International Civil Aviation Organization

Seventh Meeting of the Asia/Pacific ATS Inter-facility Data-link Communication Implementation Task Force (APA TF/7) of APANPIRG

Video Teleconference, 7-9 June 2021.

Agenda Item 2: Review of outcomes of relevant meetings

OUTCOMES OF RELEVANT MEETINGS

(Presented by the Secretariat)

SUMMARY

This paper presents the relevant outcomes of the Eighth Meeting of the Common aeRonautical Virtual Private Network Operations Group of APANPIRG (CRV OG/8) and First meeting of surveillance data study group (SURSG/1).

1. INTRODUCTION

1.1 The Eighth Meeting of the Common aeRonautical Virtual Private Network Operations Group of APANPIRG (CRV OG/8) was held via video tele-conference from 17 to 19 May 2021. The meeting was attended by 97 participants from 22 States/Administration, 1 International Organizations and 3 industries namely Aireon, a member of ICCAIA, Frequentis and PCCW Global. CRV OG/8 meeting report, working papers, information papers, and other resources can be accessed by following link:

https://www.icao.int/APAC/Meetings/Pages/2021-CRV-OG8.aspx

1.2 The First meeting of surveillance data study group (SURSG/1) was held from 20 April - 22 April 2021. The meeting was attended by 118 participants from 15 States/Administration and 4 International Organizations and 2 industry partners namely Frequentis and PCCW Global. SURSG/1 meeting report, working papers, information papers, and other resources can be accessed by following link:

https://www.icao.int/APAC/Meetings/Pages/2021-SURSG-1.aspx.

1.3 This paper summarized relevant information and updates with the highlight on the outcomes of CRV OG/8 and SURSG/1 to be reviewed by CNS SG/25 and APANPIRG/32.

2. DISCUSSION

Eighth Meeting of the Common aeRonautical Virtual Private Network Operations Group (CRV OG/8)

Election of Co-Chair (Asia)

2.1. Mr. Vaughan Hickford, Team Leader Network Design, Airways New Zealand was elected as the new Co-Chair (Asia) of the CRV OG.

CRV OG Operational Manual- New Zealand

2.2. New Zealand presented an overview of the CRV Operations Manual covering the location, layout and content. It was informed that the CRV OG Operations Manual is an informal publication prepared by the CRV Task Force intended to provide an easy reference for interested parties, a consolidation of material particularly of a procedural nature, about the work of the CRV OG and its contributory bodies. It was informed that The Operations Manual will be distributed to Members and Observers of APANPIRG, the ICAO Secretariat, to other States and international organizations participating in meetings, contributing and to, or having interest in the work of the CRV OG and/or its Contributory Bodies. .

2.3. The CRV OG Operations Manual (Edition 1.0) is provided in **Appendix A** to this paper and also accessible at: https://www.icao.int/APAC/Pages/eDocs.aspx under CNS section.

CRV Implementation Plan- IP Addressing Scheme for Third Party Service Provider- Singapore

2.4. Singapore presented the Internet Protocol (IP) addressing scheme for third party service providers, e.g. AIREON LLC providing Automatic Dependent Surveillance- Broadcast (ADS-B) data over the CRV and proposed the amendments to the CRV Implementation Plan.

2.5. In late 2020, the ad hoc CRV OG, including Fiji, New Zealand and Singapore, agreed to use 10.46.0.1 to 10.46.255.254 IP range, for the allocation of IP addresses to third party service providers. Each third party service provider can be assigned with 254, 510, 764 or 1022 usable network addresses but depending on third party service providers' technical specifications. Based on which third party service providers, namely AIREON LLC and PCCWG, were allocated with /24 IP address blocks.

2.6. With aforementioned, the meeting agreed to formulate the following Draft Conclusion for the consideration by the ACSICG/8 meeting.

<table>
<tr><td colspan="3">Draft Conclusion CRV/08/01 – CRV Implementation Plan amendment (Version 2.1, Attachment A)</td></tr>
<tr><td colspan="2">What: That, the CRV Implementation Plan be amended to include the following new text in paragraph 2.4.2 – IP Addressing

iii. In the development of the IPv4 plan, a flexible margin has been designated to allow future growth or change. Through draft Conclusion CRV OG/8/01, using 10.46.0.1 to 10.46.255.254, each third party Service Provider (e.g. AIREON LLC providing Automatic Dependent Surveillance - Broadcast data over CRV) is assigned 254, 510, 764 or 1022 usable Network addresses (depending on Service Providers' technical requirements); and</td><td>Expected impact:
☐ Political / Global
☐ Inter-regional
☐ Economic
☐ Environmental
☒ Ops/Technical</td></tr>
<tr><td>Why: To allocate IP addresses to third party service providers for the delivery of services over CRV</td><td colspan="2">Follow-up: ☒Required from States</td></tr>
<tr><td>When: 21-Jun-21</td><td colspan="2">Status: Draft to be adopted by Subgroup</td></tr>
</table>

Who:	☒Sub groups ☐APAC States ☐ICAO APAC RO ☐ICAO HQ ☒Other: ACSICG

2.7. The proposed *CRV Implementation Plan amendment (Version 2.1*) is provided in **Appendix B** to this paper.

CRV Landing page- New Zealand

2.8. New Zealand presented implementation of a CRV landing page on the APAC ICAO website to provide information about CRV and how to join CRV. The location and content of the landing page was proposed and agreed by the meeting, and is to be implemented by the ICAO APAC Regional Office IT Team at: https://www.icao.int/APAC/Pages/default.aspx.

2.9. ICAO APAC office has implemented CRV Landing page at: https://www.icao.int/APAC/Pages/Join-CRV.aspx

Creation of expert groups within CRV OG along the lines of Strategy, Design, Transition and Operations- New Zealand

2.10. New Zealand presented a proposal to implement expert groups within the CRV OG for the purposes of increasing member participation outside the OG meetings and to provide the ability to turn around decisions and changes quicker than waiting for the OG meeting. As APAC region is in the early stage of implementing CRV, there is more work required in the establishment of both the network and the Polices, Process and Procedures required to administer the network. The APAC solution is to create Sub-Groups within the OG along the lines of Strategy, Design, Transition, and Operations. Continuous Service Improvement would continue as the wider group lead by the Co-Chairs. The groups make up and responsibilities will be recorded in the Operations Manual. The member States/Administration volunteered for four expert group are as follows:

SN	Expert Group Name	Volunteered Member	Group leader
1	Service Strategy	Singapore, USA, India	New Zealand/Fiji
2	Service Design	Singapore, USA, Hong Kong China	New Zealand/Fiji
3	Service Transition	China, Singapore	New Zealand/Fiji
4	Service Operations	Australia, China, Singapore, India	New Zealand/Fiji

Latest CRV operational performance report- PCCWG

2.10. PCCWG shared Latest CRV Updates and CRV Network Yearly Service Review. PCCWG informed that there are *38 circuits* in *26 cities* with different CRV packages, A, B+, C+, C and D. There are 2 service providers in the CRV network and 3 sites (B+, C) are under implementation. It was further informed that 8 cities are planning to join CRV in 2021 which are *Mumbai (India), Jakarta (Indonesia), Makassar (Indonesia), Bangkok (Thailand), Moscow (Russia), Khabarovsk (Russia), New Caledonia, and French Polynesia.*

2.11. The meeting was informed that Standard CRV contractual period is 5 years and all authorities should join CRV network before 31 December 2022. *Additional charges* may apply to new users with billing start date later than 31 December 2022.

2.12. Bhutan shared the challenging situation since its CRV implementation as per the commitment to ICAO APAC common regional target while the peer States with Bhutan are in process to join CRV. Therefore, Bhutan is not able to utilize the CRV while they have to pay recurring charges every month to PCCWG. Bhutan requested the ICAO APAC Regional Office and CRV OG to help in negotiating with PCCWG to waive or reduce recurring charge till the peer States (India and Thailand) are ready. Bhutan also requested the ICAO APAC Regional Office to discuss for alternate solutions such as connection through Hong Kong, China or any other States hosting BBIS, which have joined CRV, in order to utilize CRV for AMHS traffic by Bhutan for the intended purpose. The meeting agreed to establish an ad hoc group to explore Bhutan's issue. The ICAO Secretariat will coordinate with Bhutan, Hong Kong China, Singapore, co-chairs of CRV OG, ACSICG chair and other concerned parties to set up on line discussion for addressing the issue before ACSICG/8 meeting.

In Case Of CRV Core Network Failure- Japan

2.13. Japan shared an experience of CRV Core network failure and proposed its measures. On 8th March 2021, Japan experienced an incident where the line did not switch automatically when a CRV network failure occurred. At the time of incident, the core router installation work was being conducted at Osaka PoP site and LAN cables were accidentally disconnected from core router. By this accident, three main lines over package A had been downed and the line did not change to sub-lines automatically. Accordingly, JCAB ATSEP staff manually changed from the main route to the sub route by disconnecting the cable from main CE router.

Update the AMHS/ATN Implementation Status Table and the APAC CRV Implementation Table- Sec

2.14. The meeting was informed about the State Letter Ref.: T 8/2.10 - AP041/20 (CNS) dated 2 March 2020, that extended the Reminder for implementation of Common aeRonautical VPN (CRV) in APAC Region by 2020. It was further informed that CRV OG might recommend to establish an Air Navigation Deficiency Report beginning 2021 for those States/Administrations that have not implemented CRV.

2.15. Considering the challenges and difficulties faced by States/Administrations under current pandemic situation, the APANPIRG/31 meeting adopted the Conclusion C31/12 - *Target Year of CRV Implementation in APAC Region* recommended by CNS SG/24, to postpone the target year of regional implementation of CRV *from 2020 to the end of 2021*. A State Letter Ref.: T 8/2.10-AP002/21(CNS), dated on 6 January 2021 was sent for this matter.

2.16. The latest updates submitted by the service provider on planning and implementation status of CRV was presented. As per the report, states having CRV Under Operation are *Australia, Bhutan, China, Fiji, Hong Kong China, Japan, New Zealand, Philippines, PNG, Republic of Korea, Singapore and USA,* states having CRV Under Provisioning are *Malaysia and Nepal* and states having Hot Prospects in 2021 are *India, Indonesia, New Caledonia, French Polynesia, Russia, Thailand.*

2.17. France informed that they had commitment to implement CRV before end of 2021 but COVID-19 Pandemic has changed the scenario and France will *not be able to join CRV before 2023*.

Connecting Russian Communication Centers to CRV- Russian Federation

2.18. As per Com Coordination Meeting between Japan, China, Mongolia, and Russia in Bangkok in May 2019 on the transition of information exchange using AMHS procedures, the Russian Federation agreed to consider the possibility of connecting to the CRV at three locations, namely Moscow, Khabarovsk and Irkutsk. The ICAO Regional Office facilitated the organization of negotiations between PCCWG and the Russian Federation on joining the CRV. The draft technical and

commercial proposals by PCCWG were formed and sent in February 2021. Russia informed that the situation with the transition to AMHS between the Com Centres of Beijing and Khabarovsk is slightly better. The satellite communication circuit has been replaced with a terrestrial one. It was further informed that since November 2020, meteorological information in the IWXXM format is being transmitted between ROC and IROC using AMHS procedures.

Korea new AMHS System Upgrade and CRV Implementation Plan- ROK

2.19. ROK informed that ROK tried to implement CRV under the COVID-19 pandemic, but the test with China and Japan was delayed, and this year (2021), the IOT using Basic AMHS-CRV conducted between Korea and Japan has failed. In order to minimize the delay the exchange of IWXXM and the implementation plan, Korea Airports Corporation (KAC) has started a project to upgrade Basic AMHS to Extended version.

Update of China CRV implementation and operation- China

2.20. China shared CRV Implementation status between China and other States that have joined the CRV. It was informed that China has been contracted with PCCW Global Ltd. on August 2020 and China had already completed the CRV connection implementation on 26 October 2020. Currently, China has single connection about CRV network for data. China has completed the transition and creation of AMHS and ATFM connection with States/Administrations that have joined CRV namely Japan and Hong Kong, China and AMHS data that support IWXXM format is being tested by CRV with other States/Administrations. The setting up of ATFM traffic over CRV is based on the planning requirement from operational departments responsible for traffic flow management.

Fiji's Experience in Providing Voice and AMHS Services over The CRV using SLA Package D- Fiji

2.21. Fiji shared their experience and the performance analysis in providing voice and AMHS services over the CRV network using SLA Package D with Australia, New Zealand & USA. The PCCWG SLA Package D High Level diagram was shared with the specified service performance level. Fiji also shared a performance analysis of the CRV Package D from August 2020 to February, 2021 to compare with the performance of CRV Package C+ based on the data provided by PCCWG NOC. Fiji recommended *SLA Package D as the CRV solution for small ANSP like Pacific Island* States and other small ANSP in the region to operate voice & AMHS services.

Backup B2B Internet Service between FAA and Air services- USA

2.22. FAA presented newly implemented B2B internet service between FAA and Air Services Australia as a backup to CRV. This B2B internet backup is designed to support AMHS. Since joining the CRV beginning in 2018, FAA telecommunication services to the Asia/Pacific region now rely solely on the CRV. In May 2021, FAA and Airservices Australia have successfully completed the testing of B2B connections at AMHS MTAs located at Salt Lake City and Brisbane. The B2B connection at these two AMHS MTAs will be permanently available. This connection will be tested monthly following the AIRAC cycle. This B2B connection is solely used to back up the CRV connection between the Salt Lake City AMHS and Brisbane AMHS when the CRV MPLS core or its Provider Edge (PE) routers are completely inoperable and AMHS alternative routing cannot be performed.

FAA CRV Service-USA

2.23. FAA has been a user of the CRV since January 2018 with initial services to Australia, Fiji and New Zealand. As CRV services' performance has met FAA telecommunication requirements, the FAA has expanded its service to more ANSPs. FAA's Oakland Center is configured with Package

A and 2MB bandwidth. Salt Lake City and Atlanta (AMHS Com centers) both have individual Package C with 2MB bandwidth. The FAA is coordinating to have a direct voice and AMHS services with Papua New Guinea. When Indonesia joins the CRV, FAA is expected to begin its coordination with Indonesia to establish direct AMHS and voice services.

Update of CRV service of the Philippines- Philippines

2.24. Philippines provided an update of AMHS, VOICE and AIDC implementation of the Philippines over CRV service. The Philippines have been in CRV operations since March 18, 2018 with package-A subscription from PCCW Service Provider. With CRV implementation, the Philippines has been able integrate a voice and data connections with the following adjacent FIR's; Hong Kong, Taipei, Singapore and Oakland. Philippines shared the progress of AMHS, AIDC and VOICE circuits over CRV network after a series of Interoperability and Pre Operational Tests.

2.25. Philippines informed that through Backbone Boundary Intermediate Systems (BBIS), the AIDC implementation with Ujung Pandang Indonesia has been successful. There were ongoing email coordination with Japan to connect a voice circuits thru CRV network and a suggestion to implement AIDC thru Backbone Boundary Intermediate Systems channel.

Revisit the CRV solution for small Pacific Islands and small ANSPs in APAC- Fiji

2.26. Fiji presented the CRV solution for small Pacific Islands and small ANSPs in APAC region to implement CRV for voice & AMHS services. From the recent regional CRV implementation update submitted by PCCWG, it is *noted that there has been slow implementation progress with the Pacific Island States and small ANSP in the region to date.* With the target date for the implementation of CRV by 2022, the CRV OG must find ways to assist these member States to implement CRV and ensures that *No Country is Left Behind*.

2.27. The paper proposed CRV Solution for Vanuatu, Kiribati & Tuvalu in joining CRV. The alternative solution will using VPN over internet using SLA Package D over 1.0M internet connection at a much lower cost. The performance analysis has confirmed that the service is reliable and is recommended for small Pacific Island and small ANSP in the region. It was recommended that the CRV OG should work closely with the small Pacific Islands, small ANSP in the region and PCCWG on a cost effective CRV solution to implement CRV. The meeting formulated the following draft conclusion for consideration by the ACSICG/8 meeting.

<table>
<tr><td colspan="3">Draft Conclusion CRV/08/02 - Implementation of CRV for small Pacific Island and small ANSP in the region using CRV Solution, PCCWG SLA Package D.</td></tr>
<tr><td colspan="2">What: That, the CRV OG should consider the following to assist small Pacific Islands & small ANSP in APAC in the implementation of CRV:
a) Small Pacific Island and small ANSP in the region to consider using CRV SLA package D as the CRV solutions to implement CRV for the exchange of voice & AMHS services
b) With target date to implement CRV by the end of 2021 by APANPIRG Conclusion C 31/12, it is recommended that the CRV OG to work closely with the small Pacific Islands, small ANSP in the region and PCCWG on a cost effective CRV solution to implement CRV.</td><td>Expected impact:
☐ Political / Global
☐ Inter-regional
☒ Economic
☐ Environmental
☒ Ops/Technical</td></tr>
<tr><td>Why: To facilitate the implementation of CRV for the small Pacific Island & small ANSP in the region</td><td colspan="2">Follow-up: ☒Required from States</td></tr>
</table>

When:	17-May-21	Status:	Draft to be adopted by PIRG
Who:	☒Sub groups ☒APAC States ☐ICAO APAC RO ☐ICAO HQ ☐Other: XXXX		

Distribution of Surveillance Data to PNG via CRV- Aireon LLC (a member of ICCAIA) and NuiSky Pacific (PNG)

2.28. PNG discussed about the implementation of Space-Based ADS-B system in PNG and in particular that Space based ADS-B is now operational and one path is already using CRV for operational surveillance data. Space based ADS-B is now available on the CRV and can be supplied to other ANSPs without the additional cost of dedicated point to point circuits. When developing a CRV solution for small Pacific Islands and small ANSPs in APAC, members may wish to take note of this capability and take note the PNG plan to use CRV to allow data sharing between FIRs. Meeting concluded that the Space Based ADS-B data on CRV is an extremely important steps for future usage of CRV for the purposes other than initially planned.

Presentation of PCCW Network Based IWXXM Translation and Exchange Services- Fiji and PCCWG

2.29. Fiji and PCCWG presented PCCW IWXXM Translation and Exchange Services, which can serve as an alternative solution for member States to fulfil the exchange of IWXXM messages as promulgated in Amendment 78 to ICAO Annex 3. It was informed that PCCWG has been developing the SWIM service on a private and scalable platform in partnering with one of leading aviation vendors - Frequentis. Additionally, PCCW Network Based IWXXM Translation and Exchange Services is one of the modules on PCCW SWIM (IWXXM, FIXM and AIXM) which is hosted in the high availability private platform and fully controlled environment which connects to CRV network infrastructure.

Updates on CRV Pioneer State Contribution to the ICAO Managed Service Agreement (MSA)- Sec

2.30. The ICAO Secretariat informed meeting in CRV OG/2 about the fund balance as on 31 March 2017 of *USD 104,596* and proposed a draft of revision of Annex 1b to the MSA. The APANPIRG/28 adopted the Conclusion **APANPIRG/28/19**: *Amendment of the Management Service Agreement for CRV project (RAS14801).* CRV OG and concerned States/Administrations have taken various follow-up actions for Conclusion **APANPIRG/28/19**. However, the Conclusion itself remains as one of outstanding Conclusions/Decisions up to APANPIRG/31 held in December 2020. The CRV OG/6 meeting adopted the recommendation of the WP/08 through the **Decision CRV OG/6/3-** *Using the Rest of CRV Pioneer State Contribution to the ICAO Managed Service Agreement (MSA).*

2.31. On 15 April 2021, the ICAO Secretariat held an online discussion among TCB, ICAO APAC and ICAO SAM on how to address the unspent funds from the completed CRV project (RAS14801) and the possibility for APAC to make reference to the REDDIG II in SAM region. The meeting agreed that it is important to first prepare the safety and security assessment requirement to define scope of the work based on available fund and priorities of work to be done.

MPLS/IP Based Inter-Regional Connection-Sec

2.32. There are communications requirements between APAC ANSPs and SAM ANSPs, CRV and REDDIG II, in order to set up the AMHS P1 connection between AMHS COM Centers of Christchurch (New Zealand) and Santiago (Chile). It is technically possible for two nodes of different networks (with different providers) to set up an IP connection. In this case, the concept of MPLS Network to Network Interface (NNI) is applied and the CSPs involved with different customers

establish agreements. This concept can be applied by the CSPs of CRV and REDDIG II, in order to connect nodes of the two networks.

2.33. Further discussion on the administrative and technical aspects to establish the required aeronautical communications between APAC and SAM ANSPs through MPLS NNI are in progress. Besides this, discussions are also being done for various other feasible options for CRV and REDDIG II interconnection. Meeting was invited to provide need/willingness/interest to join other regional networks.

2.34. Singapore, New Zealand, and India shared their interest for the proposal for interconnection of CRV and REDDIG II. However, it was reiterated that commercial requirement and cost burden for states for interregional connection will be main factors for states' willingness to join the proposal. Co-Chair informed to meeting that the proposal is under initial discussion and further discussion on business model and commercial aspects will be done at later stage.

High Level Network Options to REDDIG- PCCWG

2.35. PCCWG described the options and considerations for connecting REDDIG users in South America. PCCWG presented two options for this interconnection purpose. Option 1 was CRV connection to South America (SA) ANSP and Option 2 was Network to Network Connection. Description of each option along with their potential advantages were discussed.

CRV Connection to Santiago Chile- New Zealand

2.36. New Zealand presented information on the costs of an extra CRV circuit for Airways New Zealand. Airways New Zealand has a requirement to exchange AIDC data with Santiago Chile. Airways New Zealand is on CRV and Santiago Chile is in REDDIG II. At present the only options for Airways New Zealand is to have a CRV connection installed in Santiago Chile or a REDDIG connection installed in New Zealand. New Zealand shared cost of installing a single Package C, CRV connection. It was informed that the additional circuit severely affects the Cost Benefit of using CRV, other options such as NNI will need to be explored.

Update on APAC Aeronautical Fixed Service Safety and Protection Planning- Sec

2.37. The paper presented the update of the planned cybersecurity and cyber safety/resilience related activities in ICAO Asia/Pacific Region which was a workshop on cyber safety and resilience and cyber tabletop exercise scheduled for *19 to 21 November 2019* at the ICAO APAC Office in Bangkok, a 5-day cyber-security and cyber safety training course jointly organized by ICAO (GAT) and Embry-Riddle Aeronautical University (ERAU) planned for *March 2020* at ICAO APAC Regional Office, and a joint ad hoc working group among CRV OG, ACSICG and SWIMTF focusing cybersecurity, cyber safety and resilience planned for *21 -23 April 2020* in USA.

2.38. The 5-day cyber-security and cyber safety training course was finally suspended until further notice. Due to the outbreak of COVID-19 pandemic, ICAO APAC Regional Office inform concerned parties about the Postponement of APAC Aeronautical Fixed Service Safety and Protection Planning Working Group Meeting (AFSSP WG 2020) until further notice. The ICAO Secretariat informed that the Cybersecurity webinar planned by ICAO APAC RO on 14 June 2021 is a step for replacement of Postponement of APAC Aeronautical Fixed Service Safety and Protection Planning Working Group Meeting (AFSSP WG 2020).

