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| **ANNEX 1**    INTERNATIONAL CIVIL AVIATION ORGANIZATION |
| **Common Regional Virtual Private Network (CRV)Of Asia/Pacific Air Navigation Planning and implementation Regional Group (APANPIRG)** |
| **Cost Benefit Analysis (First iteration)** |
| INTERNATIONAL CIVIL AVIATION ORGANIZATION  ASIA-PACIFIC OFFICE |

**Document Change Record**

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| 1 | 29 April 2014 | Creation of draft CBA for CRV TF/2 and ACSICG/1 meetings |  |
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1. Introduction

The First Meeting of the CRV (Common Regional Virtual Private Network) Task Force elaborated a work plan for carrying out the study mandated by the Asia/Pacific Air Navigation Planning and Implementation Regional Group (APANPIRG) under Decision 24/32 Common Regional Virtual Private Network (VPN) Task Force.

It was recognized that such a service could be considered as a multinational service, as per ICAO Document ASIA/PAC BASIC ANP Doc9673, and that such approach would require a cost benefit analysis to make sure that the project was cost efficient and beneficial for both developing and advanced States. The task was initiated to collect data from various member states as per Appendix 1 template in order to better define the recurring costs and problems associated with the current configurations. Every State or Administration of the Asia/Pacific Region was invited to reply to this Survey to ICAO Asia and Pacific Office (ICAO APAC Survey).

Fifteen organizations including one ANSP and fourteen States, have positively contributed through the ICAO APAC Survey, as per Appendix 2. This Cost Benefit Analysis (CBA) document analyzes the reports based on the Survey of these States and evaluates options that will help APANPIRG and the member states to take a decision for joining the CRV network and plan their budget accordingly.

* 1. Current Status

Currently, Aeronautical Fixed Telecommunication Network (AFTN) and AMHS services in the Asia/Pacific Region are operated over point-to-point international private lines (IPL). This network configuration exhibits a number of limitations, including (but not limited to):

* Half circuit arrangement between States is increasingly difficult to order and time consuming;
* Circuit upgrades between states is also impacted due to variable pricing and bandwidth availability of the half circuit at each State;
* Dynamic routing is not supported due to limited bandwidth and no central administration of the network;
* Incompatible network protocol do not support Extended Service as specified in ‘Manual on Detailed Technical Specifications for the Aeronautical Telecommunication Network (ATN) using ISO/OSI Standards and Protocols (ICAO Doc9880)’;
* New features enhancement as recommended by ICAO 12th Air Navigation Conference such as System Wide Information Management (SWIM) is not supported;
* Network security measures cannot be implemented which leads many States to implement their own security measures and policy addingto overall costs; and
* Different budget cycles and priorities between States make the synchronization of upgrades difficult and in turn limit the seamless distribution of Aeronautical Fixed Service (AFS) data.
  1. Brief introduction to CRV

In an attempt to resolve these issues, the CRV Task Force was formally established in accordance with APANPIRG Decision (24/32), (Bangkok, Thailand, 24-26 June 2013).

It was decided that a dedicated, common network operated by a Communication service provider is a viable approach to be studied to replace the current configuration. Common networks have successfully been deployed in other ICAO regions (e.g. PENS in the EUR Region and MEVA in the CAR Region). Therefore, the Meeting adopted the following decision:

Decision 24/32 - Common Regional Virtual Private Network (VPN) Task Force

That, a Task Force with Subject Matter Experts (SME) be established to study the virtual private network and develop a detailed proposal by 2016. The Task Force reports the outcome of its study to APANPIRG through ACSICG and CNS SG.

1. Scenario Analysis

The CBA document has studied two scenarios: introducing and not introducing a common aeronautical regional network in the Asia/Pacific region. Cost and benefit analysis was performed for the two scenarios.

* 1. Scenario 1 – Do Nothing

This chapter considers the case of not introducing the CRV.

* + 1. Benefit Analysis
       1. Summarized cost of current link infrastructure from ICAO APAC Survey

From ICAO APAC Survey and analyses on the data provides following

**Type of circuits in use:**

There are three types of circuits currently used by states, ‘Voice only’, ‘Data only’ and ‘Multiplexed Data + Voice’. Summarizing all usage types, the total number of circuits are 181. Distribution of usage is ‘Data only’: 43%, ‘Voice only’: 43% and ‘Multiplexed Data+ Voice’: 14%. Usage of Multiplexed ‘Voice’ and ‘Data’ remains quite low at 14%, indicating that separate circuits are provided for data and voice in most cases.

**Bandwidth in use:**

Currently circuits with 64 Kbps bandwidth accounts for the highest number of circuits in use and amount to 39% of all the circuits in use in Asia/Pacific region. 9.6kbps accounts for 12%. Furthermore the slowest bandwidth used is 2.4kbps and highest bandwidth is 2Mbps. There are 8 lines of 2Mbps.

**Ratio of Landline to Satellite circuits:**

Regarding the use of connection between various states, the ratio of Land Line is 85%, and the ratio of Satellite is quite low at 15%.

In accordance with the result from ICAO APAC Survey, the cost of the communication infrastructure that is currently connected is summarized in the table below:

Figure 1: *Result of ICAO APAC Survey*

|  |  |  |  |
| --- | --- | --- | --- |
| For all  Communications | For voice only | For data only | For multiplexed data + voice |
| Total monthly cost  of communications  for all States (in US$) | 415,647 | 185,009 | 162,498 | 68,140 |
| Total yearly cost  of communications  for all States (in US$) | 4,987,764 | 2,220,110 | 1,949,976 | 817,678 |
| Average yearly cost  by State (in US$) | 332,518 | 148,007 | 129,998 | 54,512 |
| Average kbps cost  (in US$) | 98.7 |  |  |  |
| Caveats:   * Number of States/Administrations in the Survey is 15 organizations (States/ANSPs). * All currencies have been converted into US$ based on the March 14 rate * Costs are a minimal estimate since costs as per use are not included | | | | |

It may be noted that the 15 organizations (States/ANSPs) that were reported by ICAO APAC Survey are spending a total US$ 5 million per year for international aeronautical ground-to-ground communications (voice and data).

* + - 1. Negative impact from doing nothing (can be considered as cost)

Negative impact of non-introduction of the CRV by states based on available data is as follows:

* + - * 1. Inability to support GANP technology roadmap

SWIM is an integral part of the Global Air Navigation Plan (GANP) and relates to a number of Aviation System Block Upgrades (ASBUs) modules. It will offer SWIM technical services based as much as possible on mainstream information technologies (IT) technologies. It will preferably be based on commercial off-the-shelf (COTS) products and services. Typically dedicated, secured IP networks will be applied to the underlying basic ground/ground connectivity. Also a dedicated IP network is an explicit requirement of the technology roadmap to enable SWIM and Voice over IP for inter‐centre voice ATM communications. In Asia/Pacific region, IP network that connects between each States is not currently implemented. The CRV if not implemented will be a major stumbling block in realizing the future plan of ICAO.

* + - * 1. Difficult to expand / manage ground-ground communications (lack of scalability and manageability)

The management - and specifically the upgrade - of the present IPL which are based on half circuit agreements between states is becoming increasingly difficult. Setting up and maintaining the circuits require regular coordination between telecommunication service providers and are difficult to manage. The actual implementation of the circuit requires a long lead time as each State has a different contract procedure and is required to pay for its own half circuit thus making it increasingly difficult to order the circuits in several States. Also, there is no common point for management of faults thus requiring each state to individually research into the cause of a circuit failure and thus it takes a lot of time to isolate the fault. Furthermore, whenever an upgrade of circuit is required due to increased bandwidth requirements, the service provider is not able to upgrade and mostly a new circuit is required to be established to cater for higher bandwidth.

