

CNS SG/22

Appendix B to the Report

INTERNATIONAL CIVIL AVIATION ORGANIZATION



COMMON AERONAUTICAL VPN (CRV) IMPLEMENTATION PLAN

Version 1.0

20 April 2018

COMMON AERONAUTICAL VPN (CRV)
IMPLEMENTATION PLAN – V1.0

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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

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ABBREVIATION	DESCRIPTION
SWIM	System-Wide Information Management
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

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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.

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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	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 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
5	Test and	1. Perform acceptance test with associated	3 to 6 months

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S/No.	Subject	Projected Activities	Projected Schedule
	evaluation	applications 2. Perform acceptance test with respective ANSPs	
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 ANSP'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.

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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 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

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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.

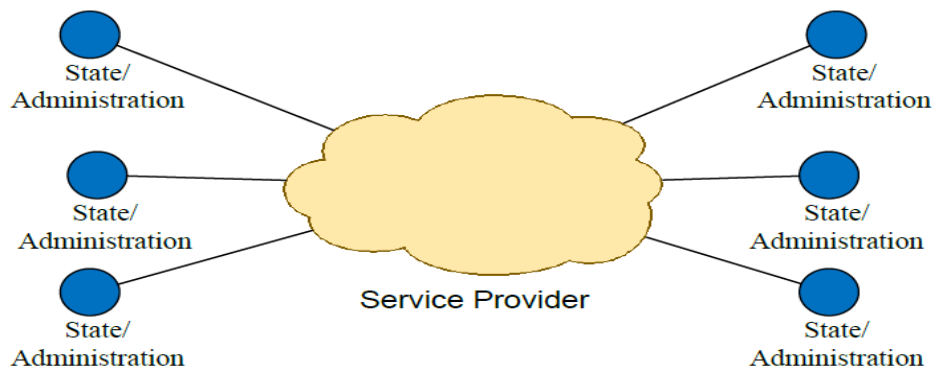


Figure 1: High level system overview of CRV

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
- iii. 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).

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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.

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.

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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:

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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

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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.