2.39. The objectives of the webinar along with a tentative programme, as of 7 May 2021, was shared with the meeting. Meeting was informed that due to the restrictions of available resources

and online mode, the webinar has been considered as a light version of this kind and is deemed to collect feedback for preparation of a face-to-face heavy version in 3 days for 2022.

Update on ICAO APAC Regional Webinars- Sec

2.40. The meeting was informed about the *18 webinars* to be hosted by ICAO APAC office in the year 2021 as **ICAO APAC series of webinars** along with the objectives of webinars related to CNS i.e. ICAO APAC Cybersecurity Webinar, Webinar on Implementation of CRV in APAC region, SWIM workshop, and Webinar on Implementation of ADS-B. The meeting was invited to contribute individual practice and experience to the webinar of interest as a speaker and to take maximum advantages of the webinars by registering more participants from states.

Presentation of PCCW Global's Surveillance Data Sharing Platform- PCCWG

2.41. PCCWG described the system architecture of PCCW SWIM service and its progresses to build its Surveillance data-sharing platform with EMS and Service Registry. The meeting was informed that PCCWG is working with Frequentis Comsoft to host their SDDS-NG (Surveillance Data Distribution System – Next Generation) in PCCW SWIM for qualified States/Administrations/Stakeholders to publish or subscribe surveillance data by following the guidelines of the CRV OG & SWIM TF.

Cohabitation between VSAT And 5G Cellular Network- France

2.42. France shared DSNA background and experience regarding the potential influences of the 5G cellular network deployment on operational VSAT terminal stations. The telecommunication operators have been awarded the frequencies to test and begin the 5G cellular network deployment. In Europe, the new 5G cellular network operates in the 3.4 GHz to 3.8 GHz range corresponding to the beginning of the C-band which is also used by the VSAT telecommunication terminals for receiving space-to-earth signal in the 3.4 GHz to 4.2 GHz band.

2.43. By DSNA, in close relationship with the Frequency Regulatory Authority, the VSAT reception frequencies for all the stations have been shifted outside the 5G spectrum. However, perturbations and interferences have been detected on one of the VSAT operational station due to the 5G deployment commencing. Thus, perturbations and interferences could append even if the frequency of the VSAT reception signal is outside the authorized 5G spectrum. As a mitigation, a waveguide filter specifically designed to reject the 5G disturbances is foreseen to be installed in the reception branch.

First Meeting of the Surveillance Study Group (SURSG/1)

Election of Chair

2.44. Mr. Vincent Wong, Acting Chief Electronics Engineer of the Air Traffic Engineering Services Division of the Hong Kong Civil Aviation Department (HKCAD), was elected as the chair of the surveillance study group (SURSG).

Surveillance Exchange Model Framework- Hong Kong, China

2.45. Hong Kong, China presented some key considerations leading to a proposal of ANSP's collaboration scheme in sharing and enriching surveillance coverage for the region to benefit the aviation community. The sharing of surveillance data is expected to benefit the aviation industry in the APAC region given a more comprehensive and much wider map of surveillance coverage in the region. The paper explored ANSP's surveillance data sharing collaborative approach to expand surveillance coverage.

Proposed Solutions for Sharing of Surveillance Data- Singapore

2.46. Singapore proposed solutions for States to share surveillance data and listed the pros and cons of the solutions. It was discussed that there are three models, namely distributed solution, central database, and hybrid model, which can potentially be used for the implementation of the data sharing. Detailed description, advantages, and disadvantages of each model were described. It was further informed that there might be some interested parties, who are not subscribers to CRV or without SWIM capabilities, but are keen to share their surveillance data with other States. Adjustment to the models will be required to accommodate these parties. One possible solution could be for these parties to connect directly to one or more of the centralized service data providers, if available.

Distribution of Surveillance Data to PNG via CRV- ICCAIA&PNG

2.47. ICCAIA (Aireon) and Papua New Guinea jointly presented the status of Space based ADS-B data distribution using CRV. It was informed that NiuSky Pacific Limited has designed and is in the final stages of implementing a countrywide CNS/ATM modernisation program in PNG. In 2020, the CRV Operations Group authorised Aireon to connect and contract with the CRV provider. The contract has been signed by Aireon and NiuSky Pacific Limited. Aireon has established the first of two connections to CRV while NuiSky Pacific Limited implemented and tested the initial CRV connections. Space based ADS-B data can now be delivered to other Aireon customers in Asia Pacific via CRV, potentially without need for any additional communication link or telecommunications costs. The meeting noted the implementation of Space-Based ADS-B system in PNG and in particular, that Space based ADS-B is now operational and one path is already using CRV.

Surveillance Data Sharing Platform- PCCW Global

2.48. PCCW Global described the system architecture of PCCW SWIM service and its progresses to build its Surveillance data-sharing platform with EMS and Service Registry. It was informed that PCCW Global aimed at expanding the network by offering value-added services on top of the advanced aeronautical network. These services cover the provision of critical information through the globally interoperable System Wide Information Management (SWIM) infrastructure, interfaces and exchange models. By combining PCCW Global network infrastructure and hosting facilities with Frequentis, State ANSPs will be able to benefit from SWIM initiatives without the high investment costs and development expenses of traditional systems. The meeting was informed that PCCW Global is working with Frequentis Comsoft to host their SDDS-NG (Surveillance Data Distribution System – Next Generation) in PCCW SWIM for qualified States/Administrations/Stakeholders to publish or subscribe surveillance data by following the guidelines of the CRV OG & SWIM TF.

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

a) note the outcome of the CRV OG/8 and SURSG/1 and take any necessary follow-up actions; and

b) discuss any relevant matters as appropriate.

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Common Regional Virtual Private Network (CRV) Operations Group (OG) of Asia/Pacific Air Navigation Planning and Implementation Regional Group (APANPIRG) (APANPIRG CRV OG)

OPERATIONS MANUAL

First Draft v1.3 - November 2020

Record of Amendment

A/L No	Date	Entered By	A/L No	Date	Entered By
1.0	11/09/2019	Vaughan Hickford			
1.1	15/01/2020	Vaughan Hickford			
1.2	14/10/2020	Vaughan Hickford			
1.3	10/11/2020	Vaughan Hickford			

Contents

1 PART I: FOREWORD

1.1 Introduction

a. The Common Regional Virtual Private Network Operations Group (CRV OG) Operations Manual is an informal publication prepared by the CRV Task Force, intended to provide, for easy reference of interested parties, a consolidation of material, particularly of a procedural nature, about the work of the CRV OG and its contributory bodies. It contains the Terms of Reference of the CRV OG established by the Asia/Pacific Air Navigation Planning and Implementation Regional Group (APANPIRG) (Decision 27/34). It also contains the working arrangements and internal instructions developed by the Group for the practical application of its Terms of Reference.

b. The document describes; Terms of Reference; Composition; Position within ICAO; Working Arrangements; Rules of Procedure and Practices governing the Conduct of Business.

c. The framework of Part and Sections headings in addition to the page numbering has been devised to provide flexibility and the facilitation of the revision of additional or new material. Each Part includes an Introduction giving its purpose and status. A Table of Contents is also provided which serves also as a subject index and as a check list for the current pages.

d. All pages bear the date of issuance. Replacement pages will be issued as necessary and any portion of a page that has been revised will be identified by a vertical line in the margin. Additional arterial will be incorporated in the existing Sections or will be the subject of new Sections, as required.

e. Changes to text will be identified by a vertical line in the margin in the following manner;

   i. N for new or revised text;
   ii. E for editorial modification that do not alter the substance or meaning of the text;
   iii. D for deleted text

   iv. For practical reasons, this shall not be applied to title pages or to the routine insertion and deletion of Conclusions and Decisions. The absence of change bars, when data or page numbers have changed, will signify reissue of the section concerned or rearrangement of text (e.g., following an insertion or deletion with no other changes).

f. The Operations Manual will be distributed to Members and Observers of APANPIRG, the ICAO Secretariat, and to other States and international organizations participating in meetings, contributing to, or having interest in the work of the CRV OG and/or its Contributory Bodies.

2 PART II: TERMS OF REFERENCE, COMPOSITION AND POSITION IN ICAO OF THE CRV OG

2.1 Background

The establishment of APANPIRG CRV OG was proposed during the deliberations of the CRV Task Force (TF) as a dedicated group to provide oversight of the CRV operations and the performance of the CRV Service Provider. The APANPIRG CRV OG is formally established by APANPIRG Decision 27/34.

2.2 Terms of Reference

The Common Regional Virtual Private Network (VPN) Operations Group (OG) will provide oversight of the function and performance of the CRV and the performance of the Service Provider. The following are the activities to be performed:

a. Oversee the implementation of the CRV post Contract Award;
b. Manage issues arising from the transition with CRV TF, if any;
c. Co-ordinate and standardize the establishment or upgrade of CRV services as required;
d. Co-ordinate activities with other ICAO CRV OGs, if any, to make sure that decision making and communication with CRV Service Provider is consistent and timely;
e. Oversee the performance of the CRV Service Provider, including customer service;
f. Oversee the performance of the CRV network;
g. Oversee the escalation and solving by the CRV Service Provider of issues associated with the provision of the CRV, including safety and security related issues;
h. Assist with the resolution of issues associated with the provision of the CRV among the CRV Users as required, including safety and security related issues;
i. Assist with the migration of Aeronautical Fixed Services (AFS) onto the CRV, in line with the GANP and seamless ATM plan;
j. Maintain CRV OG documentation associated with the function, performance and management of the CRV, including the CRV OG Operations Manual, a list of CRV users and a record of variations to the common tender package;
k. Accept deliverables from the CRV Service Provider on behalf of the CRV Users as required;
l. Promote the use of CRV; and
m. Perform any other activity as required by CRV operations.

2.3 Reporting

The CRV OG will report to Asia/Pacific Air Navigation Planning and Implementation Regional Group (APANPIRG) through ACSICG and CNS SG.

2.4 Participation

The CRV OG will include all APAC Member States/Administrations, and any other organization as needed.

2.5 Conduct of the work

It is anticipated that the CRV OG will conduct its work primarily by Web Conferences, teleconferences and other electronic means of communications. Face to Face meetings of CRV OG may be required on an annual basis. The ICAO APAC Regional Office will provide secretariat support for the CRV OG.

2.6 Rapporteur

There will be two Co-Chairpersons of the CRV OG, one primarily responsible for Asia coordination and the other for Pacific coordination.

2.7 Position within ICAO

a) CRV OG shall be the guiding and co-ordinating organ for all activities conducted within ICAO concerning the Common Regional VPN for the Asia and Pacific Regions. However, it shall not assume authority vested in other ICAO bodies, except where such bodies have specifically delegated their authority to the Group. The activities of the Group shall be subject to review by the APANPIRG.

b) The work of groups established and meetings held within the framework of ICAO, concerned with the Asia and Pacific CRV shall be coordinated with the CRV OG to ensure full harmonization with all regional activities regarding the development and operation of the Asia/Pacific system.

3 PART II: WORKING ARRANGEMENTS

3.1 APANPIRG Procedural Handbook

The CRV shall be guided by the APANPIRG Procedural Handbook to ensure that work arrangements are consistent with its parent body

3.2 Administration of the CRV OG

c) The CRV shall be administered as follows:

   i. by two (2) Chairpersons, one elected from the Representatives designated by member States of the Group from ASIA Region and one from the PACIFIC region; and

   ii. by ICAO Regional Director, Asia and Pacific Office designated as Secretary CRV OG by the Secretary General of ICAO. In the execution of duties the Secretary will be supported by the Asia and Pacific Regional Office.

d) The Chairpersons, in close co-ordination with the Secretary, shall arrange for the most efficient working of the Group. The Group shall always work with a minimum of formality and paperwork.

e) Between meetings of the CRV OG, some subjects may be dealt with by correspondence among appointed Representatives of Member States through the Secretary of the CRV OG. However, if States are to be consulted this should be done through the ICAO Regional Director, Asia and Pacific Office.

Service Strategy

- Strategy Management
- Service Portfolio Management
- Financial Management
- Business Relationship Management
- Demand Management

Service Design

- Service Catalogue Management
- Availability Management
- Capacity Management
- IT Service Continuity Management
- Service level Management
- Design Co-ordination
- Information Security Management
- Supplier Management

Service Transition

- Transition Planning and Support
- Change Management
- Service Asset & Configuration Management
- Release and Deployment Management
- Service Validation and Testing Management
- Change Evaluation
- Knowledge Management

Service Operation

- Event Management
- Incident Management
- Request Fulfilment
- Problem Management
- Access Management

Continual Service Improvement

- Service Review
- Process Evaluation
- Definition of CSI Initiatives
- Monitoring CSI Initiatives

4 PART III: SERVICE STRATEGY

4.1 Strategy Management

Process Objective: To assess the service provider's offerings, capabilities, competitors as well as current and potential market spaces in order to develop a strategy to serve customers. Once the strategy has been defined, Strategy Management for IT Services is also responsible for ensuring the implementation of the strategy.

a) Reduce telecommunication costs in most cases (to be confirmed by local CBA)
b) Enable integration in the aeronautical infrastructure and enhanced services (GANP, regional objectives)
c) Enhance information security
d) Provide a standardized interface for AFS (instead of multiple protocols, some of which are obsolescent)
e) Rationalize coordination for network management and enhancement
f) Respond to Air Traffic requirements in a timely and standardized manner
g) Coordination with Other Regional Private Networks
h) Promote the use of CRV

4.2 Service Portfolio Management

Process Objective: To manage the service portfolio. Service Portfolio Management ensures that the service provider has the right mix of services to meet required business outcomes at an appropriate level of investment.

- Criteria for services to be added to CRV.
- POC of new services.

4.3 Financial Management

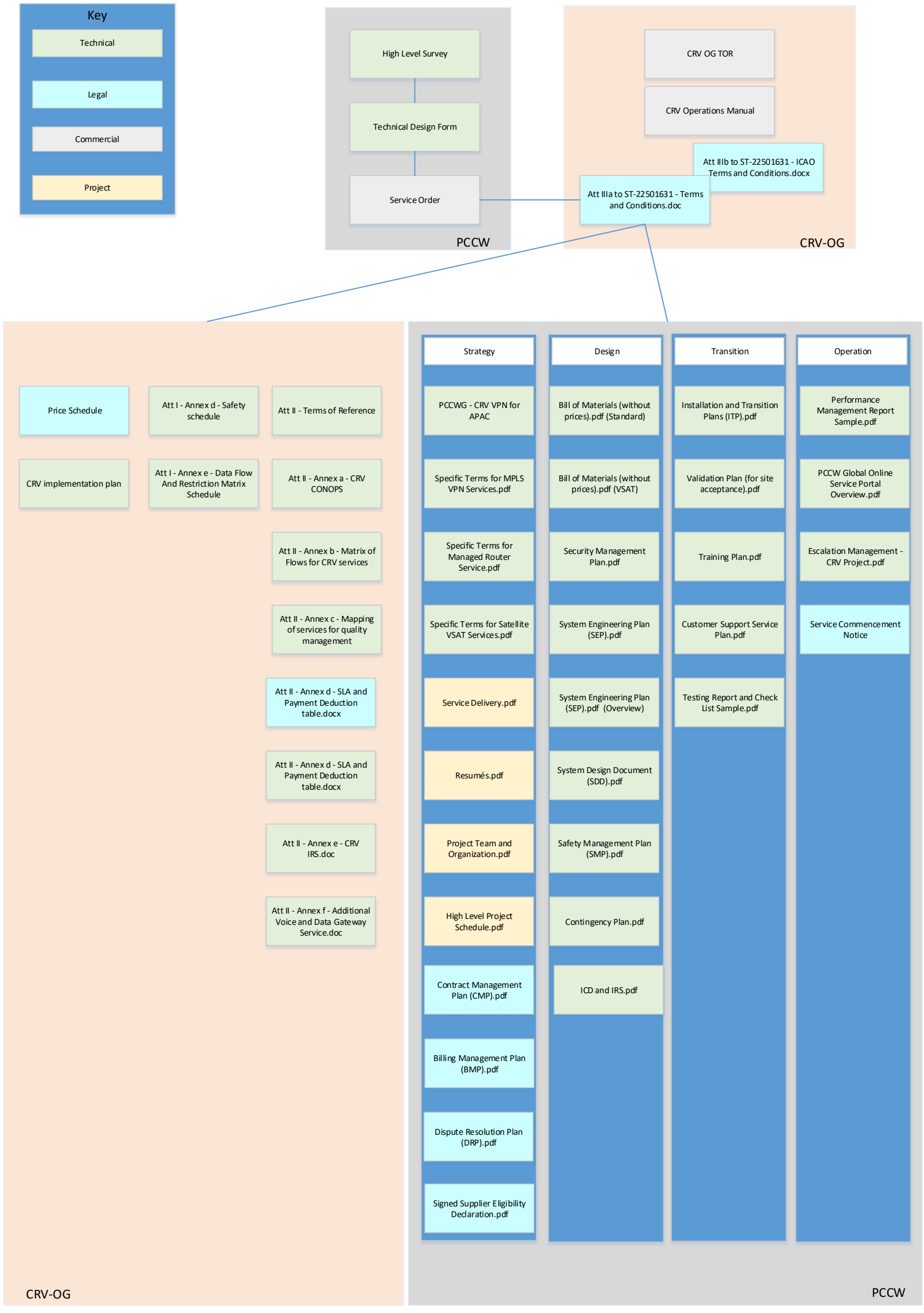
Process Objective: To manage the service provider's budgeting, accounting and charging requirements.

4.4 Business Relationship Management

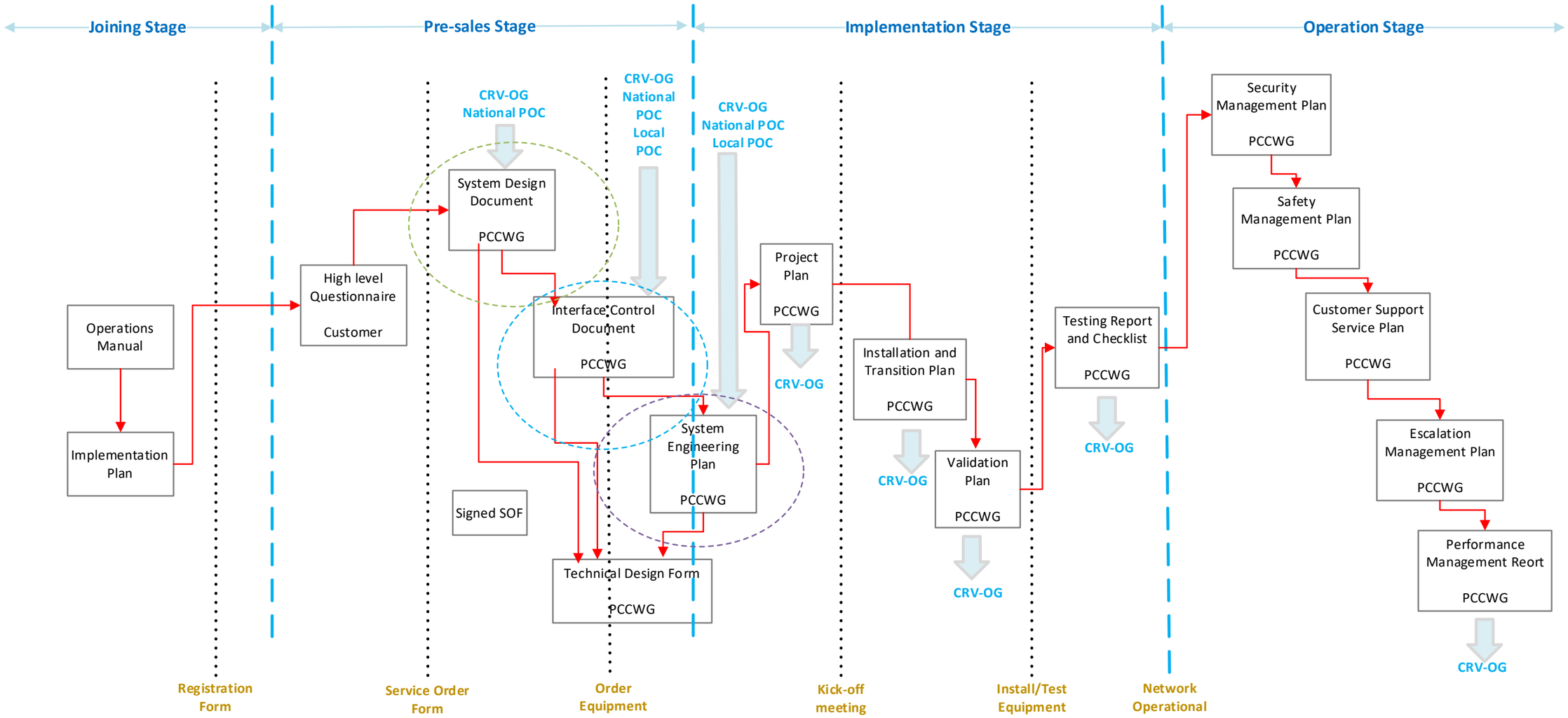
Process Objective: To maintain a positive relationship with customers. Business Relationship Management identifies the needs of existing and potential customers and ensures that appropriate services are developed to meet those needs.

4.4.1 Legal Documentation

The list below shows the precedence of the legal documents that pertains to CRV.



4.4.2 Design and Implementation document flow



4.4.3 Common Package

The Common Package is the common set of documents required to be used to join and operate the CRV Network.

The documents and how they relate to the stages in the Design and Implementation document flow is detailed below.

This is located on the CRV Users Portal here: Common Package.

4.4.4 Joining Stage

a. Operations Manual

This provides the Policies, Processes and Procedures for the Strategy, Design, Transition and Operation of the CRV network.

b. Implementation Plan

The purpose of this Implementation Plan is to provide guidance for all States/ Administrations on the operation requirements for implementing the Common aeRonautical Virtual Private Network (CRV) used in Asia/ Pacific (APAC) Region and the roadmap for implementation.

It contains information on Points of Contacts for each State, Allocated IP addressing for States and Service Providers, proposed implementation dates and suggested tests.

IP Addressing is also listed on the APAC CRV Portal.

c. Registration Form

Provides the information required to connect to CRV as an ANSP.

Example of the Registration Form

4.4.5 Pre-Sales Stage

a. High Level Questionnaire

This provides the high level information to PCCW to be able to provide the Service Order Form (SOF) for signing.

Example of the High Level Questionnaire

b. Service Order Form

Provides the information to PCCW to provide the connection and initiate billing.

Example of the Service Order Form.

c. System Design Document

This is the over-arching Design Document for the CRV Network.

Example of System Design Document

d. Interface Control Document

Example of Interface Control Document

e. Technical Design Form

Example Technical Design Form

f. System Engineering Plan

This is a living document covering the technical aspects of the CRV implementation. Any changes can be updated by the User or PCCW.

Example of a System Engineering Plan

4.4.6 Implementation Stage

a. System Engineering Plan

This is a living document covering the technical aspects of the CRV implementation. Any changes can be updated by the User or PCCW.