* + - * 1. No common interface – different interfaces due to different technologies used such as X.25, VSAT, etc.

The existing regional network has been built up with large number of IPLs between individual States. These circuits use various underlying protocols and physical interfaces such as X.25, X25/IP conversion, or voice/data MUX, making it increasingly difficult to manage for the technical teams. In addition, many interfaces, which were designed to support point-to-point or application-to-application exchanges, have limited flexibility to accommodate new users, additional systems, new content or changed formats use.

* + - * 1. Obsolescence

According to the ICAO APAC Survey, the maintenance of low-speed IPL by the telecommunication service provider is becoming increasingly difficult. The legacy technologies like X.25 or PES/TES VSAT etc. are almost obsolete, requiring lot of effort and increasing costs to maintain and sustain the network. The service providers are therefore reluctant to maintain the legacy technologies. X.25 technology has been taken over by IP based/ MPLS networks which are more efficient and provide higher bandwidths at lower costs. Also, the Voice/Data Multiplexer has become difficult to maintain as the industry has moved to Voice over Internet Protocol (VoIP) standard. In some cases, spare parts can no longer be obtained from industry.

* + 1. Cost Analysis
       1. Current predictable cost

Currently, the contract method of IPLs is based on half circuit arrangement: the cost is shared by two States for establishing one circuit. In view of difficulty in analyzing each line approach of total cost and average connecting cost in the Asia/Pacific region has been adopted accordance with the purpose.

The analysis of the data based on annual cost per circuit for each bandwidth connection reveals that 64Kbps accounts for 39% of the total circuits and the protocol mainly used is X.25 protocol, and the average cost per circuit is US$ 30,673.

The reason of usage of 64Kbps being so widespread is the use of underlying X.25 protocol which supports 64Kbps as a maximum bandwidth. The cost worked out is per circuit, so total cost for each State depends on the number of connections.

In the future, the need for internet protocol suite (IPS) would increase, requiring faster line speeds. As per the plans AMHS will be used to exchange weather information (WXXM) defined by the XML format, and thus the lines for AMHS will be expected to use IPS for accommodating increased flow of data through XML format.

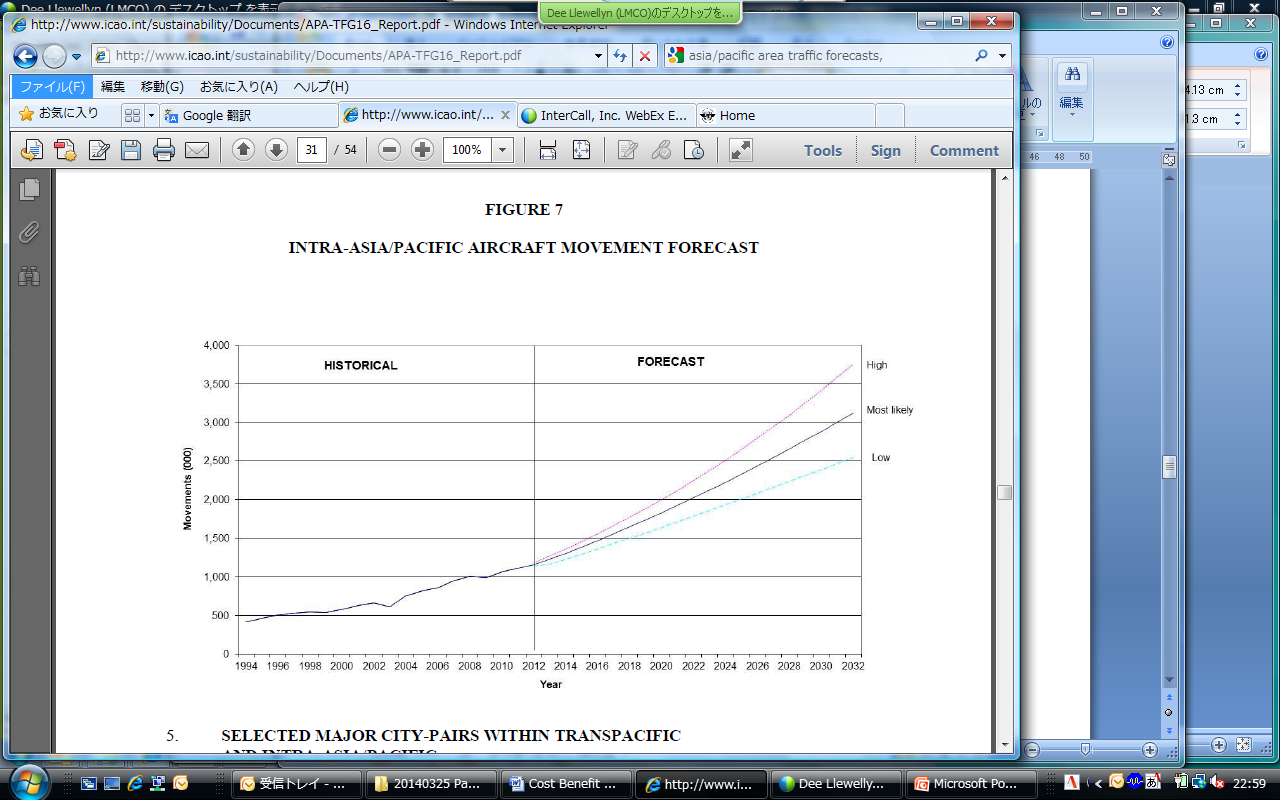
Figure 3: *The Number of lines per bandwidth*

Furthermore, it may be seen that bandwidth requirements/ new circuits will increase in the short-term to cater for the exchange for AIDC messages with adjacent States.

Also as per ICAO APAC Survey, MUX for Voice and Data cannot be maintained by telecommunication service providers in near future, so it is imperative to look for alternative method or install individual circuits for different services.

In the medium to long term perspective, strong growth of demand is expected toward 2032. The demand for aircraft movement of the Intra-Asia/Pacific is shown in the figure 5 below. To cater to these demands, States will need to achieve the ASBUs in GANP (e.g. SWIM). Therefore, the wider bandwidths supported by a secure IP/ MPLS network will be required by existing and new international aeronautical communication services.

Figure 5: *Intra-Asia/Pacific Aircraft Movement Forecast*



Forecasts of Transpacific and Intra-Asia/Pacific Traffic to the Year 2032

(REPORT OF THE ASIA/PACIFIC AREA TRAFFIC FORECASTING GROUP (APA TFG) SIXTEENTH MEETING MONTREAL, 19 – 21 SEPTEMBER 2012)

Consequently, it may be seen that the present method of constructing the network by IPLs to meet the existing requirements as listed above, the cost to maintain the circuits will continue to upwards from yearly US$ 5 million presently being used by 15 States in ICAO APAC Survey.

* 1. Scenario 2 – Move to CRV

This chapter considers the case of introducing the CRV network in the Asia/Pacific region.