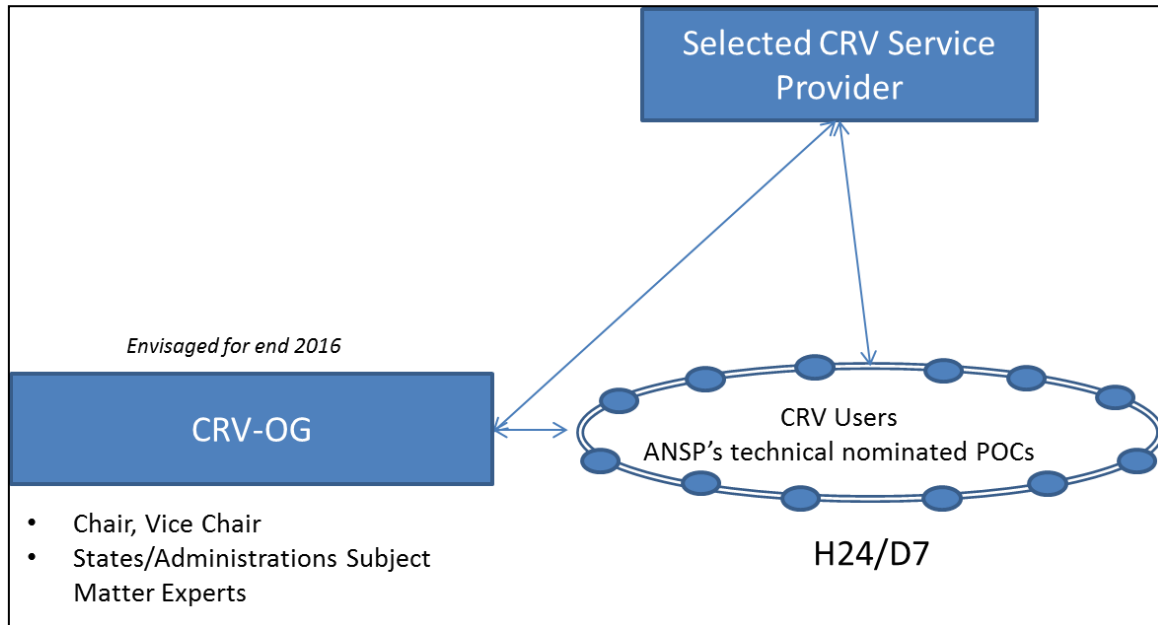


Figure 3: Relevant Entities to this Project.
(Source: CRV Tender doc - Att II - Terms of Reference_v3)

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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:

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- 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.

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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

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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

COMMON AERONAUTICAL VPN (CRV)
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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

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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@avi- ation-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

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State/ Administratio n	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 1 st 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.m y	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

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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

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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 (Communication s/ 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

COMMON AERONAUTICAL VPN (CRV)
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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 Banphawatthanra k	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 Telecommunicat ion 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

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

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

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

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

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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;

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- 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.

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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.Earnes@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

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State	State/ANSP	Site	Local CRV Points of Contact	Email	Telephone / Fax	Service installation
Bhutan	Air Navigation Services, Ministry of Information & Communications Department of Civil Aviation	Paro	Mr. Pema Tashi		Mobile :+975 17622702 Office: +975 8 271347 (Ext.:107), Fax.: +975 8 271944	Paro Airport
	Air Navigation Services, Ministry of Information & Communications Department of Civil Aviation	Paro	Mr. Sangay Senior Communication Officer	sangay@doat.gov.bt	Tel: +97508 271407, 272511 Mobile: +97517342667 Fax.: +97508271407	Paro Airport
Brunei Darussalam		Brunei			Tel.: Fax :	Brunei International Airport

COMMON AERONAUTICAL VPN (CRV)
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State	State/ANSP	Site	Local CRV Points of Contact	Email	Telephone / Fax	Service installation
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,CAA C	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,CAA C	Guangzhou			Tel.:+86-020-86122850 Fax :+86-020-86636200	Guangzhou COM Network Center No.3 Nanyun East Street, Airport Road, Baiyun District Guangzhou, China
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- Administration of Airports	Macau			Tel.: (+853)28861111 Fax: (+853)28862222 Email: airportdirector@ada.com.mo	Macau International Airport PAC on Talpa Macao, China

COMMON AERONAUTICAL VPN (CRV)
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State	State/ANSP	Site	Local CRV Points of Contact	Email	Telephone / Fax	Service installation
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 Fax: (689) 40 86 10 39	Service d'Etat de l'Aviation Civile BP 6011 - 98702 Faa'a International Airport
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			

COMMON AERONAUTICAL VPN (CRV)
IMPLEMENTATION PLAN – V1.0

State	State/ANSP	Site	Local CRV Points of Contact	Email	Telephone / Fax	Service installation
			<u>India</u>			
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
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

COMMON AERONAUTICAL VPN (CRV)
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State	State/ANSP	Site	Local CRV Points of Contact	Email	Telephone / Fax	Service installation
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 Kepeyan 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.
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

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State	State/ANSP	Site	Local CRV Points of Contact	Email	Telephone / Fax	Service installation
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.
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 Aérienne	Noumea	Mr. Félicien TORRES	felicien.torres@aviation-civile.gouv.fr	Tel.:	Nouméa Magenta Airport, 179, rue Roger Gervolino BP H1 - 98849 Noumea Cedex

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State	State/ANSP	Site	Local CRV Points of Contact	Email	Telephone / Fax	Service installation
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, Pakistan	Karachi	Mr. Fasih-uz-zaman	aftnophq@caapakistan.com.pk	+92 (21) 924-8732 +92 (21) 924-8733 (fax)	Jinnah International Airport
Palau		Koror			Tel.: Fax :	Roman Tmetuchl International Airport

