic and SB-S)
• Iridium (current and NEXT)

Call Priority

<table>
<thead>
<tr>
<th>Priority</th>
<th>Description</th>
<th>Communication Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>Flight Safety</td>
<td>ATS</td>
</tr>
<tr>
<td>10</td>
<td>Regularity and Meteorological</td>
<td>Aeronautical Operational Control (AOC)</td>
</tr>
<tr>
<td>9</td>
<td>Public Correspondence</td>
<td>Airline Passenger Communications (APC)</td>
</tr>
</tbody>
</table>
Simplified Network Diagram – Inmarsat

AIRCOM® Satcom Voice

MTSAT

MTSAT GES

Inmarsat I3 and I4 Networks

Hawaii GES

Burum GES

Fucino GES

Perth GES

SITAONAIR

Singapore
EGTA +65 6415 7911

Australia
EGTA +61 9273 4224

Hong Kong
EGTA +852 3060 2660

Oakhill, USA
EGTA +01 703 821 7419

SITA In-country Call Collection

SITAONAIR Voice Network

SITAONAIR (EGTA) Voice Switch

PSTN

PSTN

MTSAT

MTSAT GES

Hawaii GES

Burum GES

Fucino GES

Perth GES

IRIDIUM

IRIDIUM

Iridium Gateway

ANSP

VCCS

ATC Voice Network

NAVCanada Voice Switch

Canada
EGTA +1 514 841 2180 EGTA +1 514 841 2122

France
EGTA +33 1 4993 2333

Singapore
EGTA +65 6415 7911

Australia
EGTA +61 9273 4224

Hong Kong
EGTA +852 3060 2660

Oakhill, USA
EGTA +01 703 821 7419

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Since March 2019 CAAS Singapore is leading a project to test SITAONAIR Satcom Voice one stage dialing for DCPC research in collaboration with Inmarsat SSP.

The participants include:

- Airlines: initially Singapore Airlines (pilots and Ground Ops). Currently Cebu Airlines among others are joining as well. And
- Frequentis - CAAS’s Voice Communications Systems (VCS) provider

CAAS presented several working papers about this trial at ICAO CP-CIWG/3 (Montreal, Oct19) and ICAO APAC ACSICG/6 (Bangkok May 2019), presenting results on Adoption of direct controller-pilot communication (DCPC) satellite voice communications.
Both the Data Communication Infrastructure Working Group (DCIWG) and the Operational Data Link Working Group (OPDLWG) of the ICAO Communications Panel (CP) decided in October 2018 to form a SATVOICE sub-group to coordinate the works of SATVOICE between the technical and operations working groups.

The objectives of this sub-group are to (i) review the RCP for new generation SATVOICE applications in the PBCS manual; and (ii) evaluate and lobby for the use of DCPC SATVOICE.

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Unlike VHF voice, where the receiving party needs to wait for the caller to complete his/her call and PTT before he/she could reply, SATVOICE operations can be full duplex two-way, this will shorten the voice call acknowledgement time as the receiving party can reply as soon as the picking up the call.

As a result of the various technical enhancements, the durations of SATVOICE call establishments have reduced significantly to a level where controllers could directly establish calls with pilots without assistance from radio operators. For this reason, SATVOICE could potentially be direct controller-pilot communication (DCPC).

The PBCS manual currently defines RCP 400/Vro for the radio operator and leaves a placeholder for RCP 400/Vatc for DCPC. It is noted that RCP 400/Vatc is reserved for RCP allocations associated with controller intervention via DCPC. The SATVOICE sub-group will be updating the numbers to determine the RCP XXX/Vatc, where XXX is a new figure to be determined.