* + 1. Benefit Analysis
       1. Support Global Air Navigation Plan (GANP) roadmap

‘ICAO’s Global Air Navigation Plan (GANP) (ICAO Doc 9750)’ has introduced the Aviation System Block Upgrade (ASBUs) framework and roadmaps in 2013. As a follow-up to APANPIRG/24 Conclusion 24/2, regarding the establishment of Regional Priorities and Targets, and referring to the ICAO APAC Seamless ATM plan v1.0, the initial regional priorities endorsed by APANPIRG/25 in September 2014 should be:

* ATFM/A-CDM (B0-NOPS);
* AIM (B0-DATM);
* AIDC (B0-FICE);
* FUA (B0-FRTO);
* Surveillance (B0-ASUR); and
* Data-link ADS-C and CPDLC (B0-TBO).

To enable specifically AIDC (B0--FICE) in the initial regional priorities, implementation of a common network internationally is essentially required. According to the ICAO APAC Survey, currently, there are many problems, such as described in 1.1 Current Status to the introduction of IPLs. For catering to the future services, the communication infrastructure is required in an environment that can take advantage of IT technology.

A dedicated, common regional virtual private network operated by a communication service provider will be of utmost importance in the Asia/Pacific region, in order to promote the implementation of the GANP roadmap and is under consideration to replace the current configuration. Common networks had successfully been deployed in some other ICAO regions (e.g. PENS in the EUR Region and MEVA in the CAR Region).

* + - 1. CRV technology is the enabler for future services:

The CRV network shall be established by using the IP based virtual private network (IP-VPN) service, which will be a closed private IP network via the access line.

Specific service level agreement (SLA) will be put in place between States and a common service provider to guarantee the speed of the circuit, the quality of service (QoS) and other performance and quality parameters.

The usage fee shall be determined based on bandwidth usage or other similar criteria as agreed upon or quoted by a common service provider and is expected to be lower than the one of existing IPL.

As compared to IPL services, such as wide-area Ethernet or conventional Frame Relay, the IP-VPN is advantageous in terms of low running cost, and easy to construct with a flexible network configuration. In addition, priority control and bandwidth control is also feasible, thereby allowing high speed and large capacity of data flow enabling voice communication as well using VoIP.

Therefore, the CRV is sufficient to meet the technical requirements of demands on future concepts, as applications may be developed using IT technology according to the future concepts.

* + - * 1. SWIM

The SWIM is mainly contained in the ASBUs B1-SWIM and B2-SWIM. In addition, the modules relating to service improvement through digital aeronautical information management and integration (B0-DATM & B1-DATM) as well as modules for improving operational performance through FF-ICE (B1-FICE, B2-FICE, and B3-FICE) are important early components of overall SWIM.

Figure 6: *Roadmap of Global Air Navigation Plan*



As an IP network based on IP-VPN, the CRV network will be the future communication infrastructure to support the SWIM.

* + - * 1. ASBUs – B0-FICE

The ICAO, B0-FICE in ASBUs is required to be implemented during the period Block0 (2013 ~ 2018).

Figure 7: *Summary of Module B0-FICE in ASBUs*

|  |  |
| --- | --- |
| **B0-FICE** | |
| **Item** | Increased Interoperability Efficiency and Capacity through Ground – Ground Integration |
| **Summary** | Supports the coordination of ground – ground data communication between ATSU based on ATS Inter-facility Data Communication (AIDC) defined by ICAO Document 9694. |
| **Comment** | Increased Interoperability, Efficiency and Capacity though Ground – Ground Integration  Improves coordination between air traffic service units (ATSUs) by using ATS inter-facility data communication (AIDC) defined by ICAO’s Manual of Air Traffic Services Data Link Applications (Doc9694). The transfer of communication in a data link environment improves the efficiency of this process, particularly for oceanic ATSUs. |

It is set as the target in the short term. Therefore, the reduction in lead time to introduce the procedures will greatly contribute to the achievement. The whole process to implement AIDC with adjacent FIR can be expedited by implementing the CRV instead of establishing IPL which will be expensive and difficult to manage.

* + - 1. Manageability

The CRV will provide a seamless and homogeneous service in view of better management and service level agreements that will be in place between individual states and the communication service provider. Service provider will be in a better position to manage, report and restore the circuits in case of failure. In addition, dynamic increase in bandwidth of the circuits and network will be possible as per the requirement on short notice. The network will be using the underlying IP protocol and thus COTS products/applications will be easily available. The system of monitoring and the maintenance by service provider will be built in 365 days 24 hours. Fault detection will be easy and fault status and reporting can be determined by point of contact quickly and fault section and report generated end-to-end. Monitoring of communication equipment and the circuits shall be possible remotely (e.g. Ping Monitoring, CPU utilization, Memory usage/rate, Traffic (in/out)). In addition, the country that connects to the CRV will be able to ensure the monitoring environment using the WEB.

* + 1. Cost Analysis
       1. Initial One-off deployment costs

To assess the one-off deployment costs, a survey was carried out on several IP-VPN service providers (KDDI, NTT communications). The results of the survey is as follows.

1. The one-off deployment does not depend on the bandwidth.
2. If 21 locations in the 15 States of ICAO APAC Survey introduce IP-VPN, the estimated amounts would be:
3. Large difference occurs in the estimated amount by the situation of the communications infrastructure in each State.
4. From US$ 600 ~ to: US$ 50,000.

Based on the information above, following a conservative approach, the initial one-off deployment costs of introducing the CRV would be assumed to be as follows:

1. The one-off deployment costs should be assumed that it will be introduced as the most expensive case to communication facility of 21 locations.

21(locations) x 50,000(US$) = US$ 1,050,000

1. The costs necessary to TCB for CRV introduction is estimated at: US$ 180,000
2. Adapting the current equipment owned by States to interface with the CRV network is assessed as not needed, because the common service provide will deploy and maintain all necessary equipment.
3. The costs for States representatives to participate in the CRV task force are estimated as follows:

15(States) x 5,000(US$) x 10(times) = US$ 750,000

1. It is required 100 days until operation after application for IP-VPN. In addition, Project management, Design, Safety, Installation and Tests cost for the creation of the network for 15 States (21 locations) for States would be assumed to be US $ 700 per day.

21(locations) x 100(Days) x 700(US $) = US$ 1,470,000

As a result, the initial one-off deployment cost conservative estimative for 15 States (21 locations) amounts to US$ 3,450,000.

* + - 1. Total cost of ownership over 10 years

To compare the cost of the two scenarios on a fair basis, the cost of moving to the CRV has to be estimated over the CRV lifecycle, 10 years (initial 5 years contract plus 5 years extension), including the initial one-off deployment costs to implement the CRV network.

According to *Proposed Asia/Pacific Internet Protocol (IP) Virtual Private Network (VPN) (APANPIRG/24 - WP/20*, using an IP-VPN could result in 30% cost saving and significant additional bandwidth when compared to point-to-point circuits.

The initial one-off deployment costs could be recovered in one or two years, even if it is assumed that the introduction of IP-VPN would only encompass all connected points that were reported in the ICAO APAC Survey (conservative approach).

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 |
| Scenario 1 Do Nothing | One-off costs  (15 States) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Yearly service costs (extrapolated),  (15 States) | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 |
| Cumulative total | 5.00 | 10.00 | 15.00 | 20.00 | 25.00 | 30.00 | 35.00 | 40.00 | 45.00 | 50.00 |
| Scenario 2 Move to CRV | One-off costs  (15 States) | 3.45 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Yearly service costs (extrapolated),  (15 States) | 3.50 | 3.50 | 3.50 | 3.50 | 3.50 | 3.50 | 3.50 | 3.50 | 3.50 | 3.50 |
| Cumulative total | 6.79 | 10.29 | 13.79 | 17.29 | 20.79 | 24.29 | 27.79 | 31.29 | 34.79 | 38.29 |

Figure 8: *Total cost of ownership over 10 years for 15 States, for the 2 scenarios*

Figure 9: *Compared total cost of ownership over 10 years for 15 States, for the 2 scenarios*

In reality it is foreseeable that the number of connections will have to be increased in both scenarios as more States opt in.