Example of a System Engineering Plan

b. Project Plan

Provided to each state post signing of the Contract and is only relevant to that state. It is updated regularly by the PCCW Project manager

Example of a Project Plan

c. Installation and Transition Plan

Example of an Installation and Transition Plan

d. Validation Plan

This is PCCW's testing plan post implementation of the Managed Service

Example of a Validation Plan

e. Testing and Report Checklist

This is the result of PCCW's Testing plan post implementation of the Managed Service and is accompanied by the Service Commencement Notice (SCN)

Testing and Report Checklist

4.4.7 Operation Stage

a. Security Management Plan

Example of the Security Management Plan

b. Safety Management Plan

Example of a Safety Management Plan

c. Customer Support Service Plan

This details the contact details for any Problems or Incidents that the State may encounter.

Example of a Customer Support Service Plan

d. Escalation Management Plan

This details the contact details if the need arises to escalate any Tickets. It also details the escalation criteria

Example of an Escalation Management Plan

e. Performance Management Report

Example of a Performance Management Report

4.5 Demand Management

Process Objective: To understand, anticipate and influence customer demand for services. Demand Management works with Capacity Management to ensure that the service provider has sufficient capacity to meet the required demand.

5 PART IV: SERVICE DESIGN

Service Design

- Service Catalogue Management
- Availability Management
- Capacity Management
- IT Service Continuity Management
- Service level Management
- Design Co-ordination
- Information Security Management
- Supplier Management

5.1 Service Catalog Management

Process Objective: To ensure that a Service Catalogue is produced and maintained, containing accurate information on all operational services and those being prepared to be run operationally. Service Catalogue Management provides vital information for all other Service Management processes: Service details, current status and the services' interdependencies.

5.1.1 Requirements

a. Latency (from the ADDENDUM TO THE SPECIFIC TERMS)

Locations	Average Round Trip Delay
Within the cities specified in Asia (On-net/Off-net)	200ms
Within the cities specified in Oceania (On-net/Off-net)	200ms
Between the cities specified in Middle East and Europe (On-net/Off-net)	200ms
Within the cities specified in Europe (On-net/Off-net)	200ms
Other cities combination not specified above	600ms

b. Availability (from the ADDENDUM TO THE SPECIFIC TERMS)

Service Package	Service Availability
Package A	99.97%
Package B	99.5%
Package B+	99.95%
Package C	99.5%
Package C+	99.7%
Package D	99.5%

c. Jitter (from the ADDENDUM TO THE SPECIFIC TERMS)

The Target Average Jitter Level for voice application and data application is 15ms and 250ms respectively

d. QoS/DSCP markings

Service class name	DSCP Name
Border Gateway Protocol (BGP)	CS6
Voice	EF
Voice Signaling	CS5 (preferred) EF (if CS5 is not possible)
ADS-B	CS4
AFTN, ATN.	AF21
All traffic not otherwise defined.	DF (CS0)

e. Security

Security is the responsibility of each of the ANSPs. Basic security is provided by PCCW utilising Route Filtering and GRE tunnels between ANSP sites.

5.1.2 Criteria to add a new service

a. Considerations

i. Connecting a Service Provider / Service Consumer (SPSC) to the CRV can be initiated by any party that identifies a need for an SPSC to connect to it. The following should be consider by the SPSC and the CRV-Member state.

ii. Service Provider (SP) is defined as a company that provides aeronautical service using the CRV as the means of communication.

iii. Service Consumer (SC) is defined as a company or organisation that consumes aeronautical information using the CRV as the means of communication.

iv. The SPSC should be referred to PCCW to enable an initial discussion with them to assess the feasibility of connecting to the CRV. During this discussion the SPSC should clarify:

v. Interfaces

vi. Data transfer rates

vii. DSCP marking etc.

viii. It is recommended that Service Providers use public ip addressing for the delivery their services.

ix. It is recommended that Service Consumers are provided with a 10.x.x.x ip addressing from the CRV Member State where the PCCW NID is installed.

x. SPSCs will NOT be a member of the CRV Operations Group (OG). The OG may establish a CRV user group that could facilitate discussion on the use of the CRV by SPSCs.

xi. SPSCs will need to adhere to the Common Regional VPN (CRV): System Design Document (SDD). Substantive changes to the SSD MUST be endorsed by the CRV OG.

xii. CRV member states should consider ICAO Doc 9855 AN/459 Guidelines on the Use of the Public Internet for Aeronautical Applications as guidance when they are the Primary sponsor.

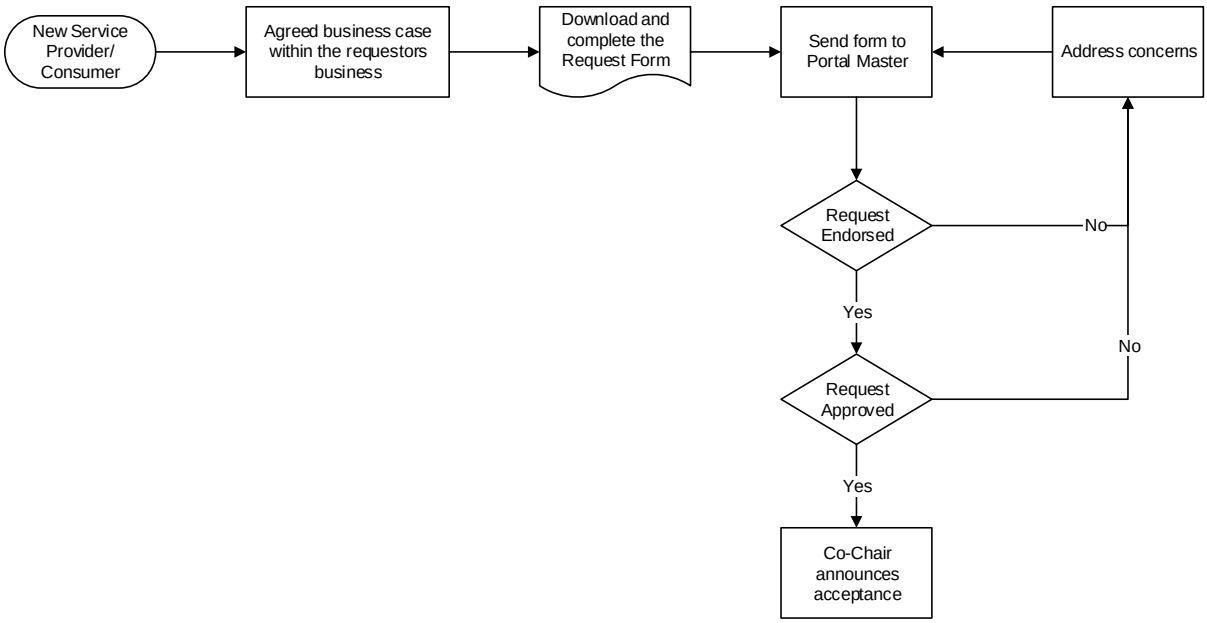
xiii.

xiv. The CRV OG IS NOT responsible for the accreditation/certification/validation of a Service Provider, but must ensure that the all reasonable steps have been taken to ensure that the Service Provider has sufficient systems and process in place to provide their service over the CRV.

xv.

xvi. Service Consumers and CRV members SHOULD ensure that when obtaining a Service from a Service Provider that the service meets their operational service requirements.

b. Process



1. Procedure.

i. The information required in the connection request, should be presented in English and in a clear and logical format. The following process will be used for an SPSC to obtain approval connect to the CRV:

ii. Provide a business justification including Benefits Realization for joining the CRV

iii. For a Service Provider:

a. provide a documentation using Section 2.3 ACCREDITATION OF AN IASP in ICAO Doc 9855 AN/459 as a guide including a cyber-security plan.

iv. For a Service Consumer; at a minimum, provide a CRV connection plan and cyber-security plan on how they will shield the CRV from their organisation.

v. Obtain a Primary CRV member state to sponsor their connection to the CRV.

vi. Obtain business justification from Primary Sponsor to support their request.

vii. Obtain a Secondary CRV member state to sponsor their connection to the CRV based on the information above.

viii. The information provided above, will be provided to the CRV OG via the APAC CRV portal.

ix. CRV OG members will be notified and have 25 business days to review and address any concerns that they may have with the request.

x. After the 25 days, if the majority of reviews by CRV OG members are endorsed, the CRV OG chairs will review the request.

xi. For the request to be approved, both CRV OG C-Chairs need to approve the request.

xii. A Document/Certificate will be provided to the primary sponsor that can used to verify that the SPSC is approved to connect the CRV.

xiii. The on boarding of Service Provider / Service Consumer will be supported by the Airways New Zealand provided APAC CRV SharePoint portal. There will be word forms to facilitate the information and these forms will be migrated to an automated SharePoint Workflow as soon as practical.

Service Provider / Service Consumer will be required to undertake the following:

Provide a business justification including Benefits Realisation for joining the CRV

Provide a High Level System Design oh how their Service could potentially connect to the CRV.

Service Providers to use Public IP Addressing

Service Consumers to use the ICAO allocated IP addresses

Interfaces

Data transfer rates

DSCP marking

5.2 Availability Management

Process Objective: To define, analyse, plan, measure and improve all aspects of the availability of IT services. Availability Management is responsible for ensuring that all IT infrastructure, processes, tools, roles etc. are appropriate for the agreed availability targets.

5.2.1 Monthly Performance Management Reports

Provided by PCCW to each State that has joined CRV covering:

- Router report
- Interface report
- QoS report
- Traffic report

(More SLA data is available from the PCCW Portal)

5.2.2 Monthly Operations Reports

Provided by PCCW to each State that has joined CRV covering:

- Active Service Inventory
- Site Availability (More SLA data is available from the PCCW Portal)
- Ticket Statistic
  - Problem Statistic
  - Incident Statistic
  - Requests
  - Maintenance
- Ticket Details
- AOB

5.2.3 Monthly meetings with PCCW

Conducted via Telephone conference that is hosted by PCCW, with each State that has joined CRV to discuss:

- States Performance Management Report (information from the Portal)
- States Operations Report (Service Report)

5.2.4 Quarterly Operations Reports

Provided by PCCW to the OG covering:

- Implementation progress
- Site Availability (More SLA data is available from the PCCW Portal)
- Ticket Statistic
  - Problem Statistic
  - Incident Statistic
  - Requests
  - Maintenance
- Ticket Details
- AOB

5.2.5 Annual OG meetings

- Implementation progress
- Site Availability (More SLA data is available from the PCCW Portal)
- Ticket Statistic
  - Problem Statistic
  - Incident Statistic
  - Requests
  - Maintenance
- Ticket Details
- Network Utilisation
- AOB

5.2.6 Root cause analysis reports

Provide detail post every Incident to the affected State and the APAC CRV OG. Include these in each of the Monthly, Quarterly and Annual Report.

5.2.7 Notifications of Maintenance

Ensuring that all affected parties of maintenance releases are updated as appropriate.

5.2.8 Diversity Audits

A rolling audit of States/Sites physical and logical connectivity based on the information provided in the Service Commencement Notice.

5.2.9 Testing failover

State LOA/MOU/Technical Letter for carrying out failover testing to ensure service continuity.

5.3 Capacity Management

Process Objective: To ensure that the capacity of IT services and the IT infrastructure is able to deliver the agreed service level targets in a cost effective and timely manner. Capacity Management considers all resources required to deliver the IT service, and plans for short, medium and long term business requirements.

Co-ordinate and standardize the establishment or upgrade of CRV services as required

Oversee the performance of the CRV network;

5.4 IT Service Continuity Management

Process Objective: To manage risks that could seriously impact IT services. ITSCM ensures that the IT service provider can always provide minimum agreed Service Levels, by reducing the risk from disaster events to an acceptable level and planning for the recovery of IT services. ITSCM should be designed to support Business Continuity Management.

a) CRV Contingency Operations

from CRV TF/6 report there is this report:

The meeting discussed again the contingency plan in relation to the safety case. To mitigate the risk of a total or major failure (such as IT disaster that would affect the whole CRV), two layers of process would have to be articulated:

- *the procedures and measures planned and implemented by PCCW; and*
- *consistently, the procedures and measures planned and implemented by the CRV Users, as part of their contingency plan required by ICAO SARPS.*

Furthermore, the meeting agreed that procedures to mitigate the total failure of CRV should be discussed by CRV OG as part of the contingency planning.

5.5 Service Level Management

Process Objective: To negotiate Service Level Agreements with the customers and to design services in accordance with the agreed service level targets. Service Level Management is also responsible for ensuring that all Operational Level Agreements and Underpinning Contracts are appropriate, and to monitor and report on service levels.

5.6 Design Co-ordination

Process Objective: To coordinate all service design activities, processes and resources. Design coordination ensures the consistent and effective design of new or changed IT services, service management information systems, architectures, technology, processes, information and metrics.

Change Requests

Engineering Package

Legal Documents

Dial Plan

5.7 Information Security Management

Process Objective: To ensure the confidentiality, integrity and availability of an organization's information, data and IT services. Information Security Management usually forms part of an organizational approach to security management which has a wider scope than the IT Service Provider.

Security is the responsibility for the implementation of security controls to ensure the integrity of services.

As a minimum the connectivity states is via GE Tunnels.

Other methods of ensuring the security of the connectivity are:

a. Utilising as small an IP Address range as possible.
b. Only advertising relevant IP addresses.
c. Only accepting verified IP Routes when required.
d. Utilising firewalls.
e. Utilising NAT.
f. Utilising Intrusion Protection Software (IPS)

It is recommended that external security advice is sought.

5.8 Supplier Management

Process Objective: To ensure that all contracts with suppliers support the needs of the business, and that all suppliers meet their contractual commitments.

a) Oversee the performance of the CRV Service Provider, including customer service;

b) Oversee the escalation and solving by the CRV Service Provider of issues associated with the provision of the CRV, including safety and security related issues

6 PART V: SERVICE TRANSITION

Service Transition

- Transition Planning and Support
- Change Management
- Service Asset & Configuration Management
- Release and Deployment Management
- Service Validation and Testing Management
- Change Evaluation
- Knowledge Management

6.1 Transition Planning and Support

Process Objective: To plan and coordinate the resources to deploy a major Release within the predicted cost, time and quality estimates.

a) Covered by the Implementation Plan

6.2 Change Management

Process Objective: To control the lifecycle of all Changes. The primary objective of Change Management is to enable beneficial Changes to be made, with minimum disruption to IT services.

All changes are to be conveyed to PCCW via their Change Request Form. And covered by the Change Management Process as found in the Common Package.

6.3 Service Asset and Configuration Management

Process Objective: To maintain information about Configuration Items required to deliver an IT service, including their relationships.

a) Maintain CRV OG documentation associated with the function, performance and management of the CRV, including the CRV OG Operations Manual, a list of CRV users and a record of variations to the common tender package;

   This information is collated in the following ways:

   CRV Operations Manual – APAC Portal
   A list of CRV users – Registrations page on the APAC portal
   Record of Variations is found in the APAC CRV Portal in the Common Package Folder

6.4 Release and Deployment Management

Process Objective: To plan, schedule and control the movement of releases to test and live environments. The primary goal of Release Management is to ensure that the integrity of the live environment is protected and that the correct components are released.

a) Oversee the implementation of the CRV post Contract Award;

b) Manage issues arising from the transition with CRV TF, if any

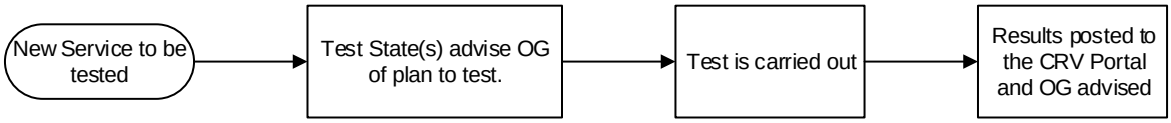
6.5 Service Validation and Testing Management

Process Objective: To ensure that deployed Releases and the resulting services meet customer expectations, and to verify that IT operations is able to support the new service.

a) Accept deliverables from the CRV Service Provider on behalf of the CRV Users as required;

b) Refer to the CRV Implementation Plan

c) New Services



New services being tested by any state,
Notifies OG intention to test as soon as practical.
Advises CRV OG and PCCW 48hrs prior to testing

Testing is to be carried out with a DSCP marking of DF so as to avoid impacting other services.

The results of the tests are to be posted on the CRV portal and the OG advised of the posting.

6.6 Change Evaluation

Process Objective: To assess major Changes, like the introduction of a new service or a substantial change to an existing service, before those Changes are allowed to proceed to the next phase in their lifecycle.

6.7 Knowledge Management

Process Objective: To gather, analyse, store and share knowledge and information within an organization. The primary purpose of Knowledge Management is to improve efficiency by reducing the need to rediscover knowledge.

a) All information relating to the ongoing operation of the network shall be retained in the APAC CRV Portal

There will be a link to the portal from the ICAO APAC page.

b) To add items to the portal.

c) To Workflow a document.

7 PART VI: SERVICE OPERATION

7.1 Event Management

Process Objective: To make sure CIs and services are constantly monitored, and to filter and categorize Events in order to decide on appropriate actions.

a) Managed by PCCW

7.2 Incident Management

Process Objective: To manage the lifecycle of all Incidents. The primary objective of Incident Management is to return the IT service to users as quickly as possible.

a) Managed by PCCW

After an incident, an incident report (IR) can be provided upon request.

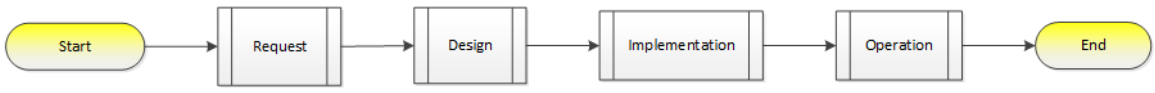
Under normal circumstances, an IR would be ready in 3 working days.

An IR Form template is provided in the Common Package as an example.

7.3 Request Fulfilment

Process Objective: To fulfil Service Requests, which in most cases are minor (standard) Changes (e.g. requests to change a password) or requests for information.

- Process

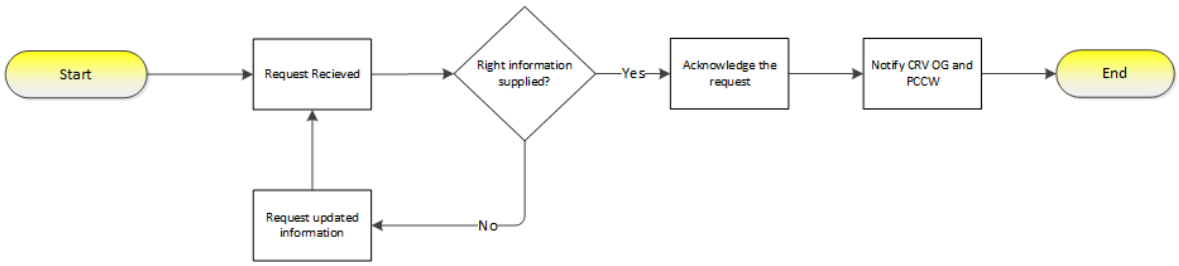


- Procedure
  - Request

    There are four types of requests:

    1. Request to join CRV as a user.
    2. Request to change
    3. Request to add a new service
    4. Request to terminate the CRV connection

    - Process



- Procedure

1. Details on how to join CRV are posted on the ICAO APAC and ICAO MID pages.
2. An initial request is sent to the APAC CRV Portal Administrator requesting to join, leave or add a new connection to CRV.
3. Upon receipt of the request to join, leave or add new connection to CRV, a registration form is provided.
4. Upon receipt of the registration form to join or leave, check the content is complete:
    a. ANSP Making the Request
    b. Technical Point of Contact
    c. State(s) connecting to.
    d. Proposed services between ANSPs
    e. Proposed go live/removal date
5. If complete, acknowledge the request with a link to the Common Package, the Operations Group Manual and the Implementation Plan and the CRV Portal.
6. If not complete, request updated information.
7. Notify the CRV OG and PCCW.
8. Update the Registrations List.

- Design
    - Go to Design Co-ordination
- Implementation
    - Go to Change Management
- Operation
    - Go to Service Operation

7.4 Problem Management

Process Objective: To manage the lifecycle of all Problems. The primary objectives of Problem Management are to prevent Incidents from happening, and to minimize the impact of incidents that cannot be prevented. Proactive Problem Management analyses Incident Records, and uses data collected by other IT Service Management processes to identify trends or significant Problems.

a) PCCW Initiated – Follow the Customer Support Service Plan

b) Authority Initiated

a. Troubleshoot local connectivity

b. Polling the NID. On the ANSP NID provided by PCCW, a local loop back will be configured using a specified IP address from the allocated range of IP addressing. This will be called the troubleshooting IP address.

c. Troubleshoot with peers

d. Fault with PCCW following the Customer Support Service Plan

7.5 Access Management

Process Objective: To grant authorized users the right to use a service, while preventing access to non-authorized users. The Access Management processes essentially execute policies defined in Information Security Management. Access Management is sometimes also referred to as Rights Management or Identity Management.

a) Physical Access Control

   i. The Cabinet for Core Routers are locked

   ii. The network main PoP sites are under 7x24 CCTV monitoring and recording

b) Remote Network Access Control

   i. The remote access of Cores and CE routers are controlled by access-list ACL that is only allow authorized terminal of management systems.

   ii. The TACACS is deployed to allow the authorized persons of PCCWG to access Core Routers or CE routers as AAA clients.

c) Portal Access

   Review member's access annually.

PART VII: CONTINUAL SERVICE IMPROVEMENT

Continual Service Improvement

- Service Review
- Process Evaluation
- Definition of CSI Initiatives
- Monitoring CSI Initiatives

7.6 Service Review

Process Objective: To review business services and infrastructure services on a regular basis. The aim of this process is to improve service quality where necessary, and to identify more economical ways of providing a service where possible.

Volunteers for each section

Small groups around these sections.

Report back up to the master document owner

Approval by Chairs

Approval by APANPIRG

Master owner of the document updates and publishes every two months?

Quarterly conference call to start with to update the document.

7.7 Process Evaluation

Process Objective: To evaluate processes on a regular basis. This includes identifying areas where the targeted process metrics are not reached, and holding regular bench markings, audits, maturity assessments and reviews.

7.8 Definition of CSI Initiatives

Process Objective: To define specific initiatives aimed at improving services and processes, based on the results of service reviews and process evaluations. The resulting initiatives are either internal initiatives pursued by the service provider on his own behalf, or initiatives which require the customer's cooperation.

7.9 Monitoring CSI Initiatives

Process Objective: To verify if improvement initiatives are proceeding according to plan, and to introduce corrective measures where necessary.

8 PART VIII
DEFINITIONS

8.1 Definitions

A Service is defined as any service provided over the CRV supporting Meteorological Service for International Air Navigation or Air Traffic Control Services.

Service Provider / Service Consumer (SPSC)

Incident - An Incident is defined as an unplanned interruption or reduction in quality of an IT service (a Service Interruption).

Eg. A link has been flapping in the network causing reroutes.

Problem - A cause of one or more Incidents. The cause is not usually known at the time a Problem Record is created.

Eg. Link flaps have been caused by unplanned work by a third party.