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Existing RCP 400/Vro voice communications transaction time allocations, based on PSTN "two-stage dialling" and through radio operator procedures – an extract from Figure B-3 of the PBCS manual.
CAAS SATVOICE TRIAL

Lionel Lin Hongyi
Executive Engineer (Communications/Navaids Systems)
Aeronautical Telecommunications & Engineering (ATE) Division
CAAS Voice SATCOM Trial

Background

SATVOICE can cover remote/oceanic areas
  - Non line-of-sight (LoS)

SATVOICE (2-stage dialing) currently is only used as a back up for High Frequency (HF) voice in such areas
  - Manual number dialing, unintuitive aircraft identification and slow authentication
  - Lengthy and cumbersome call establishment process that is prone to human errors
Objective of CAAS SATVOICE Trial

Data collection using SATVOICE (1-stage dialling) for
- Call establishment time (Ground-to-Air & Air-to-Ground)
- Controllers and Pilots feedback on usage of SATVOICE
- Other parameters required by ICAO Comms Panel for RCP study.

Evaluate the potential usage of SATVOICE as Direct Controller-Pilot Communication (DCPC)

Review the Required Communication Performance (RCP) for new generation DCPC type of SATVOICE applications
- Current RCP for SATVOICE is RCP400
- DCPC SATVOICE may be able to achieve RCP130 or even RCP60
## Latest Results (Oct 2019)

### G2A Calls (C to X)

<table>
<thead>
<tr>
<th></th>
<th>95%</th>
<th>95% (Pilot Response)</th>
<th>99%</th>
<th>99% (Pilot Response)</th>
<th>Average of all calls</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time (C to X)</td>
<td>22.0 sec</td>
<td>15.82 sec</td>
<td>32.0 sec</td>
<td>24.51 sec</td>
<td>13.7 sec</td>
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### A2G Calls

<table>
<thead>
<tr>
<th></th>
<th>95%</th>
<th>99%</th>
<th>Average of all calls</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time</td>
<td>17.0s</td>
<td>25.0s</td>
<td>10.3 sec</td>
</tr>
</tbody>
</table>

From Mar 2019 to Oct 2019, CAAS has collected a total of **1,003 call records for Ground-to-Air (G2A)** and **3,418 call records Air-to-Ground (A2G)**. The interim results suggest that DCPC SATVOICE could potentially be RCP 60/Vatc, with performance comparable to Very High Frequency (VHF) voice.
Possible Follow Up

More ANSPs are encouraged to conduct DCPC SATVOICE trials

Airlines are also encouraged to explore the use of DCPC SATVOICE as alternative to CDPLC and HF voice
Current Results

<table>
<thead>
<tr>
<th>Flight No</th>
<th>Tail No</th>
</tr>
</thead>
<tbody>
<tr>
<td>B8168</td>
<td>B8168</td>
</tr>
<tr>
<td>SIA960</td>
<td>9V-SYH</td>
</tr>
<tr>
<td>DLH790</td>
<td>DAIXF</td>
</tr>
<tr>
<td>SIA34</td>
<td>9VSGF</td>
</tr>
<tr>
<td>HVN772</td>
<td>VNA863</td>
</tr>
<tr>
<td>QTR946</td>
<td>A7AND</td>
</tr>
<tr>
<td>SIA917</td>
<td>9VSCN</td>
</tr>
</tbody>
</table>
# Current Results

<table>
<thead>
<tr>
<th>Flight No</th>
<th>Tail No</th>
</tr>
</thead>
<tbody>
<tr>
<td>SIA960</td>
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<td>SIA34</td>
<td>9VSGF</td>
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<tr>
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<td>9VSCK</td>
</tr>
<tr>
<td>SIA602</td>
<td>9VSCI</td>
</tr>
<tr>
<td>SIA891</td>
<td>9V-SQN</td>
</tr>
<tr>
<td>SIA872</td>
<td>9VSCH</td>
</tr>
<tr>
<td>SIA188</td>
<td>9VSSH</td>
</tr>
</tbody>
</table>
DCPC- Direct Controller-Pilot Communications

CAAS - SITAONAIR SATCOM Trial Project results

As presented at the ICAO, CAAS has collected ATC officers (ATCO) and pilots feedback on this service.