If the number of connecting points is increased, the IPL network in Scenario 1will need to be further meshed and the service costs will increase accordingly. In the Scenario 2, the IP-VPN network is not sensitive to the increase in the number of connecting points, which will augment the distance between the 2 scenarios, in favour of Scenario 2.

For example, for an IP network of 1Mbytes with 5 connecting points, the cost comparison between IPL and IP-VPN would be estimated by the following modeling approach:

* Current IPL line is composed of domestic access lines and international IPL line. The costs of the global IPL line is assumed to be 100, in addition, total costs of access lines to the end of both on the global IPL is assumed to be 100. In this case, it becomes 200 to carry out 1 line.
* Regarding the IP-VPN access, since the cost of IP-VPN becomes at least 30% reduction compared with the cost of international IPL line, the cost of the global IP-VPN is assumed to be 70. Since there is no difference in the cost of the access line to the global IP-VPN, it is assumed to be 100.
* It should be noted that, if there is no requirement to increase the bandwidth and access lines, it is not necessary to implement one more line even if the number of connecting States has increased.

Figure 10: *The Cost Comparison between IPL and IP-VPN connectivity*

Access

Access

Access

Access

IP-VPN

IPL

IP-VPN

International

Portion

100 x 10

Access

100 x 70% x 5

5

100 x 10

100 x 5

Figure 11: *The Costs increase of IPL and IP-VPN with an increasing number of Parties*

This shows that the distance between the 2 scenarios as regards the total cost of ownership has been estimated in a conservative way. Costs increase induced by greater connectivity is exponential in Scenario 1 and linear in Scenario 2. Any new need of connectivity would favour even more the scenario 2.

1. Summary

Currently, the Aeronautical Fixed Telecommunication Network (AFTN) and Air Traffic Service Message Handling System (AMHS) provide ground to ground message switching functions based on point-to-point IPLs in the Asia/Pacific Region. The protocol in use is mainly X.25 protocol, which is almost obsolete and becoming difficult to maintain.   
In the Scenario 1, Do Nothing, the acquisition of new IPL circuits by half circuit arrangement between States will become increasingly difficult and require lot of time to establish. Its sustainability may even be threatened by equipment and technology obsolescence.

The Scenario 2 presents strong advantages. Since the AMHS in BBIS is equipped with a dual-stack ATN router, it corresponds to the IP network. Therefore, the IP network is a strong candidate while considering setting up of a new network to facilitate intra region communication. In addition, to achieve the GANP ROADMAP, when considering the introduction of the SWIM, the IP network is essential as a common communication platform that can be connected by various stakeholders. The implementation of the common IP network in the Asia/Pacific region will solve issues of obsolescent technology and enable the introduction of new applications.

The overall architecture of the CRV will provide use of optimum bandwidth and number of circuits for connecting between Asia/Pacific states thus providing sufficient cost benefits and will be a cost effective solution. In the future, the aircraft movement in Asia/Pacific region is forecasted to grow exponentially. Considering the above issues, the introduction of the CRV network is essential, in particular, to build up a system that can correspond to the introduction of new technology for performing collaborative decision-making.

Figure 12: *Summarized Cost Benefit Analysis for CRV*

|  |  |  |
| --- | --- | --- |
|  | Scenario 1 – Do Nothing  (based on ICAO survey) | Scenario 2 – Move to CRV |
| Quantitative benefit | | |
| Cost | Scenario of reference Costs increase induced by greater connectivity is exponential | Expected reduction of the total cost of ownership by 23% over 10 years for 15 States (same number as for Scenario of reference)  Initial one-off deployment efforts paid back in one to two years  Costs increase induced by greater connectivity is linear |
| Performance | Lower performance due to low speed/obsolescent technology and unsuitable design | Better performance based on performance and safety monitoring, and ad hoc design including high speed technology (1~2 Mbps connectivity) |
| Diversity | Fallback solutions by Operator when available | Solutions available on the market (logical fallback on IP-VPN and physical diversity etc) but shall be required through user requirements and monitored |
| Reactivity (Delays) | Longer period to implement a new line with poor control of delays (a couple of months)  Poor synchronisation in change management between APAC States | Reduced time to coordinate and implement any upgrade following pre-established and homogeneous contractual requirements (a couple of weeks) |
| Qualitative benefit | | |
| Safety | Lay down by Point to point, secured by physical | Ensured through network design |
| International commitment | Not possible to meet ICAO GANP objectives | Possible to meet ICAO GANP objectives |
| Contingency | Manage with coordinating each half-circuit by both Service Providers | Manage a whole network by Service Provider |
| Upgradeability | Need for new line and facility to upgrade Bandwidth | Easy to upgrade Bandwidth without installing additional facility |

* **Addendum**

As planned in the CRV planning, CRV Task 27 “Data Collection All states” and Task 28 “Update CBA for ACSICG/2 from RFI” may bring new elements. Particularly the Task 27 Data Collection All states may be used to update the Scenario 1 actual costs to a larger set of States (currently 15 States participated). In this case the Scenario 2 should also be updated to encompass the same number of Parties.

Besides, Task 28 “Update CBA for ACSICG/2 from RFI” could be used to ascertain the assumption made in Paragraph 2.2.2.2 on the cost reduction according to APANPIRG/24 - WP/20 Proposed Asia/Pacific Internet Protocol (IP) Virtual Private Network (VPN).

Nevertheless it is not expected that such updates would change dramatically the assessment that the Scenario 2 Move to CRV is definitively more cost efficient and operationally needed by the APAC Region, considering the expected traffic growth in the coming years.

Appendix 1

**ICAO Cost Benefit Analysis Survey template**

**Location**

1. Please specify the physical postal address of your Communication Center and its phone number

**Costs**

1. Please specify the monthly recurring costs and bandwidth for all circuits used for international telecommunication, for both data and voice

Please specify for each one:

* For data communications: which data are conveyed (AFTN, etc) and destination of the data
* For voice communications: destination of the communications
* Currency of the costs

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Telecommunications** | **Application(s) conveyed** | **Destination** | **Current bandwidth** | **Monthly cost** | **Currency** |
| **Data** |  |  |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
| **Voice** |  |  |  |  |  |
|  |  |  |  |  |  |

**Obsolescence**

1. Please specify if you experience issues with the maintenance of the international telecommunication circuits and their associated equipment

**Reliability**

1. Please specify the frequency of disruptions you experience in the last 2 years, and origin (last mile infrastructure, backbone, other?)
2. Please specify if you need telecommunication backup or diversity
3. Please specify if you have only one circuit for international telecommunication
4. Please specify if you need to have voice telephone service. If you do, please advise if you have any issue in maintenance support.