INTERNATIONAL CIVIL AVIATION ORGANIZATION

COMMON AERONAUTICAL VPN (CRV) IMPLEMENTATION PLAN

Version 2.1~~0~~

1~~7~~5 May 2021~~9~~

Table of Contents

ABBREVIATIONS

ABBREVIATION	DESCRIPTION
AFTN	Aeronautical Fixed Telecommunication Network
AIDC	ATS Inter-facility Data Exchange
AMHS	Air Traffic Service Message Handling System
ANSP	Air Navigation Service Provider
APANPIRG	Asia/Pacific Air Navigation Planning and Implementation Regional Group
APAC	Asia/Pacific
ATC	Air Traffic Control
ATM	Air Traffic Management
ATN	Aeronautical Telecommunication Network
ATS	Air Traffic Services
BBIS	Backbone Boundary Intermediate System
BIS	Boundary Intermediate System
CAA	Civil Aviation Authority
CAR	Caribbean Region
CBA	Cost Benefit Analysis
CNS	Communications, Navigation and Surveillance
ConOps	Concept of Operations
CRV	Common aeRonautical Virtual Private Network
DSCP	Differentiated Services Code Point
EUR	European Region
FIXM	Flight Information Exchange Model
FPL	Flight Plan
ICAO	International Civil Aviation Organization
IP	Internet Protocol
IPS	Internet Protocol Suite
IWXXM	ICAO Weather Information Exchange Model
MET	Meteorological
MPLS	Multi-Protocol Label Switching
NAT	Network Address Translation
NID	Network Interface Device
OH	Operational Hazard
OG	Operation Group
OSI	Open Systems Interconnections
PoC	Point of Contact
QoS	Quality of Service
RFI	Request for Information
RFP	Request for Proposal
SARP	Standards and Recommended Practices
SAT	Site Acceptance Test
SIP	Session Initiation Protocol
SME	Subject Matter Expert
SOP	Standard Operating Procedures
ST	Sealed Tender
SWIM	System-Wide Information Management

ABBREVIATION	DESCRIPTION
TF	Task Force
WXXM	Weather Information Exchange Model (based on XML)
UC	Use Case
VoIP	Voice Over Internet Protocol
VPN	Virtual Private Network
XML	Extensible Markup Language

1.0 INTRODUCTION

1.1 Purpose

The purpose of this Implementation Plan is to provide guidance for all States/ Administrations on the operation requirements for the upcoming Common aeRonautical Virtual Private Network (CRV) used in Asia/ Pacific (APAC) Region and the roadmap for implementation.

The details includes in Table 1, Table 2 and Appendix A, a list of all States/ Administrations concerned, and for each State/ Administration it includes the:

i. National Points of Contact and Local Points of Contact; and

ii. expected deployment date.

The information contained in this document was first adopted by the 1st Meeting of CRV Operations Group (CRV OG/1). It is intended that this Implementation Plan shall be used as the means to:

i. identify all actions required to implement CRV;

ii. ensure a harmonized approach for the APAC Region;

iii. monitor and report on progress; and

iv. identify any issues, risks or problems which may arise.

1.2 Overview of the CRV

Currently, aeronautical ground-ground communications in the ICAO Asia/Pacific Region, and in particular Aeronautical Fixed Telecommunication Network (AFTN) and AMHS services, operate over point-to-point international leased circuits. However, this network configuration exhibits a number of limitations such as the inability to switch to new protocols like Voice over IP (VoIP) or System Wide Information Management (SWIM) efficiently, high cost for every connection and limited flexibility for increase in bandwidth.

A CRV Task Force (TF) was formally established in accordance with APANPIRG Decision (24/32), (Bangkok, Thailand, 24-26 June 2013). The concept of CRV was taken from other common network that has already implemented in other regions such as Pan-European Network Services (PENS) and FAA Telecommunication Infrastructure (FTI).

The CRV is a dedicated multiprotocol label switching (MPLS) Internet Protocol (IP) based Virtual Private Network (VPN) communication network provided by a common network service provider and support all Aeronautical Fixed Service (AFS) in the APAC region. Telecommunication costs are reduced as States/ Administrations will only require minimal connections to a far reaching network instead of individual connections to each neighboring State/ Administration. The CRV service provider provides the service to allow CRV members to exchange voice and data information with each other.

Each CRV member should determine the amount of bandwidth require for each Quality of Service (QoS) sub queue. In addition, each CRV member should also determine the total access bandwidth that they need to subscribe.

2.0 IMPLEMENTATION OVERVIEW AND PROCESSES

2.1 General Description of Implementation

States/ Administrations should refer to the implementation roadmap (see Appendix A) to take note of the estimated CRV implementation date provided by other States/ Administrations that they wish to exchange data/ voice via the CRV.

The implementation date, type of data, voice, bandwidth and QoS between the two States/ Administrations shall be negotiated and agreed bilaterally and supported by the CRV service provider.

CRV service provider is to put up individual service contracts for the two connecting States/ Administrations.

The work processes and CRV implementation roadmap in 2.2 provides a breakdown of the estimated schedule and serve as a guide.

2.2 Implementation Schedule/ Roadmap

The planned project timeline for each States/ Administrations to implement CRV could be based on the estimated work processes schedule and roadmap for CRV.

2.2.1 Work Processes

The projected activities and schedule to implement the services includes the following:

S/No.	Subject	Projected Activities	Projected Schedule
1	Technical requirements and SOW	1. Respective ANSPs develop their associated requirements and Statement of Work (SOW) that specify performance, interface, conversion, operational procedure, acceptance test procedure 2. Present to Vendor for comment and response 3. To seek CRV-OG concurrence on deviation from CRV common package 4. Finalize requirements	6 to 9 months
2	Negotiation and agreement between two connecting States/ Administrations	1. To decide the type of data or voice to be exchanged via CRC, QoS for each type of applications and the required bandwidth 2. CRV Contractor to comment and response to the agreed requirements 3. Agree to implementation schedule	6 to 9 months
3	CRV Contractor proposes Contract to ANSP	4. Contractual and Legal review 5. Technical and operational review 6. Finalize contract 7. Establish contract and payment system	6 to 9 months
4	Site preparation	Site preparation and implementation of the service	1 to 3 months

S/No.	Subject	Projected Activities	Projected Schedule
5	Test and evaluation	1. Perform acceptance test with associated applications 2. Perform acceptance test with respective ANSPs	3 to 6 months
6	Service acceptance	Service acceptance	1 week

2.2.2 Roadmap for CRV

The roadmap for CRV implementation in the APAC Region is appended in Appendix A.

2.3 Application Transition Schemes

This paragraph provides States/ Administrations the recommended transition scheme for each application (e.g. AMHS, ATFM, ADS-B, Voice, etc.) targeted to be implemented or migrated from the existing communication link/ network.

2.3.1 AMHS

Being IP, it should be possible to reroute the existing connection at the IP layer either by an address translation or by pointing the LA at a new IP address in the AMHS system. However the recommended approach will be to setup a parallel connection using the CRV that can be thoroughly tested to the satisfaction of both ANPS's. Once the stability of the CRV has been verified, the cutover would be conducted by the respective com-centers at the AMHS system level. The actual approach taken will require a negotiation between each pair of ANSP's.

2.3.2 AFTN

Depending on the existing AFTN connection there are a number of migration strategies available.

Option 1. Migration to AMHS

Setting up a new AMHS link over the CRV as per ICAO grand master plan *xyz.123* would be the preferred option for migration of AFTN. It would allow the new connection to be setup and tested independently.

Option 2. Migrate from native X.25 to XoT

Where the existing connection is a native X.25 connection end to end, and migration to AMHS is not possible, then XoT is the next preferred option. It is recommended that a new LA be setup that uses the XoT over CRV path. Once the XoT connection has been verified and tested by each ANSP then actual migration of AFTN would be performed by the respective com centers similar to AMHS in 2.3.1 above. If PCCW are not able to provide serial interfaces on their CE routers then it would be incumbent on the ANSP to deliver the AFTN traffic as a XoT connection.

Option 3. Migrate from XoT to XoT

Where the AFTN connection between two ANSP's is already using XoT, and if the trust in the performance of the CRV is high, then the cutover from the legacy link to the CRV could be as simple as an X25 route change on each ANSP's respective XoT routers. Alternatively, a new LA could be setup and tested before being cutover at the system level by the respective ANSP's com-centers.

2.3.3 ADS-B

To deliver their stream to the PCCW gateway, likewise at the other end it would be up to the partner ANSP to ensure that that there is a multicast path available from the CRV egress to their flight data management system. Being multicast it is possible for the same information to traverse the same two endpoints via multiple network paths simultaneously, however some ANSPs may decide to setup new multicast groups via the CRV so that the performance of the CRV can be measured against the legacy link. Alternatively, ANSPs may decide to replace the multicast stream with unicast data flows that operate via an ADS-B filter.

PCCW could implement Generic Routing Encapsulation (GRE) tunnel solution (NID to NID) between States/ Administrations who are agreeable to have direct connection for routing control over the any to any MPLS layer 3 backbone.

2.3.4 Voice

The specific strategy used to migrate the voice services will vary depending on the existing setup, the proposed voice interface between the ANSP and PCCW (E&M / ISDN / VoIP), how the partner ANSP is setup and their intended connection to PCCW. Despite this there are two main options.

Option 1 – New buttons on the operator consoles - Preferred

This option involves setting up new buttons on the operator consoles at each end. The new buttons are configured from the outset to route via the CRV. This strategy allows the new service to be configured and tested with minimal disruption to operators and also allows for an almost seamless cutover (pressing a different button). Another great advantage of this strategy is to ability to do a practical test of the voice quality by allowing the same pair of controllers test both paths within a few seconds of each other.

Option 2 – Reconfigure existing connections to use the CRV

Where Option 1 is not possible, the only other alternative is to reconfigure the existing connection. This will involve increased coordination between the two ANSP's and PCCW as well as potentially multiple technical groups within an ANSP as it is likely that multiple systems will need to be reconfigured at the same time. E.g. Voice switches, networking devices etc. This option would also involve a lengthy outage and interruption to operational staff.

2.4 Technical Specifications of CRV (for applications reference)

CRV envisaged in the ICAO CNS/ ATM concept via through two backbones (one Multiprotocol Label Switching (MPLS), based on a terrestrial, satellite, or both networks, and one based on a secured Virtual Private Network over the public internet.

i. It will be a homogeneous and generalized application of the IP protocol in the transport network for voice and data aeronautical communications;

ii. It will established an appropriate Quality of Service (QoS) quality requirements;

iii. It will have a centralized and common network management;

iv. It will have a homogeneous and standardized interface, consisting Network Interface Device(s) (NID(s)) linked to the existing local switches, satellite and/or terrestrial links based on the Multiprotocol Label Switching (MPLS) technology, as well as ground services, based on a Virtual Private Network (VPN) over the public internet;

v. It will have voice and data gateway service by the Service Provider; and

vi. For IT security, individual ANSPs may implement an authentication service based on a cooperative public key infrastructure (PKI) including IPSec for IPv4 and IPv6 and digital certificates management for public IP links between ANSPs.

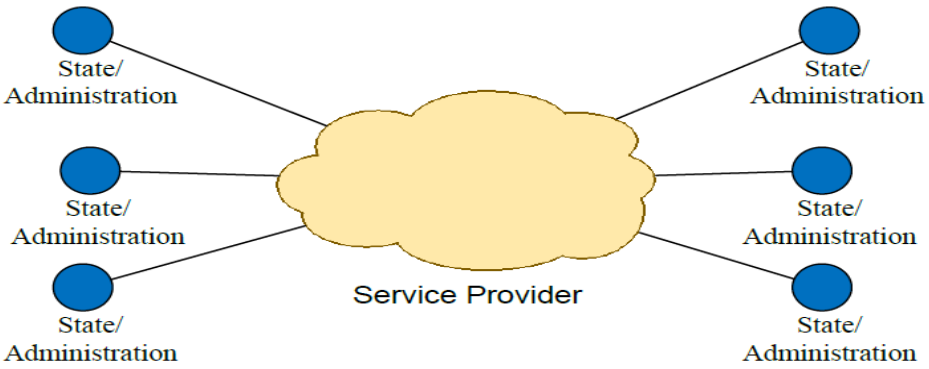


Figure 1: High level system overview of CRV

2.4.1 Service Level Agreement & Quality of Service

i. QoS are implemented using guidance from IETF RFC 4594 Configuration Guidelines for Different Service Classes. The routing protocol, voice, voice signaling, real-time interactive and standard data types shall all be given separate QoS bandwidth;

ii. Differentiated Services Code Point (DSCP) QoS markings to traffic will be used before it enters the network; and

iii. SLAs are based on States/ Administrations' requirements (i.e. Packages A, B, B+, C, C+ and D offered by CRV contractor).

2.4.2 IP Addressing

i. CRV supports IPv4 and IPv6 addressing. The overall IP addressing plan will be centrally managed by the CRV contractor and will be known as the CRV IP address plan;

ii. An IPv4 plan, appended as Appendix B, was agreed in the APAC region and was concluded through Conclusion 21/22 - Asia/Pacific ATN Interim Addressing Plan; ~~and~~

~~ii.~~iii. In the development of the IPv4 plan, a flexible margin has been designated to allow future growth or change. Through draft Conclusion CRV OG/8/01, using 10.46.0.1 to 10.46.255.254, each third party Service Provider (e.g. AIREON LLC providing Automatic Dependent Surveillance - Broadcast data over CRV) is assigned 254, 510, 764 or 1022 usable Network addresses (depending on Service Providers' technical requirements); and

~~iii.~~iv. The Middle East Regional (MID) region IPv4 plan is appended as Appendix C of this document.

2.4.3 Interface

i. The interface type provided by the NID to the CRV User is the Ethernet IEEE 802.3ab (1000 Base-T).

2.4.4 Routing Restrictions

i. Route advertisements will be restricted so that each CRV User which interacts with the CRV routing protocol can only advertise subnets which are allowed in the CRV IP Address Plan.

ii. When peering with the CRV Contractors network, it is permissible to use the CRV User's own Public IP addressing and ASN, and the CRV Contractor will use a Public AS.

2.4.5 Packet Loss Rate:

i. Packet loss rate of less than 0.1% for all the SLA-Voice; and

ii. Packet loss rate of less than 0.5% for all the SLA-Data.

2.4.6 For VoIP Transport (ED-137)

i. The VoIP Transport shall provide a maximum jitter of 40ms;

ii. The VoIP Transport shall provide a maximum packet loss of 0.1%;

iii. The VoIP Transport shall provide an availability greater than 99.9%; and

iv. The CRV shall use the high priority tags in the VPN packet headers to ensure that VoIP traffic is given high priority and minimal delay. An appropriate level of priority will be given to ED-137 SIP signaling.

2.4.7 Standards used

i. SNMP and MIB-II management protocols, implemented in accordance with RFC 1157 and RFC 1213;

ii. Implementation of the RTP/RTCP and RTP "header compression" protocols, in accordance with RFC 2508;

iii. The multiservice IP network permit the creation of VPNs using MPLS, in accordance with RFC 2547 and RFC 3031, and QoS configuration over MPLS/VPN, in accordance with RFC 3270 and RFC 2983;

iv. QoS is implemented using guidance from IETF RFC 4594. (Covered under QoS); and

v. The CRV provide transport for the ED-137 VoIP.

*Note: If at the time of the publication of this document the specific rules and standards mentioned in any of the other Sections have been revoked, superseded or updated, the new rules or standards shall be deemed as applicable.

2.5 Use Cases

Use Case 1 – ANSPs Interconnect AMHS

Summary of Situation
ANSP ‘A’ and ANSP ‘B’ wish to have a direct connection between their AMHS. Both ANSPs decide that the AMHS application shall be built upon the Aeronautical Telecommunication Network (ATN). The ATN will in turn use the CRV.

User Response
Each ANSP already has a connection to the CRV. Each ANSP:
1. Notifies the CRV-OG Coordinator of their intention to establish the new facility.
2. Determines if their existing access speed is sufficient. If it is not the ANSP will arrange with the CRV Service Provider to increase their bandwidth.
3. Negotiates bi-laterally with the other ANSP to determine what IT security arrangements are required. In this User Case they decide to implement an IPSec VPN.
4. Negotiates bi-laterally with the other ANSP to determine what testing, acceptance and commissioning procedures are required.
5. Notify CRV-OG on completion of the implementation to update records.
Operational Needs

UC1.1 The CRV link must meet the reliability and availability needs of AMHS.
UC1.2 The CRV link must provide IP version 4 transport for the ATN.
UC1.3 The CRV link must provide IP version 6 transport for the ATN.
UC1.4 The CRV link must allow the ANSPs to implement IPSec VPN tunnels.
UC1.5 The CRV link must allow for bandwidth changes.

Use Case 2 – ANSPs Implement ATC Voice over Internet Protocol Circuits

Summary of Situation
ANSPs ‘A’ and ‘B’ wish to build upon the success of their AMHS implementation and have identified four Voice over Internet Protocol (VoIP) voice circuits which should be moved to the CRV.

User Response
Each ANSP already has a connection to the CRV. Each ANSP:
1. Notifies the CRV-OG Coordinator of their intention to establish the new facility.
2. Determines if their existing access bandwidth is sufficient. If it is not, the ANSP will arrange with the Service Provider to increase their bandwidth.
3. Negotiates bi-laterally with the other ANSP to determine what IT security arrangements are required. In this Case they decide to implement an IPSec VPN to provide secure end-to-end transport between ANSPs.
4. Negotiates bi-laterally with the other ANSP to determine what testing, acceptance and commissioning procedures are required.
5. Tags the VPN traffic containing the Voice over Internet Protocol (VoIP) Real-time Transport Protocol (RTP) and Session Initiation Protocol (SIP) data with appropriate priority markings to allow the CRV Service Provider to identify the voice traffic.
Operational Needs

UC2.1 The CRV link must meet the reliability and availability needs of ATC voice.
UC2.2 The CRV link must provide an IP version 4 VPN tunnel to transport IP version 4 VoIP and SIP signaling.
UC2.3 The CRV link must provide an IP version 6 VPN tunnel to transport IP version 6 VoIP and SIP signaling.
UC2.4 The CRV link will use the high priority tags in the VPN packet headers to ensure that VoIP traffic is given high priority and minimal delay.

Use Case 3 – ANSPs Implement Automatic Ring-down Circuits

Summary of Situation
ANSPs ‘A’ and ‘B’ wish to build upon the success of their AMHS implementation and have identified an Automatic Ring-down (ARD) analog voice circuit which should be moved to the CRV.

User Response
Each ANSP already has a connection to the CRV. Each ANSP:
1. Notifies the CRV-OG Coordinator of their intention to establish the new facility.
2. Determines if their existing access bandwidth is sufficient. If it is not, the ANSP will arrange with the Service Provider to increase their bandwidth.
3. Negotiates bi-laterally with the other ANSP to determine what voice quality Mean Opinion Score (MOS) is required. Perceptual Evaluation of Speech Quality (PESQ) ITU-T Rec. P.862 may be used to measure the effects of distortions (e.g. errors, packet loss, delay, etc.) to provide the MOS score.
4. Negotiates bi-laterally with the other ANSP to determine what testing, acceptance and commissioning procedures are required.

UC3.1 The CRV link must meet the reliability and availability needs of ATC voice.
UC3.2 The CRV link must provide conversion from analog voice to VoIP.
UC3.3 The CRV link must provide appropriate SIP signaling to support the ARD functionality.
UC3.4 The CRV link must provide IP version 4 transport for the VoIP.
UC3.5 The CRV link must provide IP version 6 transport for the VoIP.
UC3.6 The CRV link will use the high priority tags in the packet headers to ensure that VoIP traffic is given high priority and minimal delay. The CRV must give an appropriate level of priority to SIP.
UC3.7 The CRV link must deliver voice so that it is clearly understood with minimal delay.

Use Case 4 – ANSPs Implement Analog Voice Circuits

Summary of Situation
ANSPs ‘A’ and ‘B’ wish to build upon the success of their AMHS implementation and have identified four analog voice circuits which should be moved to the CRV.

User Response
Each ANSP already has a connection to the CRV. Each ANSP:
1. Notifies the CRV-OG Coordinator of their intention to establish the new facility.
2. Determines if their existing access bandwidth is sufficient. If it is not, the ANSP will arrange with the Service Provider to increase their bandwidth.
3. Negotiates bi-laterally with the other ANSP to determine what voice quality Mean Opinion Score (MOS) is required. In this Case they decide a MOS of 4.0 is required so they select a CRV service level that provides the required voice quality.
4. Negotiates bi-laterally with the other ANSP to determine what testing, acceptance and commissioning procedures are required.
Operational Needs

UC4.1 The CRV link must meet the reliability and availability needs of ATC voice.
UC4.2 The CRV link must provide conversion from analog voice to VoIP.
UC4.3 The CRV link must detect analog signaling and provide appropriate SIP signaling and vice versa.
UC4.4 The CRV link must provide IP version 4 transport for the VoIP.
UC4.5 The CRV link must provide IP version 6 transport for the VoIP.
UC4.6 The CRV link will use the high priority tags in the packet headers to ensure that VoIP traffic is given high priority and minimal delay. The CRV must give an appropriate level of priority to SIP.
UC4.7 The CRV link must deliver voice so that it is clearly understood with minimal delay.

3.0 IMPLEMENTATION SUPPORT

3.1 Introduction

The aim of the transition is to be interruption less. But as the services must migrate from the current network infrastructure to the CRV, an interruption time due to disconnection and reconnection, is mandatory and the team involved (CRV-OG, CRV Members and Contractor) will be of utmost importance to the overall process.

This chapter comprises the basic teams involved in the implementation of the CRV infrastructure, the roles of each professional and the main coordination steps and stakeholders including the CRV-OG.

These responsibilities come in addition to those stated in the Terms and Conditions and Terms of Reference.

Figure 3 describes the relevant entities for the CRV implementation.

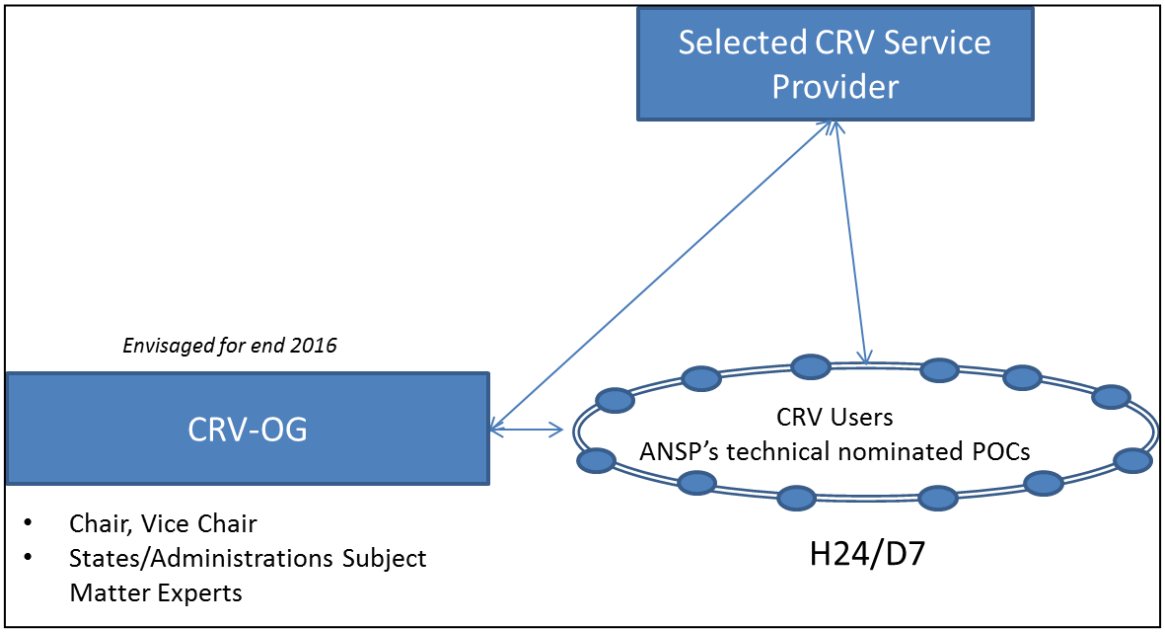


Figure 3: Relevant Entities to this Project.
(Source: CRV Tender doc - Att II - Terms of Reference_v3)

3.2 Implementation Team

The implementation team will be composed of the CRV-OG representatives, the National Points of Contact (NPOC), Local Points of Contact (LPOC) and the CRV Contractor Team, as described in the following sections.