Some of the feedback:

- Call Connection – ATCO - good quality calls in general, clarity no worse off than VHF voice;
  - Pilot - able to receive ATC SATVOICE call strength 5/5 with minor background noises (low tone beating noise) similar to TV static noise;

- Call Volume – ATCO - lower than VHF voice volume in general, but in the acceptable range;
  - Pilot - volume low with electronic feedback initially but quality quickly improved;

- Call Latency – ATCO - feels more “laggy” than VHF voice, but much better than HF voice;
  - Pilot - there is a 0.5 sec – 1 sec delay where the transmitted message is being relayed through the SATCOM system. To allow efficient communication, suggest ATCO gives a pause for the response to come through rather than take it as no response;

- Avionics – Pilots find it easy to make calls, and easy to identify incoming calls
  - Need to get familiar with SATVOICE ringtone; and

- VCS – ATCOs find it easy to search for flight numbers to make outgoing calls on the VCS.

While the trial still continues, the interim results and feedback leave no doubt around the quality of the SITAONAIR AIRCOM® Satcom Voice.
Thank you
**Interface Control Definition**

**AIRCOM® Satcom Voice**

**IP addresses:**
- To support GTA calling, SITA operates two voice gateways with IP addresses in public range (57.x.x.x)
- ATG calls will be routed via the SITA voice network - from the Inmarsat Voice Gateway to ATC center voice gateway(s)

**Dial Plan (GTA)**
- **Called Party**
  - 3 + P + <AES-ID> – Dial Airframe via Inmarsat
  - 2 + P + <AES-ID> – Dial Airframe via Iridium
  - 8 + P + <AES-ID> – Dial Airframe Automatically
- **Calling Party:** full PSTN number of calling center

**Dial Plan (ATG - Inmarsat only)**
- **Called Party:** full PSTN number of calling center
- **Calling Party:** 870 5 + P + <AES-ID>

<table>
<thead>
<tr>
<th>Definition</th>
<th>Priorit Digit (P)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emergency</td>
<td>1</td>
<td>AtoG direction only</td>
</tr>
<tr>
<td>Operational High</td>
<td>2</td>
<td>Normal ATC usage</td>
</tr>
<tr>
<td>Operational Low</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Non-Operational</td>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>

<AES-ID> – ICAO AES-ID in octal (8-digits)
Interface Control Definition
AIRCOM® Satcom Voice

SITAONAIR VoIP implementation
• Use G711 without any compression (may take 96Kbps over WAN links)
• (RealTime) QoS set up on WAN routers

VoIP codec requirements
• Avoid compression
• Minimize codec conversion to avoid degrading voice quality
• Codec supported on the Inmarsat GES side is G711 A-law 64k
• Voice quality score is between 1 to 5 using MoS
  Mean Opinion Score : G711 scores 4.1 / 5, and
  G729 scores 3.92 / 5

<table>
<thead>
<tr>
<th>MoS Rating</th>
<th>Label</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Excellent</td>
</tr>
<tr>
<td>4</td>
<td>Good</td>
</tr>
<tr>
<td>3</td>
<td>Fair</td>
</tr>
<tr>
<td>2</td>
<td>Poor</td>
</tr>
<tr>
<td>1</td>
<td>Bad</td>
</tr>
</tbody>
</table>
Interface Control Definition
AIRCOM® Satcom Voice

Security
- AIRCOM® Satcom Voice enabled via private (MPLS) networks only
- ATC center source IP authorized in STA Firewalls and Voice Gateways
- SIP Authentication not required

Testing
- Generating simulated air-to-ground test calls can be supported towards any destination number on the ATC center side
- Inmarsat test calls can be initiated by using a VoIP phone in the SITA VoIP network to emulate an aircraft phone without needing to go through an actual Inmarsat or Iridium network
- SITA will make available real Inmarsat and Iridium avionics in lab to enable testing