**Required and actual performance**

1. Please specify if you have required performance or service levels in your contract
2. Please specify if your provider reports about actual performance, or if you monitor the performance
3. Please specify if you need an increase in bandwidth but are unable to do so due to cost increase technical limitation of infrastructure, or contractual limitation of the service contract

Appendix 2

**The Result of ICAO Cost Benefit Analysis Survey**

1. **State or Air Navigation Service Provider**

* Australia, Airservices Australia
* Fiji (Airports Fiji Limited)
* Hong Kong China
* Japan
* India
* Macau
* Malaysia
* Mongolia
* Myanmar, Department of Civil Aviation
* New Zealand
* Republic of Korea
* Philippines
* Singapore
* Thailand
* United States (Salt Lake City, Oakland)

1. **Usage Type**

* data
* voice
* data + voice

1. **Telecommunication Specification**

|  |  |  |
| --- | --- | --- |
| **Data** | **Voice** | **Data + Voice** |
| (on a shared 64k link) | voice | C-BAND Half-Link (VSAT) |
| Data | (on a shared 256k link) | IPL Half-Link (E1) |
| IPL Half-Link (x.21) | (on a shared 64k link) | IPL Half-Link (x.21) |
| Land Line (E1) | As per use | IPL Whole-Link (x.21) |
| Shared 86k link | ETPI | SAT Whole-Link (x.21) |
| SITA | Land Line (4 wires) |  |
| VSAT | Land Line (E1) |  |
| VSAT downlink | PHILCOM |  |
| VSAT Uplink | Shared 86k link |  |
|  | Voice |  |
|  | V-SAT |  |

1. **Application(s) conveyed**

|  |  |  |  |
| --- | --- | --- | --- |
| ADS/CPDLC | 1 | ATS-Lease Line | 1 |
| AFTN | 50 | Compressed voice | 4 |
| AFTN & voice | 5 | DDN/Data (IP) | 1 |
| AFTN (VSAT) | 2 | DDN/Data+voice (IP) | 2 |
| AFTN / ATN Bis Router | 1 | Direct speech circuit | 18 |
| AFTN +voice (Optic) | 2 | DSC (1 line) | 2 |
| AFTN- Satellite | 5 | DSC (3 lines) | 1 |
| AFTN, AMHS | 3 | Hotlines | 1 |
| AFTN, AMHS, Voice | 1 | IASC |  |
| AFTN, Radar, Voice | 1 | IDD (Programmed ISD phone) | 2 |
| AFTN/AIDC | 1 | IMBS | 11 |
| AFTN-Lease Line | 4 | Intl calls | 1 |
| AFTN-Satellite | 1 | PABX | 1 |
| AIDC | 2 | PDC/DATIS | 1 |
| AIDC/AMHS | 1 | Radar, voice | 1 |
| AMHS | 4 | Telephone | 1 |
| AMHS- Satellite | 3 | Voice | 7 |
| AMHS/AIDC | 1 | VoIP | 2 |
| ATN | 1 | X25 Data (AFTN) | 1 |
| ATN Bis Router | 1 | X25 Data (ATN) | 4 |
| ATS- Satellite | 5 |  |  |
| **TOTAL** | 160 | | |

1. **Current bandwidth (Kbps) and number**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 2.4Kbps | 8 | 86Kbps | 2 | 768Kbps | 1 |
| 4.8Kbps | 6 | 128Kbps | 7 | 1,540Kbps | 1 |
| 8.0Kbps | 6 | 137.5Kbps | 3 | 1,544Kbps | 2 |
| 9.6Kbps | 21 | 142.5Kbps | 3 | 2,048Kbps | 8 |
| 19.2Kbps | 1 | 232.5Kbps | 1 |  | |
| 32Kbps | 4 | 256Kbps | 6 |  | |
| 64Kbps | 70 | 512Kbps | 1 |  | |
| **TOTAL** | 151 | | | | |

1. **Type of Transmission Path (LL/VSAT/Satellite) and number**

|  |  |
| --- | --- |
| Land Line | 141 |
| Satellite | 15 |
| VSAT | 10 |
| **TOTAL** | 166 |

1. **Costa (US$)**

|  |  |  |  |
| --- | --- | --- | --- |
| For all  communications | For voice only | For data only | For multiplexed data + voice |
| Total monthly cost  of communications  for all States (in USD) | 415,647 | 185,009 | 162,498 | 68,140 |
| Total yearly cost  of communications  for all States (in USD) | 4,987,764 | 2,220,110 | 1,949,976 | 817,678 |
| Average yearly cost  by State (in USD) | 332,518 | 148,007 | 129,998 | 54,512 |
| Average kbps cost  (in USD) | 98.7 |  |  |  |
| Caveats:   * Number of States/Administrations in the survey 15 * All currencies have been converted into USD based on the March 14 rate * Costs are a minimal estimate since costs as per use are not included | | | | |

1. **Contact**

|  |  |
| --- | --- |
| Australia, Airservices Australia | Communication Centre  National Operation Centre  Level 3 , Alan Wood Building  25 Constitution Ave, Canberra, ACT, 2600  02 6268 4150 |
| Fiji (Airports Fiji Limited) | Nadi Air Traffic Management Center, Airports Fiji Limited, Private Mail Bag, Nadi Airport. Main Phone No. 679-6725 777 ext. 4195, 679 - No. 679-6724 600 |
| Hong Kong China | Room 203, 2/F., Air Traffic Control Complex,  1 Control Tower Road, Hong Kong International Airport, Lantau, Hong Kong.  +852 2910 6222 (Duty Supervisor) |
| Japan | (1)　Air Traffic Management Center (ATMC)  1302-17 Nata Higashi-ku Fukuoka-city Fukuoka-Pref. 811-0204 Japan  (2)　Systems Development, Evaluation and Contingency Management Center (SDECC)  2-2 Kuko Ikeda-city Osaka-pref. 563-0034 Japan |
| India | Executive Director (CNS-OM)  Airports Authority of India  Rajiv Gandhi Bhawan, New Delhi -110003  91-11-24652075 / 91-11-24654142 (Fax) |
| Macau | ADA- Administraiton of Airports  Macau International Airport, PAC on Talpa  Macao, China  Tel number: (+853) 2886 1111 |
| Malaysia | Kuala Lumpur FIR  Kuala Lumpur Air Traffic Control Centre (KL ATCC)  Air Traffic Control Centre  Block B, ATCC Complex, Sultan Abdul Aziz Shah Airport  47200 Subang  Selangor Darul Ehsan  Tel : +603 78473573 Fax : +603 78473572  Kota Kinabalu FIR  Kota Kinabalu Air Traffic Control Centre  Bangunan ATCC, 88618 Kota Kinabalu  Sabah  Tel : +6088 224911 Fax : +6088 219198  Kuching Sub-Centre  Kuching Air Traffic Control Centre  Kuching International Airport, 93728 Kuching  Sarawak  Tel : +6082 455572 Fax : +6082 453199 |
| Mongolia | UB-17120, Communication Navigation Surveillance section, Civil Aviation  Authority of Mongolia, Khan-Uul district, 10th khoroo, Buyant-Ukhaa,  Ulaanbaatar, Mongolia  Phone:+976 11 281603 Fax: +976 1170049785  Email: engineershift@mcaa.gov.mn |
| Myanmar, Department of Civil Aviation | ATC Tower Building, Yangon Int’l Airport  Airport Road, (11021), Mingaladon Tsp:  Yangon, Myanmar.  95-1-533045 |
| New Zealand | • Main Site: 20 Sir William Pickering Drive, Russley, Christchurch, New Zealand  • Contingency site: Cyrill Kay Road, Auckland Airport, Auckland, New Zealand |
| Republic of Korea | AFTN Center  Address : 62, Haneul-Gil Gangseo-Gu Seoul, 157-711, Korea  Phone : 82226602931  ACC Address : P.O.B No 29, 272, Gonghangno jung-gu Inchon 400-340, Korea  Phone : 82328800335 |
| Philippines | Civil Aviation of the Philippines, Old Mia Road, Pasay City, Philippines, 1300, +63-2-8799255 |
| Singapore | Singapore Air Traffic Control Centre, LORADS II Building, 60, Biggin Hill Road, Singapore Postal Code 509950, Telephone No: 6214 8050 / 6214 8065 / Fax: 6545 9370 |
| Thailand | Aeronautical Radio Of Thailand LTD. 102 Ngamduplee Tungmahamek sathorn Bangkok Thailand 10120 Tel 0-2287-3531-41 |
| United States (Salt Lake City) | Salt Lake City Network Enterprise Management Center 2150 W. 700 N. Salt Lake City UT 84116 Main Phone Number; 801-320-2172  Oakland Air Route Traffic Control Center 5125 Central Avenue Fremont, CA 94536-6531 Main Phone Number; 510-745-3000 |
| United States (Oakland) | Oakland Air Route Traffic Control Center 5125 Central Avenue Fremont, CA 94536-6531 Main Phone Number; 510-745-3000 |