3.2.1 CRV-OG

The CRV Operations Group (OG) will provide oversight of the function and performance of the network after the CRV is completely installed. Besides, it will be involved in the oversight of the implementation of the CRV post Contract Award.

The main activities and roles applied to the CRV-OG during the implementation of the CRV infrastructure are:

i. Develop close coordination with the National CRV POC and Contractor for the complete implementation of the CRV node;

ii. Provide the CRV IP Addressing Scheme (Plan) to the Contractor, in close coordination with the National CRV POC; and

iii. Provide the classification and marking scheme for the prioritization of traffic for the QoS to be used by the aeronautical applications in the CRV network.

Note: When applying QoS, the end-to-end configuration needs to be observed (LAN- layer 2 switches and WAN- Layer 3 routers devices). So, this activity will involve close coordination with the National CRV POC and Contractor, taking into consideration the tender document Att II - Annex b - Matrix of Flows for CRV services_v2), SLA, and the tender document Att II - Annex c - Mapping of services for quality management_v2.

3.2.2 National CRV Points of Contact

Table 1 contains the National CRV Points of Contact that will be in charge of the whole process in each CRV Member, independently if the State involved has more than one node.

The main activities and roles of the National CRV Points of Contact are:

i. Develop close coordination with the CRV-OG representatives, Contractor and Local CRV POC for the complete implementation of the CRV node;

ii. Receive the requests for site surveys from the Contractor, coordinating the actions with the Local CRV POC;

iii. Participate and/or Coordinate the participation of the Local CRV POC and Local Staff in the implementation meetings with the Contractor;

iv. Participate and/or Coordinate the participation of the Local CRV POC and Local Staff in the training package (on line, on site, initial and refresh) as defined in the Section 3.12 (Training) of the Terms of Reference (TOR) document;

v. Coordinate the actions and instruct the Local CRV Points of Contact regarding all activities

involved in the implementation phase;

vi. Review and approve the System Design Document (SDD), System Engineering plan (SEP) and other documents, part of the tender package, prepared by the Contractor upon the contract award and signature;

vii. Review and approve the Validation Plan, including the Site Acceptance Test (SAT), prepared by the Contractor;

viii. Oversee if the Contractor is following the national laws and procedures concerning the assignment of frequencies with the radio regulator authorities in each country (case of microwave and satellite equipment);

ix. Update the ICAO CNS Regional Officer (ICAO Asia and Pacific Regional Office) with regard to the timeframe, situation, difficulties and other topics deemed necessary for the implementation of the CRV node(s);

x. Provide the local CRV IP Addressing Scheme - Plan to the Contractor in close coordination with the CRV-OG representatives.

xi. Provide the current numbering plan for the ATS Switched Voice Circuits to the Contractor;

xii. Provide the current direct hotline Voice Circuits configuration to the Contractor;

xiii. Provide the classification and marking scheme for the prioritization of traffic for the QoS to be used by the aeronautical applications in the CRV network (See note in the paragraph 3.2.1.3);

xiv. Receive the requests for site surveys from the Contractor and coordinate the activities with the Local CRV POC; and

xv. Approve the implementation planning.

Table 1: National CRV Points of Contact

Asia Pacific Region:

State/ Administration	ANSP/ CAA	National CRV Point of Contact (POC)	Job Title	E-mail	Telephone/FAX	Address
Afghanistan	Director of Technical Services Afghanistan Civil Aviation Authority (ACAA)	Eng. Mohammad Shaker Popal	Director of CNS	engpopal@yahoo.com	Office Tele: +93 (0)20 2311962 Mobile : +93 (0)799 601095	Kabul international airport
Australia	Airservices Australia	Mr. Terence Palmer	Team Leader Networks	Terence.palmer@airservicesaustralia.com	Tel:+61 (2) 6268 4960	Airservice Australia 25 Constitution Avenue Canberra 2600, ACT Australia
Bangladesh	Dhaka Hazrat Shahjalal	Mr. S M A Gaffar Fakir	Communication Officer (ATM) Civil Aviation Authority of Bangladesh	cocatc@caab.gov.bd	Tel +880 171 506 7502 Fax +880 (2) 890 1411	Headquarters, Kurmitola Dhaka 1229 BANGLADESH

State/ Administration	ANSP/ CAA	National CRV Point of Contact (POC)	Job Title	E-mail	Telephone/FAX	Address
Bhutan	Air Navigation Services, Ministry of Information & Communications Department of Civil Aviation"	Mr. Pema Tashi	Superintendent, ANS	ptashi@bcaa.gov.bt	Mobile :+975 17622702 Office: +975 8 271347 (Ext.:107), Fax.: +975 8 271944	Paro Airport
Brunei Darussalam						
Cambodia		Mr. Neang To	Chief of CNS State Secretariat of Civil Aviation	neangto.ans@gmail.com	Tel +855 (23) 224 258 Fax +855 (23) 224 259	State Secretariat of Civil Aviation #44 Phnom Penh International Airport Russian Federation Blvd. Phnom Penh CAMBODIA

State/ Administration	ANSP/ CAA	National CRV Point of Contact (POC)	Job Title	E-mail	Telephone/FAX	Address
China	ATMB/CAAC	Mr. Huang Zheng	Engineer	huangzheng@atnc.com.cn	Tel:+86 58729977 Fax:+86 (10) 67331459	Air Traffic Management Bureau of CAAC No.301 Weatern, Dongwei Rd, SunHe, Chao Yang District, Beijing, China
Hong Kong, China	Civil Aviation Department, Hong Kong, China	Mr. MH Hui	Chief Electronics Engineer	mhhui@cad.gov.hk	Tel:+852 2910 6505 Fax:+852 2845 7160	Civil Aviation Department Headquarters 1 Tung Fai Road Hong Kong International Airport, Lantau HONG KONG, CHINA
China, Macau	ADA-Administration of Airports	Mr. Samson Pun	Safety Officer	samsonpun@aacm.gov.mo	Tel:+853 8796 4150 Fax:+853 2833 8089	Civil Aviation Authority of Macao, China Alameda Dr. Carlos D' Assumpcao 336-342, Centro Comercial Cheng Feng 18 andar MACAO, CHINA

State/ Administration	ANSP/ CAA	National CRV Point of Contact (POC)	Job Title	E-mail	Telephone/FAX	Address
Democratic People's Republic of Korea	General Administration of Civil Aviation	Mr. Ri Sung II	Vice Chief, Communication Section ATM Department	gaca@silibank.net.kp	Tel:+850 (2) 181111 Ext. 8108 Fax:+850 (2) 381 4410	General Administration of Civil Aviation Pyongyang International Airport Sunan District, Pyongyang DEMOCRATIC PEOPLE'S REPUBLIC OF KOREA
Fiji	Airports Fiji Limited	Mr. Kelepi Dainaki	Manager Air Navigation Engineering Services	kelepid@afl.com.fj	Tel:+679 673 1623 Mobile:+679 990 6110 Fax:+679 673 1123	Airports Fiji Limited Private Mail Bag Nadi Airport FIJI ISLANDS
France (territories of French Polynesia, New Caledonia and Wallis and Futuna)	DSNA (France)	Mr. Jean-Marc Valentin	ATM Expert	jean-marc.valentin@aviation-civile.gouv.fr	Tel:+687 352443 Fax:+687 265 206	Direction Aviation Civile BP H1, 98800 NEW CALEDONIA
India	Airports Authority of India	Mr. Anurag Sharma	General Manager (COM)	akkapur@aai.aero	Tel:+91 (11) 2461 0537 Fax:+91 (11) 2463 2930	Airports Authority of India Rajiv Gandhi Bhawan Saddurjung Airport New Delhi 110003 INDIA

State/ Administration	ANSP/ CAA	National CRV Point of Contact (POC)	Job Title	E-mail	Telephone/FAX	Address
Indonesia	Airnav Indonesia	Ms. Arief Agustama	Head, IT Division	arief.agustama@airnavindonesia.co.id	Tel:+62 (21) 5591 5000 Mobile: +62 811936582 Fax:+62 (21) 5591 5100	Airnav Indonesia Support Building Jl. Ir. Juanda, Tangerang INDONESIA
Japan	JCAB	Mr. Kenichi Kato	Chief of Flight Information 1st Section, Operations and Flight Inspection Division	katou-k24s@mlit.go.jp	Tel:+81-3-5253-8751 Fax:+81-3-5253-1664	2-1-3 Kasumigaseki Chiyoda-ku Tokyo 100-8918 JAPAN
Kiribati						
Lao	Lao Air Traffic Management	Mr. Lamkeo Phouxay	Director of Air Traffic Technical Service Center Lao Air Traffic Management	lamkeoattsc@hotmail.com	Tel:+856 (20) 585 777 94 Fax +856 (21) 512 216	Director of Air Traffic Technical Service Center P.O. Box 2985 Wattay International Airport Vientiane
Malaysia	Department Of Civil Aviation Malaysia	Mr. Sahrol Nizal Bin Ab Rashid	Air Traffic Management Sector for Director General of Civil Aviation Malaysia	sahrol@dca.gov.my	Tel:+603 8871 4278 Fax:+603 8881 0530	Department of Civil Aviation Malaysia No.27, Persiaran Perdana Level 4, Block Podium B, Precinct 4 62618 Putrajaya MALAYSIA

State/ Administration	ANSP/ CAA	National CRV Point of Contact (POC)	Job Title	E-mail	Telephone/FAX	Address
Myanmar	Department Of Civil Aviation	Mr. Win Maw	Deputy Director	winmawdca@gmail.com	Tel:+95 92 5018 3029 Fax:+95 (1) 533 016	Department of Civil Aviation ATC Operating Building Yangon International Airport Yangon 11021 MYANMAR
New Zealand	Airways New Zealand	Mr. Vaughan Hickford Mr. Dave Pearson	Team Leader Network Development Network Support Team Leader	vaughan.hickford@airways.co.nz	Tel:+64 (3) 358 1521 Tel:+64 (3) 357 0346	Airways New Zeland 26 Sir William Pickering Drive Russley, Christchurch, Canterbury 8043 NEW ZELAND
Pakistan		Mr. M. Fasih-uz-Zaman Khan	Senior Additional Director Com-Ops	Fasih-uz-Zaman.Khan@caapakistan.com.pk		Pakistan Civil Aviation Authority Headquarters, Terminal-I Jinnah International Airport Karachi 75200 PAKISTAN

State/ Administration	ANSP/ CAA	National CRV Point of Contact (POC)	Job Title	E-mail	Telephone/FAX	Address
Philippines	Civil Aviation of the Philippines	Mr. Elmer E. Gomez	Division Chief	elm_gomez@yahoo.com	Tel:+63 (2) 944 2192 Fax:+63 (2) 879 9244	Civil Aviation Authority of the Philippines Air Navigation Service ANS Technical Center Building Old Mia Road, Pasay City 1300 Metro Manila, PHILIPPINES
Republic of Korea	Ministry of Land, Infrastructure and Transport	Mr. Kyung Joon, Jang	Assistant Director	skyjjan@korea.kr	Tel:+82 (44) 201 4362 Fax:+82 (44) 201 5637	Ministry of Land, Infrastructure and Transport 11, Doum-ro 6 Sejong Special self-governing City REPUBLIC OF KOREA
Singapore	Singapore Air Traffic Control Centre	Mr. Augustine Lau	Engineer (Communications/ Navaids Systems)	augustine_lau@caas.gov.sg	Tel:+65 6422 7071 Fax:+65 6542 2447	Civil Aviation Authority of Singapore Singapore Changi Airport P.O. Box 1 SINGAPORE 918141
Sri Lanka	Airport & Aviation Services (Sri Lanka) Ltd.	Mr. Wipula Wimanshanthi	Head of Electronics and Air Nav Engineering	head.eane@airport.lk wipula60@gmail.com	Mobile:+94 77 304 7653 Fax:94 (11) 263 3488	Airport & Aviation Services (Sri Lanka) Ltd. Colombo Airport Ratmalana 10370 SRI LANKA

State/ Administration	ANSP/ CAA	National CRV Point of Contact (POC)	Job Title	E-mail	Telephone/FAX	Address
Thailand	Aeronautical Radio of Thailand Ltd.	Mr. Chonlawit Banphawatthanrak	Chief, Policy and Strategy Management Bureau	chonlawit.ba@aerothai.co.th chonlawit@gmail.com	Tel: +66 2285 9578 +66 6 3265 3643 +66 8 6575 7901 Fax:+66 (2) 285 9057	Aeronautical Radio of Thailand Ltd. 102 Soi Ngamduplee Tungmahamek, Sathon Bangkok 10120 THAILAND
United States	Federal Aviation Administration (FAA)	Mr. Hoang Tran	International Telecommunication Lead	hoang.tran@faa.gov	Tel:+1 (202) 267 7142	Federal Aviation Administration ATO, Programme Management Organization 800 Independence Avenue, SW Washington, DC 20591 USA

MID Region (CRV) Focal Points (updated in December 2017 at CRV OG/3 meeting):

State	Name/Title	Contact Details (Tel./Fax/Mobile/Email)
Bahrain	Mohamed Ali Saleh *Chief Aeronautical Telecomm*	Fax: +973 17329966 Tel: +973 17321187 Email: masaleh@caa.gov.bh
	Yaseen Hassan AlSayed *Head Aeronautical Telecomm Network*	Fax: +973 17329966 Tel: +973 17321183 Email: y.alsayed@caa.gov.bh
Egypt	Mr. Mohamed Ramzy Mohamed Abdallah *Director of AFTN/AMHS Technical Department*	Tel: +202 22657981 +201007736780 Email: Mrma_eg@yahoo.com
	Eng. Haitham Mohamed Ahmed Eldosoki *Director of AIM Technical Department*	Tel: +202 22650781 +201007810781 Email: Haitham.mohamed@nansceg.net
Iran	Mr. AliAkbar SalehiValojerdi *Senior Expert of IRANAFTN/AMHS Training Department*	Fax: +98 21 66025101 Tel: +98 21 6102337 Mobile: +989 124 202775 Email: aasalehi@airport.ir
	Mr. Alireza Mahdavisefat *Senior Expert of IRANAFTN/AMHS COM Centre*	Fax: +98 21 66025101 Tel: +98 21 6314 6432 Mobile: +989 333510320 Email: mahdavi@airport.ir
Iraq		
Jordan	Ms. Mona Ribhi AlNaddaf	Tel: +9626 4881473 +96279 9876710 Email: m.al-nadaf@carc.gov.jo
Kuwait	Mr. Hassan Alattar	Fax: +965-2 4721 279

State	Name/Title	Contact Details (Tel./Fax/Mobile/Email)
	Communication Engineer	Tel: +965-2 4732 530 Mobile: +965 99449454 Email: ha.alattar@dgca.gov.kw
Lebanon	Mr. Mohamad Abdallah Saad *Head of Telecommunication Equipment*	Fax: +961 1 629 031 Tel: +961 1 628 151 Mobile: +961 3 280 299 Email: msaad@beirutairport.gov.lb
Libya		
Oman	Mr. Nasser Salim Al-Suleimani Chief ATM Systems Mr. Ibrahim Said Al-Hajri ATM Systems Engineer	Email: nassers@paca.gov.om alhajri@paca.gov.om
Qatar		
Saudi Arabia	Ibrahim bash Senior Systems Engineer Automation Engineering Branch	Fax: +966 12 671 9041 Tel: +966 12 671 7717 Ext 1119 Mobile: +966 50 567 1231 Email: ibasheikh@gaca.gov.sa
Sudan	Eng. Yasir Eltayeb Sidahmed	Fax: +249 183 770001 Tel: +249 183 782701 Email: yasirts@gmail.com
Syria		
UAE	Greg Kurten A/Director CNS Communication, Navigation and Surveillance	Fax: +971 2 599 6872 Tel: +971 2 599 6860 Email: gegkurten@szc.gcaa.ae
	Shahzad Chaudhary Senior CNS Engineer Communication, Navigation and Surveillance	Fax: +971 2 599 6872 Tel: +971 2 599 6865 Email: shahzad@szc.gcaa.ae

State	Name/Title	Contact Details (Tel./Fax/Mobile/Email)
Yemen		

3.2.3 Local CRV Points of Contact

Table 2 contains the Local Points of Contact. In fact, the professionals nominated and listed in the referred tables will really take part in the installation, on behalf of the States, and will be in charge of the oversight of the Contractor´s team in each site. They will report directly to the National Points of Contact of each CRV Member. The main activities and roles for the Local CRV Points of Contact are:

i. Instruct and coordinate the actions with all the local staff involved in the CRV implementation;

ii. Develop close coordination with the National CRV POC and the Contractor´s site staff for the complete implementation of the CRV node;

iii. Coordinate the actions for the site surveys with the National CRV POC;

iv. Participate in the implementation meetings with the Contractor (if decided by the National Point of Contact);

v. Participate to the elaboration of the implementation planning;

vi. Participate in the Training Package and nominate, to the National CRV POC, the Local staff there will participate in the referred events;

vii. Report, give feedback and update the National CRV POC regarding all aspects concerning the implementation of the CRV node;

viii. Assist the National POC in the revision and approval of the SDD, SEP and other implementation documents, prepared by the Contractor;

ix. Assist the National POC in the revision and approval of the Validation Plan including the SAT, prepared by the Contractor;

x. Oversee the installation in order to ensure that the Contractor team is keeping the working area clean and free from fire hazards and if after installation, all excess material is duly removed;

xi. Make sure that the local safety rules are observed by the Contractor in terms of intervention on operational systems;

xii. Oversee the installation in order to ensure that the Contractor is following what is described in the TOR, item 3.3.2.9, concerning the Electromagnetic compatibility/ grounding;

xiii. Oversee if the QoS configuration is duly performed by the Contractor, as defined by the CRV-OG representatives and the National CRV POC;

xiv. Oversee if the CRV IP Addressing Scheme (Plan) is duly performed by the Contractor, as defined by the CRV-OG representatives and the National CRV POC;

xv. Oversee if the configuration of current numbering plan for the ATS Switched Voice is duly performed by the Contractor, as defined by the CRV-OG representatives and the National CRV POC;

xvi. Oversee if the configuration of the current Direct Circuits (DIR) is duly performed by the Contractor, as defined by the CRV-OG representatives and the National CRV POC;

xvii. Coordinate the actions for the site surveys and assist the Contractor´s personnel during the visits; and

xviii. Hold meetings with the Contractor as deemed necessary and report to National POC.

Local CRV Points of Contact (installation and oversight of the Contractor´s team on each site)

State	State/ANSP	Site	Local CRV Points of Contact	Email	Telephone / Fax	Service installation
Afghanistan	Afghanistan Civil Aviation Authority (ACAA)	Kabul	Eng. Mohd.Shaker Popal	engpopal@yahoo.com		Kabul International Airport
American Samoa		Pago Pago			Tel.: Fax :	Pago Pago International Airport
Australia	Airservices Australia	Brisbane	Mr. Michael Earnes	Michael.Eames@AirservicesAustralia.com	+61 2 6268 5042 +61 409 357 965	Australia Airservices Australia Brisbane Air Traffic Services Centre Airport Drive, Eagle Farm, Queensland 4009 Australia
Australia	Airservices Australia	Melbourne	Bibhuti Panda		+61 2 6268 5169 +61 451 060 674	Australia Airservices Australia Melbourne Air Traffic Services Centre Tower Road, Tullamarine, Victoria Australia
Bangladesh		Dhaka			Tel 088-02-8920852, 088-02-8901465 email ccoohsia@caab.gov.bd	Hazrat Shahjalal International Airport - Dhaka COM Center

State	State/ANSP	Site	Local CRV Points of Contact	Email	Telephone / Fax	Service installation
Bhutan	Department of Air Transport ANSP-Division, CNS Section	Paro	Mr. Sangay Dy. Chief Comm. Officer	sangay@doat.gov.bt	Tel: +975 8 271407 Fax: +975 8 271944	Paro
Brunei Darussalam		Brunei			Tel.: Fax :	Brunei International Airport
Cambodia		Phnom Penh	Mr. Norngsao 85-16771136, Mr. Sivaluk 66-2502-6742 (Thailand number)		Tel.: 855-23-890194, 855-23-890262, Mr. Norngsao 85-16771136, Mr. Sivaluk 66-2502-6742 (Thailand number) Fax :	Phnom Penh International Airport - Phnom Pehn COM center
China	ATMB - Air Traffic Management Bureau,CAAC	Beijing	Mr. Huang Zheng	huangzheng@atnc.com.cn	Tel.:+86(10)58729977 Fax :+86(10)67331459	Beijing Network Control Center No.301 Weatem, Dongwei Rd. Sunhe, Chao Yang District, Beijing ,China
China	ATMB - Air Traffic Management Bureau,CAAC	Guangzhou			Tel.:+86-020-86122850 Fax :+86-020-86636200	Guangzhou COM Network Center No.3 Nanyun East Street, Airport Road, Baiyun District Guangzhou, China

State	State/ANSP	Site	Local CRV Points of Contact	Email	Telephone / Fax	Service installation
China, Hong Kong		Hong Kong	Mr. Gene Kwok	gwhkwok@cad.gov.hk	Tel: +852 2910 6523 Fax: +852 2845 7160	Civil Aviation Department Headquarters, 1 Tung Fai Road, Hong Kong International Airport, Lantau, Hong Kong
China, Macau	ADA-Administraiton of Airports	Macau			Tel.: (+853)28861111 Fax: (+853)28862222 Email: airportdirector@ada.com.mo	Macau International Airport PAC on Talpa Macao, China
Cook Islands		Rarotonga			Tel.: Fax :	Rarotonga International Airport
Democratic People's Republic of Korea	ATC, Pyongyang International Airport, SUNAN District, DPR Korea	Pyongyang			Tel.: 850-2-381 5910 Fax : 850-2-831 4410	Pyongyang City
Fiji	Airports Fiji Limited	Nadi	Mr. Jioji Kinisi	jiojik@afl.com.fj	Tel: +679 6731603 Fax:+679 6731123	ATMC Equipment Room, ATMC Building Ottawa Road, Nadi Airport, Fiji Islands
French Polynesia	Service d'Etat de l'Aviation Civile / Faa'a International Airport	Papeete	Mr. Marc Deginther	Marc.deginther@aviation-civile.gouv.fr	Tel: (689) 40 86 10 32 Mobile: (689) 89 29 84 74	Service d'Etat de l'Aviation Civile BP 6011 - 98702 Faa'a International Airport

State	State/ANSP	Site	Local CRV Points of Contact	Email	Telephone / Fax	Service installation
					Fax: (689) 40 86 10 39	
India	Airports Authority of India	Mumbai	Mr. Hemant Ramchandani Joint General Manager (CNS) CSI Airport Mumbai **India**	hemantr@aati.aero	+91 (22) 2682 8123 Mobile: +91 92 2331 4272	
India	Airports Authority of India	New Delhi	Mr. K. S. Kathayat AGM (COM) IGI Airport New Delhi 110037 **India**			
Indonesia	Jakarta ATS Centre	Jakarta			Tel.: Fax :	Soekarno-Hatta International Airport Jakarta, Tangerang, Banten 19120 Indonesia
Indonesia	Makassar ATS Centre	Makassar			Tel.: Fax :	Sultan Hasanuddin International Airport Jalan Raya Airport No. 1 Makassar Sulawesi 90552, Indonesia
Japan	Tokyo Air Traffic Control Centre	Tokyo	TBD		Tel.: Fax :	1-2, Namiki, Tokorozawa city, Saitama pref. 359-0042 Japan

State	State/ANSP	Site	Local CRV Points of Contact	Email	Telephone / Fax	Service installation
Japan	Air Traffic Management Center (ATMC)	Fukuoka	TBD		Tel.: Fax :	1302-17 Nata Higashi-ku Fukuoka-city Fukuoka-Pref 811-0204 Japan
Kiribati	Mr CARLIER Yann of DGAC/DAC-New Caledonia	Tarawa			Tel.: Fax :	Bonriki International Airport
Lao People's Democratic Republic		Vientiane			Tel.: 856-21-520157, 856-21-512090, Ms. Pen 66-802969631 (Thailand number). Mr. Somboon 856-20-5560-1638	Wattay International Airport
Malaysia	Kota Kinabalu Air Traffic Control Centre	Kota Kinabalu	Mr. Mohd. Dahri Bin Munik	dahrimunik@dca.gov.my	Tel:+6 088 224911 Mobile: +6 019 8815780 Fax: +6 088 219170	ATCC Building, Jalan Kepayan **88618 Kota Kinabalu, Sabah.**
Malaysia	Kuala Lumpur Air Traffic Control Centre (KL ATCC)	Selangor	Mr. Mohd. Hamli Bin Alias	mohd.hamli@dca.gov.my	Tel: +6 03 7846 5233 Mobile: +6 012 629 5405 Fax: +6 03 7845 6590	Kuala Lumpur Air Traffic Control Centre, Level 1, Block A, Complex of Air Traffic Control Centre, **47200 Subang, Selangor**.