1. **Obsolescence**

|  |  |
| --- | --- |
| Australia, Airservices Australia | IPL circuits are not a preferred delivery method all though Australian Services Providers can still deliver the services. Current IndoSAT service to Indonesia is ageing and requires replacement. |
| Fiji (Airports Fiji Limited) | IPLC is phasing out as some service providers are not supporting this technology. Voice /data multiplexer has become difficulty to support as spare parts are obsolete. |
| Hong Kong China | Obsolescence of telecom equipment and modem at Philippines side resulting in unstable IASC/AFTN performance affecting effective ATC coordination and inducing prolonged service outage. |
| Japan | We have to spend the cost and period when we need to change the type of circuit, by the system upgrade, the end of legacy circuit service. |
| India | a) Difficulty in Availability of half circuits.  b) Phasing out of certain type of medias like satellite to submarine cable  (e.g. in case of Nairobi)  c) Obsolescence of low speed circuits.  d) Maintenance of circuits is with Communication service provider . |
| Macau | International telecommunication circuits are stable |
| Malaysia | Most of direct speech circuits between Kuala Lumpur ATCC and its neighboring ATCC (as listed in Para 2 above) are analogue circuits. The service providers at both ends are facing obsolescence issues with the network equipment used to provision these circuits. All international circuits are on half circuit arrangement whereby each ANSP will subscribe the required circuit from their preferred telecommunication service provider. |
| Mongolia | Currently we have no issues on our international telecommunication circuits for:  Beijing (cisco 3825) with VSAT and optic  Irkutsk (SDM 9880) with VSAT and optic |
| Myanmar, Department of Civil Aviation | The maintenance of Circuit and associated equipment for Yangon-Bangkok V-SAT link which conveyed AFTN and three DSC lines to Bangkok are done by AEROTHAI.'  The land line (E1) connection to Beijing is new and under installation which is substituted to old Yangon-Beijing V-SAT link. |
| New Zealand | • We have experienced sever outages with the connection to Rarotonga, one that took 6months to resolve due to the hardware used on the last mile being obsolete and the replacement was unable to be configured. We ended up sending one of our technicians to assist in the resolution.  • Tonga used to suffer multiple outages so we installed our own satellite dish and equipment.  The circuit to Tonga is on an Airways owned Satellite link, leasing Bandwidth from a satellite Service provider. Airways is planning an expansion of satellite services in the Pacific in the next Financial Year, including Rarotonga and Samoa |
| Republic of Korea | Nil |
| Philippines | Yes |
| Singapore | It is getting more difficult to lease slow speed international telecom. Circuits (64kbps and below) from Telecom Service Providers in Singapore. Some Telcos have notified that they are only able to provide services for 2Mbps (E1) and above. This is a potential problem as there is no immediate need for higher bandwidth to support existing applications. Therefore bilateral counterparts may not be willing to match the higher bandwidth due to higher cost involved. |
| Thailand | AEROTHAI provide the ATS-satellite communication services to our neighbors. We have annual maintenance procedure in place and we will inform our users (neighbors) about the maintenance. As for the ATS lease lines service, the service provider are maintaining the circuits. However, we have not received any coordination from them with regards to maintenances. The contract that we have did not require the service provider to inform us before, however, we would like to have coordination with service provider with regards to maintenance in order to plan our alternative services accordingly. |
| United States (Salt Lake City) | The Voice/Data Multiplexer has become difficult to maintain as the industry has moved to Voice over Internet Protocol (VoIP) standard. The spare part can no longer be obtained from industry. |
| United States (Oakland) | The Voice/Data Multiplexer has become difficult to maintain as the industry has moved to Voice over Internet Protocol (VoIP) standard. The spare part can no longer be obtained from industry. |

1. **Reliability**
2. **Frequency of disruptions you experience in the last 2 years**

|  |  |
| --- | --- |
| Australia, Airservices Australia | Fiji 13  New Zealand 12  Papua New Guinea 6  South Africa 34  Singapore 8  United States of America 9  Indonesia 14  Most faults relate to Carrier backbone. |
| Fiji (Airports Fiji Limited) | In the last 2 years, the circuit has been performing statisfactory. There were outages relate to the international circuits due to link problems. Traffic to adjacent Communication Centres was diverted via alternate paths when encountering link problems and no delay to traffic was recorded. |
| Hong Kong China | In the last 2 years, covering the period from January 2012 to December 2013, the performance of the international links was satisfactory. There were 6 interruptions for over 60 minutes on the international circuits due to link problems and AAG/SMW3 network cable problems. Traffic to adjacent Communication Centres was diverted via alternate paths when encountering link problems and no delay to traffic was recorded. |
| Japan | The disruptions against 38 leased circuits have been occurred 7 times in the last 2 years under the responsibility of our contracting provider, because of transmission equipment failure, urgent maintenance work, fiber damage, and network terminal unit(NTU) failure. |
| India |  |
| Macau | 4 times in the last 2 years, due to service enhancement works or maintenance activities by Telecommunication Service Provider |
| Malaysia | The service disruptions occurred almost every month on certain circuits and it took a very long to restore. Among the circuits that used to have long outages are:  • Kota Kinabalu – Manila  • Kota Kinabalu – Ujung Pandang (VSAT)  • Kuala Lumpur – Chennai  The problem could originate from either side and mostly due to the last mile cable cut or equipment obsolescence issues |
| Mongolia | No issues except solar interference, during the solar interference the AFTN is switched to optic. |
| Myanmar, Department of Civil Aviation | Nil |
| New Zealand | • Tonga suffers every year due to Solar events but this is manageable and the local technician is excellent.  • We continue to have several outages a year with Rarotonga that appear to be a combination of backbone and last mile issues. |
| Republic of Korea | Nil |
| Philippines | 6 outages/month (average in the last two years) on Hong Kong AFTN  5 outages/month (average in the last two years) on Singaore Hotline and AFTN  2 outages/month (average in the last two years) on Oakland, Ujung Pandang, Kota Kinabalu, Ho Chi Minh, Taipei,  1 outage/month (average in the last two years) on Naha, Fukuoka, Hong Kong |
| Singapore | Disruptions of services vary from one country to another, ranging from no or very little disruption to almost every day experiencing circuit issues. Faults are also varied: last mile infrastructure like modems, servers; international link outages etc |
| Thailand |  |
| United States (Salt Lake City) | The circuits have not had any issues yet. The equipment is maintained using in-house maintenance personnel and spare part. It is noted that by the end of 2014, the industry will not offer additional bandwidth nor new dedicated circuit. This will impact support for future requirement |
| United States (Oakland) | The circuits have not had any issues yet. The equipment is maintained using in-house maintenance personnel and spare part. It is noted that by the end of 2014, the industry will not offer additional bandwidth nor new dedicated circuit. This will impact support for future requirement |

1. **Need for telecommunication backup or diversity**

|  |  |
| --- | --- |
| Australia, Airservices Australia | Airservices operates two enroute centres, one in Brisbane and one in Melbourne. Each centre backs up the other, so connections need to be made to both. |
| Fiji (Airports Fiji Limited) | Yes. We have only one center without any redundant international link for communication diversity. |
| Hong Kong China | There are normally main and standby circuits for local tails due space diversity of local main/backup communication centres. Resilience arrangements are solicited from teleco for international connections to oversea counterparts, e.g. ring, satellite and submarine, two backbone circuits, etc. for network protection in the form of Service Level Agreement with CAD. |
| Japan | We have to establish 2 access lines to CRV in Japan. The one will be used at ATMC for operational purpose, the other will be done at SDECC(Systems Development Evaluation and Contingency Management Center) in Osaka there are backup features when ATMC is suffered or lost the feature by the disaster . |
| India | Yes definitely backup is required as it will ensure enhanced service levels |
| Macau | Yes we need |
| Malaysia | There is a backup service over VSAT available for Kuala Lumpur – Bangkok only. The diversity or backup is required since a single circuit especially in digital platform are normally carrying both data and voice traffic. Line failure will affect total failure of communication between both ANSPs, hence affecting the efficiency of traffic coordination and safety. |
| Mongolia | We have Optic and VSAT for both Beijing and Irkutsk. |
| Myanmar, Department of Civil Aviation | telecommunication link to India for ADSB data sharing, AFTN, AIDC and DSC |
| New Zealand | • Within New Zealand yes. We currently have a connection point at our Main operations centre in Christchurch and another connection at our operations centre in Auckland. These two are linked via our own network and form part of a ring network with other states. |
| Republic of Korea | Nil |
| Philippines | Yes |
| Singapore | Yes, both. Our backup is usually additional/redundant link which we can fall back on if the main circuit goes down. As for diversity, we can either send/receive AFTN/AMHS messages from more than one routing based on the routing tables if the main route has problem. |
| Thailand | We wish to have backup / diversity for all ATS links to reduce the single point of failure. The redundancy line should follow common rule that all paths / equipments of the line should be duplicated and separate, e.g. fiber used for each line should be different, lines coming in our facility should be separated, equipments should be duplicated and separate, termination points should be separated, etc. |
| United States (Salt Lake City) | Yes. |
| United States (Oakland) | Yes. |

1. **Have only one circuit for international telecommunication?**

|  |  |
| --- | --- |
| Australia, Airservices Australia | Airservices has 9 stand alone international circuits which carrier Voice and Data |
| Fiji (Airports Fiji Limited) | AFL has 4 dedicated international IPLC circuit that carry voice & data traffic. |
| Hong Kong China | There is only one backbone circuit subscribed for each international data connection, more than one circuits are arranged for IASC telephone connection with each counterpart. |
| Japan | None |
| India | No |
| Macau | have more than 1 circuit for international telecommunication with connections to Zhuhai and Hong Kong |
| Malaysia | There are multiple circuits available between Malaysian FIRs and neighboring FIRs. |
| Mongolia | We have 2 international telecommunication circuits such as Irkutsk (Russia), and Beijing (China) |
| Myanmar, Department of Civil Aviation | Nil |
| New Zealand | • We have 6 circuits |
| Republic of Korea | Nil |
| Philippines | - No for Oakland, Ujung, Kota, Ho Chi Minh, Taiei,Hong Kong - Yes for Naha, Fukuoka, Singapore |
| Singapore | Not Applicable. |
| Thailand | Not Applicable. |
| United States (Salt Lake City) | No. FAA has 6 dedicated circuits to Asia/Pacific region in addition to multiple connections to Pacific region using public internet or internal telecommunication network. |
| United States (Oakland) | No. FAA has 6 dedicated circuits to Asia/Pacific region in addition to multiple connections to Pacific region using public internet or internal telecommunication network |

1. **Voice telephone service**

|  |  |
| --- | --- |
| Australia, Airservices Australia | Airservices has voice intercoms to international ANSP’s as indicated in Question 2. We already mix voice and data together on many of our lines and we see this as necessary for the success of the CRV. Without voice on the CRV the cost/benefit is much poorer as we would then need to establish a separate solution for the voice." |
| Fiji (Airports Fiji Limited) | We have voice intercom to adjacent FIR centters (Brisbaneia, Auckland, Oakland) and ANSP (New Caledonia) using the voice/data mux and telephone circuit to Vanuatu, Kiribati & Tuvalu) |
| Hong Kong China | CAD has IASC telephone connections to Guangzhou, Haikou, Macao, Taipei and Manila, respectively.  IDD phones are the backup systems for IASC phones. |
| Japan | We expect the CRV to use voice over Internet Protocol (VoIP).Instead of installing the voice router maintenance, we have to install the monitoring equipment of voice router. |
| India | Yes voice circuits are already in use. Issues similar to data circuits. |
| Macau | Yes, needed. However, service will be interrupted when maintenance work is performed by Telecom SP. Coordination with end users has to be carried out to minimize impact |
| Malaysia | Voice telephone service (or also known as International Direct Dialing – IDD) is essential as alternative communication to direct speech circuit. There is no issue with regards to the availability and maintenance support for voice telephone service in Malaysia |
| Mongolia | Both of our AFTN terminals have voice telephone services. No issue in maintenance support. |
| Myanmar, Department of Civil Aviation | Nil |
| New Zealand | • We have voice services off our Voice Communication System (VCS) to Tonga, USA, Australia and Fiji.  • We utilize PABX phone lines to Tahiti, Rarotonga and Samoa |
| Republic of Korea | Nil |
| Philippines | Yes, also expericning maintenance support on voice telephone service |
| Singapore | Yes we do need to coordinate with adjacent FIRs and ATC centre. Currently we don’t have any issue with maintenance support |
| Thailand | We do need to have voice telephone service. Furthermore, for those voice telephone services, we truly need to have the maintenance procedure in place due to its importance. |
| United States (Salt Lake City) | Yes. FAA has many voice services to Asia/Pacific region. The FAA is in the process to replace the voice service that is based on voice/data multiplexer to VoIP. |
| United States (Oakland) | Yes. FAA has many voice services to Asia/Pacific region. The FAA is in the process to replace the voice service that is based on voice/data multiplexer to VoIP. |