State	State/ANSP	Site	Local CRV Points of Contact	Email	Telephone / Fax	Service installation
Malaysia	Kuching Sub-Centre Kuching Air Traffic Control Centre	Kuching	Mr. Suzaiman bin Zaini	suzaiman@dca.gov.my	Tel: +6 082 616532 Mobile: +6 016 8881971 Fax: +6 082 454523	Kuching Air Traffic Control Centre, Kuching International Airport, **93728 Kuching,Sarawak.**
Maldives	Maldives Airports Company Limited	Male			Tel.: 960-322071 Fax: 960-317202 atcc @ airport.com.mv	Malé International Airport Ibrahim Nasir International Airport Hulhule 22000, Republic of Maldives
Marshall Islands		Majuro			Tel.: Fax :	Marshall Islands International Airport
Micronesia (Federated States of)		Chuuk/Kosrae/Ponapei/Yap			Tel.: Fax :	Pohnpei International Airport
Mongolia	Communication Navigation Surveillance section, Civil Aviation Authority of Mongolia	Ulaanbaatar			Tel.: +976 11 281603 Fax : +976 1170049785	Khan-Uul district, 10th khoroo, Buyant-Ukhaa, Ulaanbaatar, Mongolia
Myanmar	Department Of Civil Aviation	Yangon	Mr. Kyaw Zay Ya	kyawzayya.27@gmail.com	Tel:95-1-533030, Ext:453 Mobile:95-9-974684449 Fax:95-1-533016	ATC Tower Building, Yangon Int'l Airport, Airport Road, 11021, Mingaladon Township, Yangon, Myanmar.

State	State/ANSP	Site	Local CRV Points of Contact	Email	Telephone / Fax	Service installation
Nauru		Nauru			Tel.: Fax :	Nauru International Airport – Yaren
Nepal		Kathmandu			Tel.: Fax :	Tribhuvan International Airport
New Caledonia	Direction de l'aviation civile / Service de la Navigation Aerienne	Noumea	Mr. Félicien TORRES	felicien.torres@aviation-civile.gouv.fr	Tel.:	Nouméa Magenta Airport, 179, rue Roger Gervolino BP H1 - 98849 Noumea Cedex
New Zealand	Airways New Zealand	Christchurch,			Tel.: Fax :	20 Sir William Pickering Drive, Russley, Christchurch, New Zealand
New Zealand	Airways New Zealand	Auckland,			Tel.: Fax :	Cyrill Kay Road, Auckland Airport, Auckland, New Zealand
Niue Islands						
Pakistan	G.M. Communication Headquarters Civil Aviation Authority, Technical Division, COM-OPS, Branch Terminal -1, JIAP,	Karachi	Mr. Fasih-uz-zaman	aftnophq@caapakistan.com.pk	+92 (21) 924-8732 +92 (21) 924-8733 (fax)	Jinnah International Airport

State	State/ANSP	Site	Local CRV Points of Contact	Email	Telephone / Fax	Service installation
	Karachi, Pakistan					
Palau		Koror			Tel.: Fax :	Roman Tmetuchl International Airport
Papua New Guinea		Port Moresby			Tel.: Fax :	Jacksons International Airport Morea-Tobo Rd Port Moresby 121 Papua New Guinea
Philippines	Civil Aviation of the Philippines	Pasay City	Mr. Gilmar D. Tiro	gilmar.tiro@gmail.com	Tel.: +63 (2) 944-2242, +63 (2) 6727729, +63 (2) 6727728 Fax :	Philippine Air Traffic Management Center CAAp Compound, Old Mia Road, Pasay City, 1300 Metro Manila, PHILIPPINES
Republic of Korea	AFTN Center	Seoul			Tel.: + 823 28800335 Fax :	62, Haneul-Gil Gangseo-Gu Seoul, 157-711, Korea
Samoa		Faleolo			Tel.: Fax :	Faleolo International Airport
Singapore	Singapore Air Traffic Control Centre	Singapore			Tel.: 6214 8050/65 Fax : 6545 9370	LORADS II Building, 60, Biggin Hill Road, Singapore Postal Code 509950

State	State/ANSP	Site	Local CRV Points of Contact	Email	Telephone / Fax	Service installation
Solomon Islands		Honiara			Tel.: Fax :	Honiara International Airport
Sri Lanka		Colombo			Tel.: Fax :	Colombo Ratmalana Airport
Thailand	Aeronautical Radio Of Thailand LTD	Bangkok			Tel.: 0-2287-3531-41 Fax :	102 Ngamduplee Tungmahamek sathorn Bangkok Thailand 10120
Timor Leste		Dili			Tel.: Fax :	Presidente Nicolau Lobato International Airport
Tonga		Tongatapu			Tel.: Fax :	Fua'amotu International Airport
Tuvalu		Funafuti			Tel.: Fax :	Funafuti International Airport
United States	FAA Oakland Air Route Traffic Control Center	Oakland			Tel.: 510-745-3000 Fax :	5125 Central Avenue Fremont, CA 94536-6531
United States	FAA Salt Lake City Network Enterprise Management Center	Salt Lake City	Mr. Tom Beschler	Thomas.ctr.beschler@faa.gov	Tel.:(609) 485-4818 Fax :	2150 W. 700 N. Salt Lake City UT 84116
Vanuatu	Mr CARLIER Yann of DGAC/DAC-New Caledonia	Port Vila			Tel.: Fax :	Bauerfield International Airport

State	State/ANSP	Site	Local CRV Points of Contact	Email	Telephone / Fax	Service installation
Viet Nam		Ho Chin Minh/Hanoi			Tel.: Fax :	Tan Son Nhat International Airport Noi Bai International Airport
Wallis and Futuna	Aviation Civile	Wallis	Mr. Bernard Le Guillou	bernard.le-guillou@aviation-civile.gouv.fr	+00-681-72-1202 Fax: 00-681-72-29-54 email: seac-wf.sna@mail.wf	Hihifo Airport Aviation Civile BP1 Mata-Utu 98600 WALLIS
ICAO MID Region						
Bahrain	Bahrain Civil Affairs	Manama				
Egypt	NANSC	Cairo				
Iran	Civil Aviation Organization	Tehran				
Iraq	CAA	Baghdad				
Jordan	CARC	Amman				
Kuwait	Directorate General of CA	Kuwait				
Lebanon	CAA	Beirut				
Libya	CAA	Tripoli				
Oman	Public Authority for CA	Muscat				
Qatar	CAA	Doha				

State	State/ANSP	Site	Local CRV Points of Contact	Email	Telephone / Fax	Service installation
Saudi Arabia	General Authoroity of CA	Jeddah and Riyadh				
Sudan	CAA	Khartoum				
Syria	CAA	Damascus				
UAE	General CA Authoroity	AbuDhabi				
Yemen	CA and Met Authrority	Sanaa				
Interregional connectivity						
Russia	Interregional connection for AFTN between Beijing China and Far East Air Navigation" 680031, Matveevskoye Shosse, 28a Khabarovsk Russia	Khabarovsk	China: Mr. Huang Zhang Tel：0086-010-67318494 ,0086-010-58729977 FAX：0086-010-67331459 E-mail:huangzheng@atnc.com.cn POC Ms. Tatyana Ivanovna Khvan Tel: 007(4212)418-591 Email: YZinovieva@dv.gkovd.ru		China: Mr. Huang Zhang Tel：0086-010-67318494 ,0086-010-58729977 FAX：0086-010-67331459 E-mail:huangzheng@atnc.com.cn POC Ms. Tatyana Ivanovna Khvan Tel: 007(4212)418-591 Email: YZinovieva@dv.gkovd.ru	China: Address：No. 301， Qian Wei Gou Cun，Sun He Xiang, Chaoyang District Beijing 100122 Russia Address: Branch "Far East Air Navigation" 680031, Matveevskoye Shosse, 28a Khabarovsk Russia

State	State/ANSP	Site	Local CRV Points of Contact	Email	Telephone / Fax	Service installation
UK	Interconnection with Singapore	Fareham	Name: Stuart Dingle	Stuart.Dingle@nats.co.uk	Name: Stuart Dingle Email: Stuart.Dingle@nats.co.uk D: 01489 612259 M: 07786 211975	Physical Address: 4000 Parkway, Whiteley, Fareham, Hants PO15 7FL
South Africa	Interconnection with India	Johannesburg				
Italy	Interconnection with Thailand	Rome				

3.2.4 CRV Contractor

The Contractor shall nominate all the staff involved in the implementation of the CRV node, mainly the Program Manager for the CRV program. The Contractor will follow all the steps described in the tender documentation, specially the TOR and Instructions to Tenderers, for the implementation of the CRV node. The main activities to be carried out by the Contractor during the implementation are:

i. Submit the updated SDD and the SEP to the CRV-OG, to the CNS Officer for the Asia/Pacific Regional Office and to the National CRV POC;

ii. Submit the requests for site surveys to the National CRV POC following the procedures described in the paragraph 4.1.2.2;

iii. Update and submit the Installation Transition Plan to the CRV-OG, to the CNS Officer for the Asia/Pacific Regional Office and to the National CRV POC;

iv. Be responsible for the supply, transport, installation, start-up and operation of all CRV equipment especially designed for a given CRV node;

v. Be dealing with customs and transport company about shipping and introducing the equipment in the Country;

vi. The interconnection (to be provided by CRV users) of the Network Interface Device (NID) to the Local Area Network (LAN) switches and other local equipment, including Voice Communication System (VCS), will be confirmed during the site survey;

vii. Demonstrate before the final validation of the SDD and through a test bed that the main characteristics of the intended design of the network will meet the performance requirements, SLA, safety, security and contingency requirements;

viii. Implement the CRV IP Addressing Scheme (Plan), following the information provided by the CRV-OG and/or the National CRV POC;

ix. Implement the classification and marking scheme for the prioritization of the traffic and Quality of Services (QoS), as described in the document Att II - Annex c - Mapping of services for quality management_v2 and in coordination with the CRV-OG and the National and Local CRV POCs (See note in the paragraph 3.2.1.3);

x. The Contractor shall measure the established parameters during circuit implementation (in accordance with ITU-T), and shall also monitor them for 24 hours to show compliance with the established specifications;

xi. Implement the configuration of current numbering plan for the ATS Switched Voice, as defined by the CRV-OG representatives and the National CRV POC, and taking into account the tender document Att II - Annex b - Matrix of Flows for CRV services_v2;

xii. Implement the configuration of the current Direct Circuits (DIR), as defined by the CRV-OG representatives and the National CRV POC and taking into account the tender document Att II - Annex b - Matrix of Flows for CRV services_v2;

xiii. Submit, in details, the escalation process to be followed for the implementation in each CRV node;

xiv. Submit, to the CRV National POC, the documentation for the training of the CRV technicians;

xv. Contractor Representative shall record the minutes of the meeting and distribute the minutes within three (3) Business Days of the meeting date;

xvi. The Contractor shall propose a planning chart that includes all the actions, steps, milestones, meetings, after negotiations with CRV Local and National POC and respect it once approved by the CRV User Representative or amend it in coordination with CRV User representatives; and

xvii. The Contractor shall help the CRV User in the uptake of responsibility before commissioning the equipment by accompanying the CRV User technicians in charge of the equipment.

4.0 BASIC SITE IMPLEMENTATION REQUIREMENTS

Chapter 4 describes the site and facilities requirements envisaged in the implementation phased for the CRV infrastructure, divided into CRV User´s and Contractor´s responsibilities, and also the main hardware and software for the proof of concept and implementation of the WAN links, LAN protocols, applications and main equipment.

These responsibilities come in addition to those stated in the Terms and Conditions and Terms of Reference.

4.1 Site/ Facilities Requirements

4.1.1 CRV User Responsibility

i. The CRV User shall provide the physical space for the installation of cabinets and equipment;

ii. The CRV User shall deliver to the premises the electric power required to feed the equipment to be provided by the Contractor;

iii. The CRV User shall provide access to the equipment to be connected to the CRV NID and to analog/ digital voice gateway;

iv. The CRV User shall accompany and assist the Contractor during the whole operation;

v. The CRV User shall provide room for storing the equipment, received before its installation; and

vi. The CRV User shall inform the Contractor about the local safety rules and procedures and produce suited documents as deemed necessary.

4.1.2 Contractor Responsibility

i. The Project Manager, on behalf of the Contractor, shall nominate and introduce all the staff involved in the site surveys and in the implementation of a CRV node. The list with the staff nominated will be submitted to the National and Local CRV POCs with the formal requests for the site survey and beginning of the very implementation of the CRV equipment and following the

procedures described in the paragraph 4.1.2.4;

ii. The Contractor shall identify the exact locations of the equipment during the site survey;

iii. The Contractor will be responsible for providing the accessories, switches, cables, connections between the main distribution panel and the NID;

iv. The Contractor shall be responsible for the installation of the CRV network equipment, accessories and the provision of the tools, testing equipment and software for the Site Acceptance Tests (SAT);

v. The procedures to the Contractor for the site surveys aiming the installation of the equipment are as follows:

a) Send a formal request to the national CRV POC, with an anticipation of 20 days for the required coordination with the local CRV POC, sending the names of the staff to be involved with the visit;
b) If authorized, the Contractor shall proceed to the site survey in the date and time indicated by the national CRV POC;
c) If the Contractor fails to comply with the survey in the exact date, the national POC will cancel the visit and the Contractor will have to restart the whole site survey process; and
d) The Contractor will provide all of the instruments and tools deemed necessary for the site survey.

vi. The Contractor shall be held liable for any damage to existing property in each CRV User facilities caused to the facilities by its staff and/or its sub-contractors';

vii. The Contractor shall comply with the site safety rules especially during critical phases such as commissioning or interferences with operational systems by following CRV User staff indications in charge of technical safety and not take personal initiatives that could have an impact on operational systems;

viii. The Contractor shall be responsible for storing the equipment before its installation;

ix. The Contractor may be asked to sign additional documents in order to follow local safety rules;

x. The Contractor shall keep the working area clean and free from fire hazards. After installation, all excess material shall be removed;

xi. The Contractor shall identify the exact locations for the installation of cabinets and equipment during the site survey;

xii. The Contractor shall provide the CRV equipment grounding in each node;

xiii. If necessary, the Contractor shall install protection against atmospheric discharges for all the equipment to be implemented for the provision of the CRV infrastructure in each node;

Note: The Contractor will be responsible for reviewing the characteristics of any existing devices that might be available as long as it is allowed the usage by the CRV representative;

xiv. The Contractor shall be responsible for the connection to the power supply in the installation site, including electrical wiring between the power outlet and the equipment rack of the Contractor, including the respective circuit breakers and devices to protect against surges and atmospheric

discharges;

xv. The Contractor shall be running simulations over a period that has to be determined before commissioning the equipment. CRV User representatives shall be involved in the setting and execution of these simulations; and

xvi. The Contractor shall procure the results of the tests.

4.2 Hardware and Software Requirements

4.2.1 General Topics

i. For the installation of the equipment to be provided, the Contractor shall follow and consider all the tender documents, especially the TOR, the Att II - Annex e - CRV IRS_v2 and the Att II - Annex f - Additional Voice and Data Gateway Service_v3.

ii. Although the Contractor operates MPLS data transport solutions, it is fully committed to the perfect operations of the applications and shall follow the initial end-to-end applications trials.

4.2.2 Hardware Requirements

i. For the satellite equipment, the Contractor shall install the indoor and outdoor units.

ii. Where Applicable, the basic satellite equipment to be provided and checked is: Block Up Converters (BUC), Low Noise Block (LNB) down converters and Satellite Modems and VSAT Network management sub-system.

iii. Where Applicable, the basic ground/terrestrial equipment to be provided will comprise: routing system of the IP VPN Internet (with the needed interfaces), the basic ground voice and data gateway (with the needed interfaces), the NID (with the needed interfaces), switches (with the needed interfaces), A/B baseband switch (with the needed interfaces), Multiprotocol Label Switching (MPLS) for the Wide Area Network (WAN) (optical and/or microwave) links equipment.

iv. Before connecting the NID and the analog/digital, if needed, the contractor´s team shall install the new racks and prepare the transition cables, such as junction coaxial cables, junction sub-d cables or RJ based cables.

v. All the test and measurement tools shall be provided by the Contractor. No testing and measurement equipment will be provided by the CRV User representatives.

vi. All the needed equipment must be shipped and acknowledge by the CRV-User before the installation phase with sufficient delay. The Provider have to take the customs procedure delay into account.

vii. All the received items must be inventoried and tested before the beginning of installation in order to avoid dispute.

4.2.3 Software Requirements

Where applicable, the basic software to be provided and/or used in each site is: Network Management Systems (NMS) software, if the SDD indicates that one or more CRV nodes will be selected to manage the CRV network in parallel with the Contractor´s Network Operations Center (NOC), software for BUC, Satellite Modems, NID, Voice/Data Gateway and switches.

4.2.3.1 Documentation Requirements

The needed documentation for the uptake of the equipment shall be provided to CRV User on its demand as deemed necessary.

5.0 TESTING AND EVALUATION.

The tests for the acceptance of the implemented equipment in each CRV node will be performed using simulations of the applications and, eventually, the real application tests that will follow the operational requirements as described in the tender documents, mainly, but not restricted to:

i. Att II - Annex a - CRV CONOPS_v2;

ii. Att II - Annex b - Matrix of Flows for CRV services_v2;

iii. CRV Implementation plan (Chapter 5); and

iv. Validation Plan including the Site Acceptance Test (SAT) protocols (prepared by the Contractor).

The main testing and measurement equipment and tools that shall be used by the Contractor are:

i. Spectrum Analyzer;

ii. cable analyzer;

iii. audio analyzer/generator;

iv. Multi-meters;

v. LAN/Network protocol analyzer; and

vi. Telephones.

Note: This paragraph doesn´t exhaust all the testing and measurement equipment to be used during the implementation phase, and the Contractor shall describe all of them in the documentation to be provided after the contract signature.

The Contractor shall test its backbone (end-to-end) and the connection to its Network Operating Center (NOC). The links will be tested using computers for asynchronous and IP flows for example, and analogical phones.

An example of asynchronous test is opening a HyperTerminal session and send characters and a Bit Error Rate Test using a software such as WinSSD.

The requirements for the test procedures will be reflected in the Chapter 5 (Testing and Evaluation). Notwithstanding this fact, the tests procedures will need some software for the applications as reflected in the following paragraphs.
Note: The following paragraphs don´t exhaust all the software and the Contractor shall describe all of them in the documentation to be provided after the contract signature.

For AFTN simulation: The simulation will consist of connecting a PC to the AFTN port at the back of the rack (with the right rate described in the document Att II - Annex b - Matrix of Flows for CRV services_v2) and close the serial interface at the other end of the circuit (loop). With the PC launch the *winssd* program (or other similar) and start the Bit Error Rate (BER) test. Run the test for 5 minutes and check that there are only a few errors.

For AMHS simulation: AMHS service is over IP (see the document Att II - Annex b - Matrix of Flows for CRV services_v2. To simulate it:

i. ping any remote equipment in the network according to the following cross matrix; and

ii. Verify that the end user is exchanging information correctly.

IP based RADAR and Asterix: The simulation will consist in selecting two sites, configuring sufficient bandwidth and multicast an IP flow.

ATS/DS Circuits: All ATS/DS calls are auto-dialed. The communication is established after the user picks up the phone. The simulation will consist of connecting a telephone on the desired line at the back of the rack, pick-up the phone make the call to the other end of the circuit. For E1 based circuits, to be connected to a VCS, this cannot be simulated.

ATS Switched Circuits: ATS switched calls are dialed. The communication is established after the user picks up the phone and dials the remote dial number. The simulation will consist of connecting a telephone on the desired line at the back of the rack, pick-up the phone and dial a remote number in order to call the other end of the circuit. For E1 based circuits, connected to a VCS, this cannot simulated.

6.0 CONTINGENCY PLAN/ BACK-OFF PLAN

6.1 Purpose

States/ Administrations are to establish contingency plan, with the CRV contractor in case of the following scenario:

i. CRV total failure;

ii. CRV partial failure (e.g. voice channel failure);

iii. Provider Edge (PE) to Customer Edge (CE) link failure (e.g. ANSP1 lose connectivity to CRV); and

iv. PE to PE failure (e.g. ANSP1 and ANSP2 unable to exchange data/ or voice).