1. **Required and actual performance**
2. **Required performance or service levels in your contract**

|  |  |
| --- | --- |
| Australia, Airservices Australia | All services have services level associated with them for response and restoration of faults |
| Fiji (Airports Fiji Limited) | We are still discussing with our service provider for an SLA. Our performance availability requirement is 99.99%. |
| Hong Kong China | Resilience arrangements are solicited from teleco for international connections to oversea counterparts, e.g. ring, satellite and submarine, two backbone circuits, etc. for network protection in the form of Service Level Agreement. The availability performance pledge required is at least 99.99%. Direct links with minimal and predictable data transmission delay for safety critical information. |
| Japan | Our systems require connecting to the closed network for the security, for example, except the connection to the public internet circuit. |
| India | At present no SLAs exist in our contract for international circuits. |
| Macau | On circuit breakdown reported to the TSP, promptly investigate the cause, repair and restore the service at the shortest practicable time |
| Malaysia | The service provider in Malaysia is unable to offer service level guarantee to international private leased circuits (IPLC) on half circuit arrangement. It is on best effort basis and very much depends on the good coordination telecommunication service providers at both ends. |
| Mongolia | No |
| Myanmar, Department of Civil Aviation | Nil |
| New Zealand | • I am not aware of any |
| Republic of Korea | Nil |
| Philippines | It is not specified in our contracts but we require the service providers to maintain no less than 97% serviceability and reliability in accordance with ICAO standard/requirements |
| Singapore | Yes we do. Currently the service performance for half-circuits for bilateral agreement is up to 99% or better, from Singapore-end to the international front end. |
| Thailand |  |
| United States (Salt Lake City) | FAA operational requirement for a circuit/connection is 99.5%. Overall performance availability requirement is 99.9%. The 99.9% of service availability requirement is defined by using the voice service as a backup for AIDC and AFTN/AMHS backup is supported by dual AMHS as well as alternative routing. |
| United States (Oakland) | FAA operational requirement for a circuit/connection is 99.5%. Overall performance availability requirement is 99.9%. The 99.9% of service availability requirement is defined by using the voice service as a backup for AIDC and AFTN/AMHS backup is supported by dual AMHS as well as alternative routing. |

1. **Does your provider report about actual performance, or if you monitor the performance**

|  |  |
| --- | --- |
| Australia, Airservices Australia | Performance is monitored by Airservices. |
| Fiji (Airports Fiji Limited) | We can only monitor the performance of the link through the operational status of the circuit. We rely on the service providers advice on the link outages and causes. |
| Hong Kong China | CAD monitors the real-time performance of international circuits on application availability perspective on daily basis. Any anomaly will be checked with teleco and counterparts for confirmation of root cause as well as liaison for timely implementation of mitigation measures in order to resume services. |
| Japan | Our provider reports immediately when the line disconnection occurred, and in monthly, they report the rate of operation, the detail of line disconnected and the network undersea cable to us. |
| India | Performance is monitored in house on Daily/Monthly basis. But no regular reports are received from the service provider. |
| Macau | Circuits are stable. Performance report provided on abnormal fault |
| Malaysia | The monitoring of performance is achieved by having monthly report based on the docket issued for each occurrence of service disruption. |
| Mongolia | We report about the actual performance |
| Myanmar, Department of Civil Aviation | SITA reports actual performance and the others are done by self monitoring. |
| New Zealand | • At present we only monitor the Tonga link as that is the only IP one. This is still being developed.  • Telecom New Zealand will provide us with information regarding outages, resolution and why the outage occurred. |
| Republic of Korea | Nil |
| Philippines | Monthly outages are submitted to the provider whilst monitoring circuit availability |
| Singapore | Yes, service providers submit monthly reports about actual performance of the circuits contracted as well as any major faults with frequent updates on the status. Separately, we also monitor the circuit performance at the AFTN/AMHS Comcentre. |
| Thailand |  |
|  |  |
| United States (Salt Lake City) | The FAA has a capability to monitor the network performance. However, most of its international circuits are shared 50% with other ANSPs that prevent it from a complete end-to-end monitoring. This caused delay in identifying the failure and correction in a timely manner |
| United States (Oakland) | The FAA has a capability to monitor the network performance. However, most of its international circuits are shared 50% with other ANSPs that prevent it from a complete end-to-end monitoring. This caused delay in identifying the failure and correction in a timely manner |

1. **Need for an increase in bandwidth?**

|  |  |
| --- | --- |
| Australia, Airservices Australia | No , at this stage this is not an issue but in the future the CRV should be flexible in the ability to increase bandwidth when required for applications such as System Wide Information Management (SWIM) |
| Fiji (Airports Fiji Limited) | No, we do not need any increase in bandwidth on the existing operational requirements but more bandwidth will be required in future to support the ASBU initiatives. |
| Hong Kong China | Increase in bandwidth to at least 64kbps for connection of ATN/AMHS services with Backbone Boundary Intermediate System (BBIS) and Boundary Intermediate System (BIS) is planned. |
| Japan | None |
| India | At present there are no plans to increase BW for international circuits however, Airports Authority of India has plans to upgrade Bandwidth as per various service requirements including RADAR, ADS-B, VHF Data, GNSS etc apart from AFTN/Voice within India based on MPLS cloud. This MPLS domestic cloud will support all the international leased circuits |
| Macau | Current bandwidth of international telecom circuits sufficient. Increase in bandwidth is necessary for future service(s) and/or backup/diversity |
| Malaysia | There are requirements for increase in bandwidth such as communication lines to Jakarta and Singapore as well as migration from analog platform to digital using IP-based communication system.  There is no issue on Malaysia side since all voice switches are already upgraded to new digital platform. However, there may be technical issues with neighboring ATCCs which are still using legacy voice switches. There are also issues with regards to cost to subscribe for additional bandwidth due to the contractual limitation faced by the neighboring ANSPs. |
| Mongolia | We have enough bandwidth to support our international telecommunication circuit, we also have optic communication system. |
| Myanmar, Department of Civil Aviation | Myanmar need to increase bandwidth of Yangon-Bangkok V-SAT link and upgrade to IP connection for AFTN/AMHS, DSC and future data link applications. But Myanmar and AEROTHAI have coordination and continues action for this issue |
| New Zealand | • The FAA has recently increased the bandwidth on the Christchurch to Oakland circuit due to a contract expiry and they are now paying for the cost of the whole circuit.  • We looked at doing the same with the Auckland to Brisbane circuit, however the cost of doing this is prohibitive. |
| Republic of Korea | Nil |
| Philippines | No bandwidth issues were encountered so far on the listed circuits |
| Singapore | Currently, there is no urgent or immediate need for increase in bandwidth. The difficulty we faced usually is due to cost factor. Since most of the circuits are bilateral, both States must agree to the cost increase (if any) to be incurred at their own end before proceeding with the procurement. |
| Thailand | As for our satellite services, we have enough spare bandwidth to accommodate an increase (temporally) in bandwidth usage without additional cost. However, for the lease lines, we do have restriction for connection with certain sites due to hardware limitation, e.g. no available port or timeslot. Furthermore, requesting for more bandwidth requires additional charges, which will take a long time for us to get approved. |
| United States (Salt Lake City) | Yes. The FAA is in need to increase the bandwidth to support Traffic Flow Management data, weather data, etc. but unable to carry out due to high cost incurred to other ANSPs. In addition, it is time consuming to upgrade the service as the selected vendors have to establish business process to each other and the process to obtain formal bi-lateral agreement. It’s usually taken 3-5 years to upgrade telecommunication service between ANSPs. |
| United States (Oakland) | Yes. The FAA is in need to increase the bandwidth to support Traffic Flow Management data, weather data, etc. but unable to carry out due to high cost incurred to other ANSPs. In addition, it is time consuming to upgrade the service as the selected vendors have to establish business process to each other and the process to obtain formal bi-lateral agreement. It’s usually taken 3-5 years to upgrade telecommunication service between ANSPs |