6.2 Harmonized Contingency Plan

States/ Administrations could also bilaterally/ multilaterally setup additional IPLC(s) as a contingency. This contingency plan could be harmonized in the APAC region to reduce costs.

7.0 MIXED OPERATING ENVIRONMENT

7.1 Routing of AFTN/ AMHS messages to non-CRV States/ Administrations

During the initial phase of the CRV implementation, States/ Administrations who have joined CRV are to ensure the routing of AFTN/ AMHS messages to States/ Administrations who have not joined CRV.

7.2 Inter-Region common network connectivity

It is envisaged for common networks (e.g. PEN, FTI and CRV) in different Regions to be inter-connected.

Appendix A – APAC IPv4 Address Plan

Appendix A

1 Introduction

1.1 Objective

This document is meant to describe the addressing plan for IPv4 addresses throughout the Asia/Pacific Region. This document defines the recommended address format for IPv4 addresses. The IPv4 network is to be used within region.

1.2 References

[1]	ICAO Doc 9705-AN/956	Manual of Technical Provisions for the ATN
[2]	ICAO Doc 9896	Manual for the ATN using IPS Standards and Protocols
[3]	ICAO Doc 7910	ICAO Location Indicators
[4]	RFC 1518	An Architecture for IP Address Allocation with CIDR
[5]	RFC 1918	Address Allocation for Private Internets
[6]	RFC 2050	BGP-4 Internet Registry IP Allocation Guidelines
[7]	RFC 3330	Special-Use IPv4 Addresses
[8]	RFC 4271	BGP-4 Specification

1.3 Terms Used

Administrative Domain	–	An administrative entity in the ATN/IPS. An Administrative Domain can be an individual State, a group of States, an Aeronautical Industry Organization (e.g., an Air-Ground Service Provider), or an Air Navigation Service Provider (ANSP) that manages ATN/IPS network resources and services. From a routing perspective, an Administrative Domain includes one or more Autonomous Systems.
Autonomous System	–	A connected group of one or more IP prefixes, run by one or more network operators, which has a single, clearly defined routing policy.

Intra-domain (interior gateway) routing protocol	–	Protocols for exchanging routing information between routers within an AS.
Inter-domain (exterior gateway) routing protocol	–	Protocols for exchanging routing information between Autonomous Systems. They may in some cases be used between routers within an AS, but they primarily deal with exchanging information between Autonomous Systems.
Local Internet Registry	–	A Local Internet Registry (LIR) is an IR that primarily assigns address space to users of the network services it provides. LIRs are generally ISPs, whose customers are primarily end users and possibly other ISPs. [LACNIC]

1.4 Acronyms

AMHS	–	ATN Message Handling System
ARP	–	Address Resolution Protocol
ATN	–	Aeronautical Telecommunications Network
BGP	–	Border Gateway Protocol
DNS	–	Domain Name Service
IANA	–	Internet Assigned Numbers Authority
ICS	–	ATN Internet Communication Service
IP	–	Internet Protocol
IPv4	–	Internet Protocol Version 4
IPv6	–	Internet Protocol Version 6
IPS	–	Internet Protocol suite
LACNIC	–	Latin American and Caribbean Internet Address Registry
LIR	–	Local Internet Registry
OSPF	–	Open Shortest Path First
RIR	–	Regional Internet Registry

1.5 Overview of Addressing Issues

The following subsections present issues that affect the completion of the addressing plan for operating the IPS-based AMHS network.

1.5.1 Public or Private Address

An important decision for the region is whether to use private or public addresses. Private addresses can be used if coordinated by all participating States and Organization; however, it is possible that existing networks already use addresses in the private block ranges. Public addresses must be obtained from a Regional Internet Registry (RIR). The Internet Assigned Numbers Authority (IANA) has delegated responsibility for administration of Internet numbering to the Latin American and Caribbean Internet Address Registry (LACNIC).

1.5.2 Address of Systems in External Regions

Systems in external regions could be assigned an address from the APAC address space rather than use an address in their regional address block. Note however that this must be coordinated with private addresses so as to avoid collisions.

2 IPv4 Addressing Overview and Fundamentals

In the Internet Protocol a distinction is made between names, addresses, and routes. A name indicates what we seek. An address indicates where it is. A route indicates how to get there. The Internet protocol deals primarily with addresses. Its main task is to forward data to a particular destination address. It is the task of higher-level protocols to make the mapping from names to addresses, for example using a domain name service (DNS). The Internet protocol forwards packet data units (PDU) to a destination address using routing tables maintained by a routing protocol. The routing tables contain the address of the next hop along the route to the destination. There are in general two classes of routing protocols: inter-domain or exterior routing protocols such as the Border Gateway Protocol (BGP) and intra-domain or interior routing protocols such as the Open Shortest Path First (OSPF) protocol. In order to forward PDUs to the next hop address, there must be a mapping from this address to the link level address, for example, an Ethernet address. This mapping is maintained by an address discovery protocol such as the Address Resolution Protocol (ARP).

An IPv4 address consists of four bytes (32 bits). These bytes are also known as octets. For readability purposes, humans typically work with IP addresses in a notation called dotted decimal. This notation places periods between each of the four numbers (octets) that comprise an IP address. For example, an IP address that a computer sees as

00001010 00000000 00000000 00000001

is written in dotted decimal as

10.0.0.1

Because each byte contains 8 bits, each octet in an IP address ranges in value from a minimum of 0 to a maximum of 255. Therefore, the full range of IP addresses is from 0.0.0.0 through 255.255.255.255. That represents a total of 4,294,967,296 possible IP addresses.

A network may be set up with IP addresses to form a private or public network. On a private network a single organization controls address assignment for all nodes. On a public network there must be some conventions to assure that organizations do not use overlapping addresses. In the Internet this function is performed by the Internet Assigned Numbers Authority (IANA), which delegates authority to Regional Internet Registries (RIR). For the CAR/SAM Region the RIR is the Latin American and Caribbean Internet Address Registry (LACNIC).

IPv4 Addresses are a fixed length of four octets (32 bits). An address begins with a Network ID, followed by a Host ID as depicted in Figure 2-1.

Figure 2-1. IPv4 Address Format

The original IP addressing scheme divided the Network ID from the Host ID is in a several octet boundaries. In this scheme the main classes of addresses were differentiated based on how many octets were used for the Network ID. This method is called classful addressing. Classful addressing was by convention further modified so that the Host ID could be split into subnet ID and sub host ID. This is typically accomplished using a subnet mask and is called classful addressing with subnetting. This eventually evolved into classless addressing where the division between the Network ID and Host ID can occur at an arbitrary point, not just on octet boundaries. With classless addressing the dividing point is indicated by a slash (/) followed the number of bits used for the Network ID. This value is called the prefix length of the address and the address value up to that point is called the network prefix.

Private Addressing is defined in RFC 1918. IANA has reserved the following three blocks of the IP address space for private Internets:

10.0.0.0 - 10.255.255.255 (10/8 prefix)
172.16.0.0 - 172.31.255.255 (172.16/12 prefix)
192.168.0.0 - 192.168.255.255 (192.168/16 prefix)

Because of the number of bits available to users, these blocks are referred to as a "24-bit block", a "20-bit block", and a "16-bit" block. An enterprise that decides to use IP addresses out of the private address space defined by RFC 1918, can do so without any

coordination with IANA or an Internet registry. Addresses within this private address space will only be unique within an enterprise or a group of enterprises (e.g., an ICAO region), which chose to cooperate over this space so they may communicate with each other in their own private Internet.

3 IPv4 Addressing

3.1 Overview CAR/SAM

3.1.1 During the fourth meeting of ATN/TF4 (Santo Domingo, Dominican Republic, 27 to 28 June 2008) the group analyzed different alternatives for the implementation of the TCP/IP in the CAR/SAM Regions identifying the available options that would facilitate this implementation in the AMHS Service and future applications. This was reviewed in accordance with Document 9880 Part IIB of the ICAO. In this respect the Meeting decided two viable options for the implantation the TCP/IP:

a) AMHS using the RFC1006 on Guiders TCP/IP (IPv4) to allow AMHS to directly interface with IPv4 Guiders for the intra-regional connections.

b) Configurating AMHS, as specified in a) with capacity for IPv4 conversion to IPv6 through the implementation of a function of IP router as gateway for the interregional connections.

3.1.2 The Sixth Meeting of Committee ATM/CNS (ATM/CNS/6) (Santo Domingo, Dominican Republic, 30 June to the 04 July 2008) analyzed this Plan of IP Addressing for CAR/SAM Regions and considered that such a plan would be sent to the ICAO for revision.

3.1.3 During the ACP/WG/I/8 (Montreal, Canada, 25 to 29 August 2008) it was concluded that it is possible to consider a regional scheme of IPv4 addressing. Taking into consideration that the private sector would be using the propose addressing scheme in other applications, the Meeting considered nonviable to apply the IP addressing scheme at a global level.

3.1.4 The Third Meeting of the Group of Regional Implementation SAM/IG/3 (Lima, Peru, 20 to 24 April 2009) considered that, taking into account specified in Table CNS 1Bb from the FASID, the AMHS system to be installed in the SAM Region will use IP protocol and will initially use the IPv4 version. The block of used IPv4 addresses will follow the format established during the ATM/CNS/SG/6 Meeting.

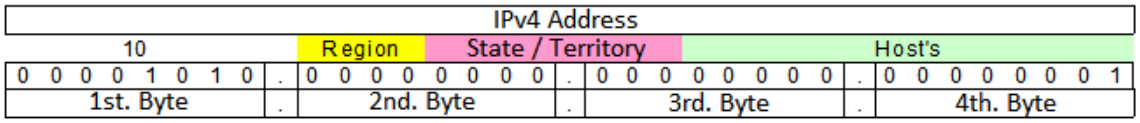
3.2 IP Addressing Plan

When we began to work on the plan of IP addressing, we once again reviewed the scheme that was originally proposed, analyzed the amount of States/Territories by

Region, the amount of addressing that each State/Territory could use and the amount of addressing reserved for the interconnection between States/Territories. The result of this study concluded that:

3.2.1 1 bit would be reduced to State/Territory level. This means the transfer of 256 States to 128 States by region. In the EUR/NAT Region, which is most numerous, has 53 States/Territories, means that there are many vacant numbers.

3.2.2 1 bit at Host's level would be added. This would allow the transfer from 4096 to 8190 hosts per State/Territory. This was considered due to the amount of future applications that would be implemented, mainly in the more developed States, and could cause the amount of directions not to be sufficient. The structure is shown below:



3.2.3 It should be noted the networks assigned to each State are private networks (RFC 1918). The first Bytes that integrate the assigned address will always maintain a decimal value of 10. Whereas the other three Bytes are used to distribute, in hierarchic form, the blocks of directions corresponding to each State.

3.2.4 The first four bits of the second Byte (4 bits) will be used to identify the regions in around which the States/Territories of the world are grouped:

- 0000 => SAM: South American Office.
- 0001 =>. NACC: North American, American Power station and Caribbean Office.
- **0010 => APAC: Asia and Pacific Office.**
- 0011 => MID: Middle East Office.
- 0100 => WACAF: Western and Central African Office.
- 0101 => ESAF: Eastern and Southern African Office.
- 0110 => EUR/NAT: European and North Atlantic Office.

3.2.5 On the other hand, the last four bits of the second Byte, and the first three bits of the third Byte (7 bits) will be used to identify the States/Territories of each region.

3.2.6 Whereas the last five bits of the third Byte and the eight bits that compose the fourth Byte (13 bits) will be used by each one of the States/Territories to assign addressing to their terminals/servers

3.2.7 The IPv4 address allocation scheme will be able to cover:

- 16 Regions.

- 128 States/Territories by each Region.
- 8190 Host' s for each State/Territory

3.2.8 The IPv4 addressing plan would allow each State/Territory to be able to make use of the block of directions assigned as needed.

a) Each State has been assigned 8190 usable Network addresses, which seem to be sufficient to cover existing needs.

b) In the development of the mentioned scheme, a flexible margin has been designated so that it will allow the future growth or change in the network in the future. For example, if a region were subdivided in two or more regions, or the emerging of a new State/Territory.

c) Argentina has already implemented its ATN network with a scheme of addresses different from the proposed one, prior to the publication of this document, has placed a border devise with the intention that this devise will make the address translation between the outer directions.

3.3.1 Network Assignment for ASIA/PACIFIC

Ref	State/Administration	Network	Direction used	Decimal notation	Binary Notation	Region	State/Territory	Host's
1	Australia	10 . 32 .0.0 / 19	First	10 . 32. 0 . 1	0 0 0 0 1 0 1 0 .	0 0 1 0	0 0 0 0 . 0 0 0	0 0 0 0 0 . 0 0 0 0 0 0 0 1
			Last	10 . 32. 31 . 254	0 0 0 0 1 0 1 0 .	0 0 1 0	0 0 0 0 . 0 0 0	1 1 1 1 1 . 1 1 1 1 1 1 1 0
2	Bangladesh	10. 32. 32 .0 / 19	First	10 . 32. 32 . 1	0 0 0 0 1 0 1 0 .	0 0 1 0	0 0 0 0 . 0 0 1	0 0 0 0 0 . 0 0 0 0 0 0 0 1
			Last	10 . 32. 63 . 254	0 0 0 0 1 0 1 0 .	0 0 1 0	0 0 0 0 . 0 0 1	1 1 1 1 1 . 1 1 1 1 1 1 1 0
3	Bhutan	10. 32. 64.0 / 19	First	10 . 32. 64 . 1	0 0 0 0 1 0 1 0 .	0 0 1 0	0 0 0 0 . 0 1 0	0 0 0 0 0 . 0 0 0 0 0 0 0 1
			Last	10 . 32. 95 . 254	0 0 0 0 1 0 1 0 .	0 0 1 0	0 0 0 0 . 0 1 0	1 1 1 1 1 . 1 1 1 1 1 1 1 0
4	Brunei Darussalam	10. 32. 96.0 / 19	First	10 . 32. 96 . 1	0 0 0 0 1 0 1 0 .	0 0 1 0	0 0 0 0 . 0 1 1	0 0 0 0 0 . 0 0 0 0 0 0 0 1
			Last	10 . 32. 127 . 254	0 0 0 0 1 0 1 0 .	0 0 1 0	0 0 0 0 . 0 1 1	1 1 1 1 1 . 1 1 1 1 1 1 1 0
5	Cambodia	10. 32. 128. 0 / 19	First	10 . 32. 128 . 1	0 0 0 0 1 0 1 0 .	0 0 1 0	0 0 0 0 . 1 0 0	0 0 0 0 0 . 0 0 0 0 0 0 0 1
			Last	10 . 32. 159 . 254	0 0 0 0 1 0 1 0 .	0 0 1 0	0 0 0 0 . 1 0 0	1 1 1 1 1 . 1 1 1 1 1 1 1 0
6	China	10. 32. 160. 0 / 19	First	10 . 32. 160 . 1	0 0 0 0 1 0 1 0 .	0 0 1 0	0 0 0 0 . 1 0 1	0 0 0 0 0 . 0 0 0 0 0 0 0 1
			Last	10 . 32. 191 . 254	0 0 0 0 1 0 1 0 .	0 0 1 0	0 0 0 0 . 1 0 1	1 1 1 1 1 . 1 1 1 1 1 1 1 0
7	Hong Kong, China	10. 32 . 192. 0 / 19	First	10 . 32 . 192 . 1	0 0 0 0 1 0 1 0 .	0 0 1 0	0 0 0 0 . 1 1 0	0 0 0 0 0 . 0 0 0 0 0 0 0 1
			Last	10 . 32 . 223 . 254	0 0 0 0 1 0 1 0 .	0 0 1 0	0 0 0 0 . 1 1 0	1 1 1 1 1 . 1 1 1 1 1 1 1 0
8	Macao, China	10. 32 . 224. 0 / 19	First	10 . 32 . 224 . 1	0 0 0 0 1 0 1 0 .	0 0 1 0	0 0 0 0 . 1 1 1	0 0 0 0 0 . 0 0 0 0 0 0 0 1
			Last	10 . 32 . 255 . 254	0 0 0 0 1 0 1 0 .	0 0 1 0	0 0 0 0 . 1 1 1	1 1 1 1 1 . 1 1 1 1 1 1 1 0
9	Democratic people's Republic of Korea	10. 33 . 0 . 0 / 19	First	10 . 33 . 0 . 1	0 0 0 0 1 0 1 0 .	0 0 1 0	0 0 0 1 . 0 0 0	0 0 0 0 0 . 0 0 0 0 0 0 0 1
			Last	10 . 33 . 31 . 254	0 0 0 0 1 0 1 0 .	0 0 1 0	0 0 0 1 . 0 0 0	1 1 1 1 1 . 1 1 1 1 1 1 1 0
10	Fiji	10. 33 . 32 . 0 / 19	First	10 . 33 . 32 . 1	0 0 0 0 1 0 1 0 .	0 0 1 0	0 0 0 1 . 0 0 1	0 0 0 0 0 . 0 0 0 0 0 0 0 1

Ref	State/Administration	Network	Direction used	Decimal notation	Binary Notation	Region	State/Territory	Host's
			Last	10 . 33 . 63 . 254	0 0 0 0 1 0 1 0 .	0 0 1 0	0 0 0 1 . 0 0 1	1 1 1 1 1 . 1 1 1 1 1 1 1 0
11	India	10. 33 . 64 . 0 / 19	First	10 . 33 . 64 . 1	0 0 0 0 1 0 1 0 .	0 0 1 0	0 0 0 1 . 0 1 0	0 0 0 0 0 . 0 0 0 0 0 0 0 1
			Last	10 . 33 . 95 . 254	0 0 0 0 1 0 1 0 .	0 0 1 0	0 0 0 1 . 0 1 0	1 1 1 1 1 . 1 1 1 1 1 1 1 0
12	Indonesia	10. 33 . 96 . 0 / 19	First	10 . 33 . 96 . 1	0 0 0 0 1 0 1 0 .	0 0 1 0	0 0 0 1 . 0 1 1	0 0 0 0 0 . 0 0 0 0 0 0 0 1
			Last	10 . 33 . 96 . 254	0 0 0 0 1 0 1 0 .	0 0 1 0	0 0 0 1 . 0 1 1	1 1 1 1 1 . 1 1 1 1 1 1 1 0
13	Japan	10. 33 . 128 . 0 / 19	First	10 . 33 . 128 . 1	0 0 0 0 1 0 1 0 .	0 0 1 0	0 0 0 1 . 1 0 0	0 0 0 0 0 . 0 0 0 0 0 0 0 1
			Last	10 . 33 . 159 . 254	0 0 0 0 1 0 1 0 .	0 0 1 0	0 0 0 1 . 1 0 0	1 1 1 1 1 . 1 1 1 1 1 1 1 0
14	Kiribati	10. 33 . 160 . 0 / 19	First	10 . 33 . 160 . 1	0 0 0 0 1 0 1 0 .	0 0 1 0	0 0 0 1 . 1 0 1	0 0 0 0 0 . 0 0 0 0 0 0 0 1
			Last	10 . 33 . 191 . 254	0 0 0 0 1 0 1 0 .	0 0 1 0	0 0 0 1 . 1 0 1	1 1 1 1 1 . 1 1 1 1 1 1 1 0
15	Lao People's Democratic Republic	10. 33 . 192 . 0 / 19	First	10 . 33 . 192 . 1	0 0 0 0 1 0 1 0 .	0 0 1 0	0 0 0 1 . 1 1 0	0 0 0 0 0 . 0 0 0 0 0 0 0 1
			Last	10 . 33 . 223 . 254	0 0 0 0 1 0 1 0 .	0 0 1 0	0 0 0 1 . 1 1 0	1 1 1 1 1 . 1 1 1 1 1 1 1 0
16	Malaysia	10. 33 . 224 . 0 / 19	First	10 . 33 . 224 . 1	0 0 0 0 1 0 1 0 .	0 0 1 0	0 0 0 1 . 1 1 1	0 0 0 0 0 . 0 0 0 0 0 0 0 1
			Last	10 . 33 . 255 . 254	0 0 0 0 1 0 1 0 .	0 0 1 0	0 0 0 1 . 1 1 1	1 1 1 1 1 . 1 1 1 1 1 1 1 0
17	Maldives	10. 34 . 0 . 0 / 19	First	10 . 34 . 00 . 1	0 0 0 0 1 0 1 0 .	0 0 1 0	0 0 1 0 . 0 0 0	0 0 0 0 0 . 0 0 0 0 0 0 0 1
			Last	10 . 34 . 31 . 254	0 0 0 0 1 0 1 0 .	0 0 1 0	0 0 1 0 . 0 0 0	1 1 1 1 1 . 1 1 1 1 1 1 1 0
18	Marshall Islands	10. 34 . 32 . 0 / 19	First	10 . 34 . 32 . 1	0 0 0 0 1 0 1 0 .	0 0 1 0	0 0 1 0 . 0 0 1	0 0 0 0 0 . 0 0 0 0 0 0 0 1
			Last	10 . 34 . 63 . 254	0 0 0 0 1 0 1 0 .	0 0 1 0	0 0 1 0 . 0 0 1	1 1 1 1 1 . 1 1 1 1 1 1 1 0
19	Micronesia	10. 34 . 64 . 0 / 19	First	10 . 34 . 64 . 1	0 0 0 0 1 0 1 0 .	0 0 1 0	0 0 1 0 . 0 1 0	0 0 0 0 0 . 0 0 0 0 0 0 0 1
			Last	10 . 34 . 95 . 254	0 0 0 0 1 0 1 0 .	0 0 1 0	0 0 1 0 . 0 1 0	1 1 1 1 1 . 1 1 1 1 1 1 1 0
20	Mongolia	10. 34 . 96 . 0 / 19	First	10 . 34 . 96 . 1	0 0 0 0 1 0 1 0 .	0 0 1 0	0 0 1 0 . 0 1 1	0 0 0 0 0 . 0 0 0 0 0 0 0 1
			Last	10 . 34 . 127 . 254	0 0 0 0 1 0 1 0 .	0 0 1 0	0 0 1 0 . 0 1 1	1 1 1 1 1 . 1 1 1 1 1 1 1 0
21	Myanmar	10. 34 . 128 . 0 / 19	First	10 . 34 . 128 . 1	0 0 0 0 1 0 1 0 .	0 0 1 0	0 0 1 0 . 1 0 0	0 0 0 0 0 . 0 0 0 0 0 0 0 1
			Last	10 . 34 . 159 . 254	0 0 0 0 1 0 1 0 .	0 0 1 0	0 0 1 0 . 1 0 0	1 1 1 1 1 . 1 1 1 1 1 1 1 0

Ref	State/Administration	Network	Direction used	Decimal notation	Binary Notation	Region	State/Territory	Host's
22	Nauru	10. 34 . 160 . 0 / 19	First	10 . 34 . 160 . 1	0 0 0 0 1 0 1 0 .	0 0 1 0	0 0 1 0 . 1 0 1	0 0 0 0 0 . 0 0 0 0 0 0 0 1
			Last	10 . 34 . 191 . 254	0 0 0 0 1 0 1 0 .	0 0 1 0	0 0 1 0 . 1 0 1	1 1 1 1 1 . 1 1 1 1 1 1 1 0
23	Nepal	10. 34 . 192 . 0 / 19	First	10 . 34 . 192 . 1	0 0 0 0 1 0 1 0 .	0 0 1 0	0 0 1 0 . 1 1 0	0 0 0 0 0 . 0 0 0 0 0 0 0 1
			Last	10 . 34 . 223 . 254	0 0 0 0 1 0 1 0 .	0 0 1 0	0 0 1 0 . 1 1 0	1 1 1 1 1 . 1 1 1 1 1 1 1 0
24	New Zealand	10. 34 . 224 . 0 / 19	First	10 . 34 . 224 . 1	0 0 0 0 1 0 1 0 .	0 0 1 0	0 0 1 0 . 1 1 1	0 0 0 0 0 . 0 0 0 0 0 0 0 1
			Last	10 . 34 . 255. 254	0 0 0 0 1 0 1 0 .	0 0 1 0	0 0 1 0 . 1 1 1	1 1 1 1 1 . 1 1 1 1 1 1 1 0
25	Pakistan	10. 35 . 0 . 0 / 19	First	10 . 35 . 0 . 1	0 0 0 0 1 0 1 0 .	0 0 1 0	0 0 1 1 . 0 0 0	0 0 0 0 0 . 0 0 0 0 0 0 0 1
			Last	10 . 35 . 31 . 254	0 0 0 0 1 0 1 0 .	0 0 1 0	0 0 1 1 . 0 0 0	1 1 1 1 1 . 1 1 1 1 1 1 1 0
26	Papua New Guinea	10. 35 . 32 . 0 / 19	First	10 . 35 . 32 . 1	0 0 0 0 1 0 1 0 .	0 0 1 0	0 0 1 1 . 0 0 1	0 0 0 0 0 . 0 0 0 0 0 0 0 1
			Last	10 . 35 . 63 . 254	0 0 0 0 1 0 1 0 .	0 0 1 0	0 0 1 1 . 0 0 1	1 1 1 1 1 . 1 1 1 1 1 1 1 0
27	Philippines	10. 35 . 64 . 0 / 19	First	10 . 35 . 64 . 1	0 0 0 0 1 0 1 0 .	0 0 1 0	0 0 1 1 . 0 1 0	0 0 0 0 0 . 0 0 0 0 0 0 0 1
			Last	10 . 35 . 95 . 254	0 0 0 0 1 0 1 0 .	0 0 1 0	0 0 1 1 . 0 1 0	1 1 1 1 1 . 1 1 1 1 1 1 1 0
28	Republic of Korea	10. 35 . 96 . 0 / 19	First	10 . 35 . 96 . 1	0 0 0 0 1 0 1 0 .	0 0 1 0	0 0 1 1 . 0 1 1	0 0 0 0 0 . 0 0 0 0 0 0 0 1
			Last	10 . 35 . 127 . 254	0 0 0 0 1 0 1 0 .	0 0 1 0	0 0 1 1 . 0 1 1	1 1 1 1 1 . 1 1 1 1 1 1 1 0
29	Samoa	10. 35 . 128 . 0 / 19	First	10 . 35 . 128 . 1	0 0 0 0 1 0 1 0 .	0 0 1 0	0 0 1 1 . 1 0 0	0 0 0 0 0 . 0 0 0 0 0 0 0 1
			Last	10 . 35 . 159 . 254	0 0 0 0 1 0 1 0 .	0 0 1 0	0 0 1 1 . 1 0 0	1 1 1 1 1 . 1 1 1 1 1 1 1 0
30	Singapore	10. 35 . 160 . 0 / 19	First	10 . 35 . 160 . 1	0 0 0 0 1 0 1 0 .	0 0 1 0	0 0 1 1 . 1 0 1	0 0 0 0 0 . 0 0 0 0 0 0 0 1
			Last	10 . 35 . 191 . 254	0 0 0 0 1 0 1 0 .	0 0 1 0	0 0 1 1 . 1 0 1	1 1 1 1 1 . 1 1 1 1 1 1 1 0
31	Solomon Islands	10. 35 . 192 . 0 / 19	First	10 . 35 . 192 . 1	0 0 0 0 1 0 1 0 .	0 0 1 0	0 0 1 1 . 1 1 0	0 0 0 0 0 . 0 0 0 0 0 0 0 1
			Last	10 . 35 . 223 . 254	0 0 0 0 1 0 1 0 .	0 0 1 0	0 0 1 1 . 1 1 0	1 1 1 1 1 . 1 1 1 1 1 1 1 0
32	Sri Lanka	10. 35. 224 . 0 / 19	First	10 . 35 . 224 . 1	0 0 0 0 1 0 1 0 .	0 0 1 0	0 0 1 1 . 1 1 1	0 0 0 0 0 . 0 0 0 0 0 0 0 1
			Last	10 . 35 . 255 . 254	0 0 0 0 1 0 1 0 .	0 0 1 0	0 0 1 1 . 1 1 1	1 1 1 1 1 . 1 1 1 1 1 1 1 0
33	Thailand	10. 36 . 0 . 0 / 19	First	10 . 36 . 00 . 1	0 0 0 0 1 0 1 0 .	0 0 1 0	0 1 0 0 . 0 0 0	0 0 0 0 0 . 0 0 0 0 0 0 0 1

Ref	State/Administration	Network	Direction used	Decimal notation	Binary Notation	Region	State/Territory	Host's
			Last	10 . 36 . 31 . 254	0 0 0 0 1 0 1 0 .	0 0 1 0	0 1 0 0 . 0 0 0	1 1 1 1 1 . 1 1 1 1 1 1 1 0
34	Timor Leste	10. 36. 32 . 0 / 19	First	10 . 36. 32 . 1	0 0 0 0 1 0 1 0 .	0 0 1 0	0 1 0 0 . 0 0 1	0 0 0 0 0 . 0 0 0 0 0 0 0 1
			Last	10 . 36. 63 . 254	0 0 0 0 1 0 1 0 .	0 0 1 0	0 1 0 0 . 0 0 1	1 1 1 1 1 . 1 1 1 1 1 1 1 0
35	Tonga	10. 36 . 64 . 0 / 19	First	10 . 36 . 64 . 1	0 0 0 0 1 0 1 0 .	0 0 1 0	0 1 0 0 . 1 1 0	0 0 0 0 0 . 0 0 0 0 0 0 0 1
			Last	10 . 36 . 95 . 254	0 0 0 0 1 0 1 0 .	0 0 1 0	0 1 0 0 . 1 1 0	1 1 1 1 1 . 1 1 1 1 1 1 1 0
36	Vanuatu	10. 36 . 96 . 0 / 19	First	10 . 36 . 96 . 1	0 0 0 0 1 0 1 0 .	0 0 1 0	0 1 0 0 . 0 1 1	0 0 0 0 0 . 0 0 0 0 0 0 0 1
			Last	10 . 36 . 127 . 254	0 0 0 0 1 0 1 0 .	0 0 1 0	0 1 0 0 . 0 1 1	1 1 1 1 1 . 1 1 1 1 1 1 1 0
37	Vietnam	10. 36 . 128 . 0 / 19	First	10 . 36 . 128 . 1	0 0 0 0 1 0 1 0 .	0 0 1 0	0 1 0 0 . 1 0 0	0 0 0 0 0 . 0 0 0 0 0 0 0 1
			Last	10 . 36 . 159 . 254	0 0 0 0 1 0 1 0 .	0 0 1 0	0 1 0 0 . 1 0 0	1 1 1 1 1 . 1 1 1 1 1 1 1 0
38	Afghanistan	10. 36 . 160 . 0 / 19	First	10 . 36 . 160 . 1	0 0 0 0 1 0 1 0 .	0 0 1 0	0 1 0 0 . 1 0 1	0 0 0 0 0 . 0 0 0 0 0 0 0 1
			Last	10 . 36 . 191 . 254	0 0 0 0 1 0 1 0 .	0 0 1 0	0 1 0 0 . 1 0 1	1 1 1 1 1 . 1 1 1 1 1 1 1 0
39	French Polynesia, France	10. 36 . 192 . 0 / 19	First	10 . 36 . 192 . 1	0 0 0 0 1 0 1 0 .	0 0 1 0	0 1 0 0 . 1 1 0	0 0 0 0 0 . 0 0 0 0 0 0 0 1
			Last	10 . 36 . 223 . 254	0 0 0 0 1 0 1 0 .	0 0 1 0	0 1 0 0 . 1 1 0	1 1 1 1 1 . 1 1 1 1 1 1 1 0
40	New Caledonia, France	10. 36 . 224 . 0 / 19	First	10 . 36 . 224 . 1	0 0 0 0 1 0 1 0 .	0 0 1 0	0 1 0 0 . 1 1 1	0 0 0 0 0 . 0 0 0 0 0 0 0 1
			Last	10 . 36 . 255 . 254	0 0 0 0 1 0 1 0 .	0 0 1 0	0 1 0 0 . 1 1 1	1 1 1 1 1 . 1 1 1 1 1 1 1 0
41	Wallis & Futuna Islands, France	10. 37 . 0 . 0 / 19	First	10 . 37 . 0 . 1	0 0 0 0 1 0 1 0 .	0 0 1 0	0 1 0 1 . 0 0 0	0 0 0 0 0 . 0 0 0 0 0 0 0 1
			Last	10 . 37 . 31 . 254	0 0 0 0 1 0 1 0 .	0 0 1 0	0 1 0 1 . 0 0 0	1 1 1 1 1 . 1 1 1 1 1 1 1 0
42	Niue Islands, New Zealand	10. 37 . 32 . 0 / 19	First	10 . 37 . 32 . 1	0 0 0 0 1 0 1 0 .	0 0 1 0	0 1 0 1 . 0 0 1	0 0 0 0 0 . 0 0 0 0 0 0 0 1
			Last	10 . 37 . 63 . 254	0 0 0 0 1 0 1 0 .	0 0 1 0	0 1 0 1 . 0 0 1	1 1 1 1 1 . 1 1 1 1 1 1 1 0
43	Pecan Island, United Kingdom	10. 37 . 64 . 0 / 19	First	10 . 37 . 64 . 1	0 0 0 0 1 0 1 0 .	0 0 1 0	0 1 0 1 . 0 1 0	0 0 0 0 0 . 0 0 0 0 0 0 0 1

Ref	State/Administration	Network	Direction used	Decimal notation	Binary Notation	Region	State/Territory	Host's
			Last	10 . 37. 95 . 254	0 0 0 0 1 0 1 0 .	0 0 1 0	0 1 0 1 . 0 1 0	1 1 1 1 1 . 1 1 1 1 1 1 1 0
44	American Samoa , United States	10. 37 . 96 . 0 / 19	First	10 . 37. 96 . 1	0 0 0 0 1 0 1 0 .	0 0 1 0	0 1 0 1 . 0 1 1	0 0 0 0 0 . 0 0 0 0 0 0 0 1
			Last	10 . 37. 127 . 254	0 0 0 0 1 0 1 0 .	0 0 1 0	0 1 0 1 . 0 1 1	1 1 1 1 1 . 1 1 1 1 1 1 1 0
45	Guam, United States	10. 37 . 128 . 0 / 19	First	10 . 37. 128 . 1	0 0 0 0 1 0 1 0 .	0 0 1 0	0 1 0 1 . 1 0 0	0 0 0 0 0 . 0 0 0 0 0 0 0 1
			Last	10 . 37. 159 . 254	0 0 0 0 1 0 1 0 .	0 0 1 0	0 1 0 1 . 1 0 0	1 1 1 1 1 . 1 1 1 1 1 1 1 0
46	Johnson Island Kingman Reef, United States	10. 37 . 160 . 0 / 19	First	10 . 37. 160 . 1	0 0 0 0 1 0 1 0 .	0 0 1 0	0 1 0 1 . 1 0 1	0 0 0 0 0 . 0 0 0 0 0 0 0 1
			Last	10 . 37. 191 . 254	0 0 0 0 1 0 1 0 .	0 0 1 0	0 1 0 1 . 1 0 1	1 1 1 1 1 . 1 1 1 1 1 1 1 0
47	Midway, United States	10. 37 . 192 . 0 / 19	First	10 . 37. 192 . 1	0 0 0 0 1 0 1 0 .	0 0 1 0	0 1 0 1 . 1 1 0	0 0 0 0 0 . 0 0 0 0 0 0 0 1
			Last	10 . 37. 223 . 254	0 0 0 0 1 0 1 0 .	0 0 1 0	0 1 0 1 . 1 1 0	1 1 1 1 1 . 1 1 1 1 1 1 1 0
48	Northern Mariana Islands, United States	10 . 37 .224. 0 / 19	First	10 . 37 . 224 . 1	0 0 0 0 1 0 1 0 .	0 0 1 0	0 1 0 1 . 1 1 1	0 0 0 0 0 . 0 0 0 0 0 0 0 1
			Last	10 . 37 . 255 . 254	0 0 0 0 1 0 1 0 .	0 0 1 0	0 1 0 1 . 1 1 1	1 1 1 1 1 . 1 1 1 1 1 1 1 0
49	Palmyra, United States	10 . 38 . 0 . 0 / 19	First	10 . 38 . 0 . 1	0 0 0 0 1 0 1 0 .	0 0 1 0	0 1 1 0 . 0 0 0	0 0 0 0 0 . 0 0 0 0 0 0 0 1
			Last	10 . 38 . 31 . 254	0 0 0 0 1 0 1 0 .	0 0 1 0	0 1 1 0 . 0 0 0	1 1 1 1 1 . 1 1 1 1 1 1 1 0
50	Wake Islands, United States	10. 38. 32 . 0 / 19	First	10 . 38 . 32 . 1	0 0 0 0 1 0 1 0 .	0 0 1 0	0 1 1 0 . 0 0 1	0 0 0 0 0 . 0 0 0 0 0 0 0 1
			Last	10 . 38 . 63 . 254	0 0 0 0 1 0 1 0 .	0 0 1 0	0 1 1 0 . 0 0 1	1 1 1 1 1 . 1 1 1 1 1 1 1 0
51	Cook Islands	10.38. 64 .0 / 19	First	10 . 38 . 64 . 1	0 0 0 0 1 0 1 0 .	0 0 1 0	0 1 1 0 . 0 1 0	0 0 0 0 0 . 0 0 0 0 0 0 0 1
			Last	10 . 38 . 95 . 254	0 0 0 0 1 0 1 0 .	0 0 1 0	0 1 1 0 . 0 1 0	1 1 1 1 1 . 1 1 1 1 1 1 1 0
52	Palau	10. 38 . 96 . 0 / 19	First	10 . 38. 96 . 1	0 0 0 0 1 0 1 0 .	0 0 1 0	0 1 1 0 . 0 1 1	0 0 0 0 0 . 0 0 0 0 0 0 0 1
			Last	10 . 38. 127 . 254	0 0 0 0 1 0 1 0 .	0 0 1 0	0 1 1 0 . 0 1 1	1 1 1 1 1 . 1 1 1 1 1 1 1 0

Ref	State/Administration	Network	Direction used	Decimal notation	Binary Notation	Region	State/Territory	Host's
53	*VACANT*							
128	*RESERVED*	10. 47 . 224 . 0 / 19	First	10 . 47 . 224 . 1	0 0 0 0 1 0 1 0 .	0 0 1 0	1 1 1 1 . 1 1 1	0 0 0 0 0 . 0 0 0 0 0 0 0 1
			Last	10 . 47 . 255 . 254	0 0 0 0 1 0 1 0 .	0 0 1 0	1 1 1 1 . 1 1 1	1 1 1 1 1 . 1 1 1 1 1 1 1 0

3.3.2 Network Assignment for USA

Ref	State/Administration	Network	Direction used	Decimal notation	Binary Notation	Region	State/Territory	Host's
1	United States	10.19.160.0/19	First	10 . 19 .160 . 1	0 0 0 0 1 0 1 0.	0 0 0 1	0 0 1 1 . 1 0 1	0 0 0 0 0 . 0 0 0 0 0 0 0 1
			Last	10 . 19. 191 254	0 0 0 0 1 0 1 0.	0 0 0 1	0 0 1 1 . 1 0 1	1 1 1 1 1 . 1 1 1 1 1 1 1 0

3.4 Using IPv4-Compatible Address Formats

In many instances, you can represent a 32-bit IPv4 address as a 128-bit IPv6 address. The transition mechanism defines the following two formats.

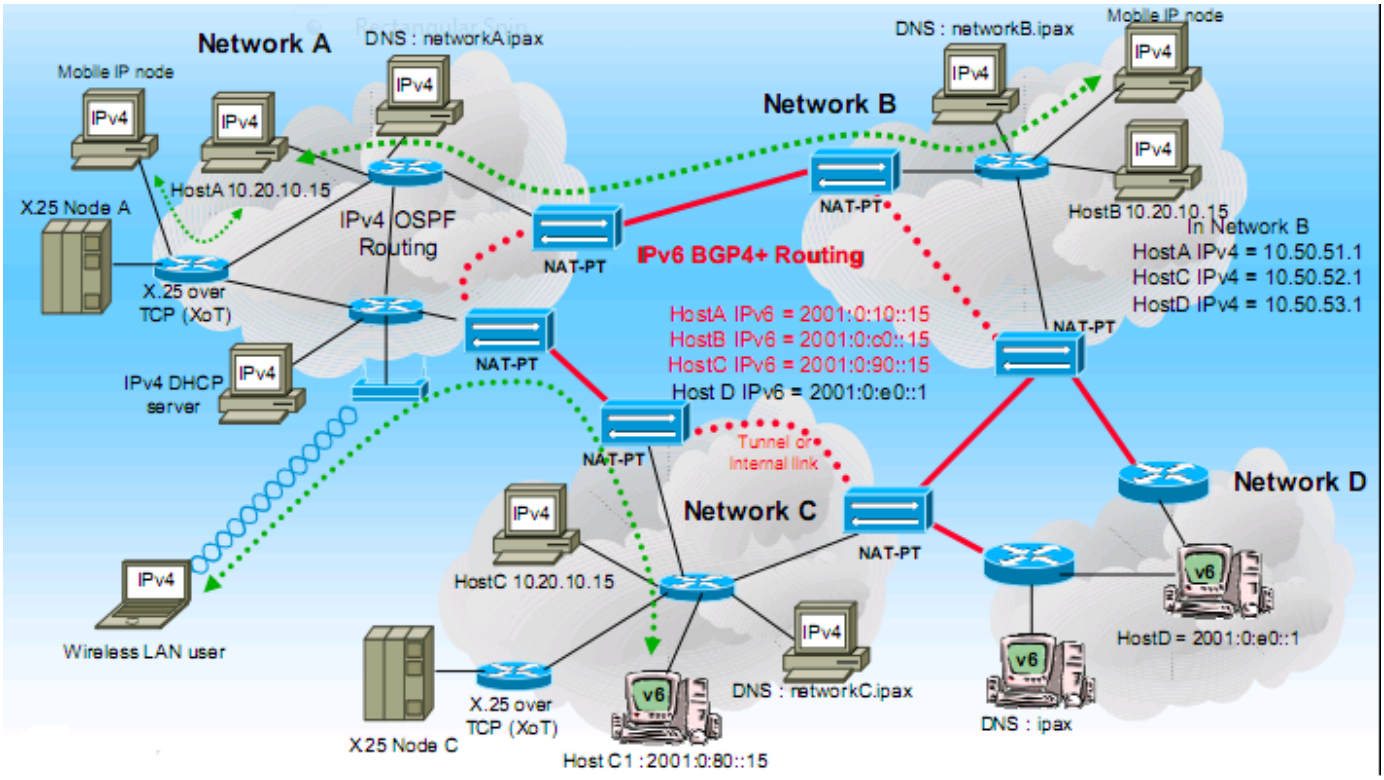
IPv4-compatible address

000 ... 000	IPv4 Address

IPv4-mapped address

000 ... 000	0xffff	IPv4 Address

The mapped address format is used to represent an IPv4 node. The only currently defined use of this address format is part of the socket API. An application can have a common address format for both IPv6 addresses and IPv4 addresses. The common address format can represent an IPv4 address as a 128-bit mapped address. However, IPv4-to-IPv6 protocol translators also allow these addresses to be used.



Appendix C – MID IPv4 Address Plan

Appendix B

No.	State	Network IP Address	Hosts IP addresses					
			Decimal Notation		Binary Notation			
					1st Byte	Region	State	Hosts
1	Bahrain	10.48.0.0/19	First	10.48.0.1	00001010.	0011	0000.000	00000.00000001
			Last	10.48.31.254	00001010.	0011	0000.000	11111.11111110
2	Egypt	10.48.32.0/19	First	10.48.32.1	00001010.	0011	0000.001	00000.00000001
			Last	10.48.63.254	00001010.	0011	0000.001	11111.11111110
3	Iran	10.48.64.0/19	First	10.48.64.1	00001010.	0011	0000.010	00000.00000001
			Last	10.48.95.254	00001010.	0011	0000.010	11111.11111110
4	Iraq	10.48.96.0/19	First	10.48.96.1	00001010.	0011	0000.011	00000.00000001
			Last	10.48.127.254	00001010.	0011	0000.011	11111.11111110
5	Jordan	10.48.0.0/19	First	10.48.128.1	00001010.	0011	0000.100	00000.00000001
			Last	10.48.159.254	00001010.	0011	0000.100	11111.11111110
6	Kuwait	10.48.0.0/19	First	10.48.160.1	00001010.	0011	0000.101	00000.00000001
			Last	10.48.195.254	00001010.	0011	0000.101	11111.11111110
7	Lebanon	10.48.0.0/19	First	10.48.196.1	00001010.	0011	0000.110	00000.00000001
			Last	10.48.223.254	00001010.	0011	0000.110	11111.11111110
8	Libya	10.48.0.0/19	First	10.48.224.1	00001010.	0011	0000.111	00000.00000001
			Last	10.48.255.254	00001010.	0011	0000.111	11111.11111110
9	Oman	10.48.0.0/19	First	10.49.0.1	00001010.	0011	0001.000	00000.00000001
			Last	10.49.31.254	00001010.	0011	0001.000	11111.11111110
10	Qatar	10.48.0.0/19	First	10.49.32.1	00001010.	0011	0001.001	00000.00000001
			Last	10.49.63.254	00001010.	0011	0001.001	11111.11111110
11	Saudi Arabia	10.48.0.0/19	First	10.49.64.1	00001010.	0011	0001.010	00000.00000001
			Last	10.49.95.254	00001010.	0011	0001.010	11111.11111110
12	Sudan	10.48.0.0/19	First	10.49.96.1	00001010.	0011	0001.011	00000.00000001
			Last	10.49.127.254	00001010.	0011	0001.011	11111.11111110
13	Syria	10.48.0.0/19	First	10.49.128.1	00001010.	0011	0001.100	00000.00000001
			Last	10.49.159.254	00001010.	0011	0001.100	11111.11111110
14	UAE	10.48.0.0/19	First	10.49.160.1	00001010.	0011	0001.101	00000.00000001
			Last	10.49.127.254	00001010.	0011	0001.101	11111.11111110
15	Yemen	10.48.0.0/19	First	10.49.128.1	00001010.	0011	0001.110	00000.00000001
			Last	10.49.223.254	00001010.	0011	0001.110	11111.11111110