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State	State/ANSP	Site	Local CRV Points of Contact	Email	Telephone / Fax	Service installation
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
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

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State	State/ANSP	Site	Local CRV Points of Contact	Email	Telephone / Fax	Service installation
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
Viet Nam		Ho Chin Minh/Hanoi			Tel.: Fax :	Tan Son Nhat International Airport Noi Bai International Airport

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State	State/ANSP	Site	Local CRV Points of Contact	Email	Telephone / Fax	Service installation
Wallis and Futuna	Aviation Civile	Wallis	Mr. Bernard Le Guillou	bernard.le-guillou@aviation-civile.gouv.fr	Tél: 00-681-72-12-02 Fax: 00-681-72-29-54 mél: seac-wf.sna@mail.wf	Hihifo Airport Aviation Civile BP1 Mata-Utu 98600 WALLIS
<u>ICAO MID Region</u>						
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				
Saudi Arabia	General Authority of CA	Jeddah and Riyadh				
Sudan	CAA	Khartoum				

COMMON AERONAUTICAL VPN (CRV)
IMPLEMENTATION PLAN – V1.0

State	State/ANSP	Site	Local CRV Points of Contact	Email	Telephone / Fax	Service installation
Syria	CAA	Damascus				
UAE	General CA Authority	AbuDhabi				
Yemen	CA and Met Authority	Sanaa				
<u>Interregional connectivity</u>						
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

COMMON AERONAUTICAL VPN (CRV)
IMPLEMENTATION PLAN – V1.0

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				

COMMON AERONAUTICAL VPN (CRV)
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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;

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- 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

COMMON AERONAUTICAL VPN (CRV)
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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.

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- 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-contractors⁷;
- 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.

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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.

4.2.4 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:

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- 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

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- 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 be 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 - CRV Implementation Table

Appendix A

State/ Administration	Intended date for CRV cut-over	Applications targeted	Envisaged SLA (peers)	Migration scheme	Prerequisites/ dependencies
Australia	Contract in May 2018 and service readiness in 3Q 2018	AFTN, ADS-B, AMHS, voice with Singapore in June 2019; with Japan would be end of 2019.		staged approach	Termination of current COM contract
Bhutan	Contract in 4Q2018, service readiness in 2Q2019	Data (AMHS, AFTN) and voice			Administrative approval from the management for the direct contract and approval from BCAA
Cambodia	As early as convenient				Internal decision making
China	Contract in 3Q2018, service readiness in 4Q2018	Data (AMHS) With Hong Kong 1Q2019; With Japan 2Q2020; With Thailand 2Q2019; With India in end of 2019.		staged approach	
Democratic People's Republic of Korea	Contract in 3Q2018 and service readiness in 4Q2018	AFTN and VoIP			

Appendix A - CRV Implementation Table

State/ Administration	Intended date for CRV cut-over	Applications targeted	Envisaged SLA (peers)	Migration scheme	Prerequisites/ dependencies
Hong Kong, China	Contract signed on 6 Apr.2018 Service readiness by 2Q2018	DATA (AMHS) and VoIP With: China 1Q2019; Manila 1Q2019; Japan 4Q2019; Thailand 2Q2019;		staged approach	Need to coordinate with relevant CAAs/ANSPs in joining CRV in a harmonized manner, etc.
Macao, China	To be confirmed				CBA migration from X25 to IP
Fiji	Contract in May 2018 and service readiness in 3Q 2018	Data (AMHS) and VoIP With: Australia and USA 3Q2018		Staged approach	CBA, safety case
France (New Caledonia and French Polynesia)	2019 is target for New Caledonia to sign contract subject to internal security assessment	ATS Voice , AMHS with Fiji & AIDC, AMHS and ATS voice with USA			CBA, cost must be affordable <i>Wallis and Futuna: no dedicated connection to CRV</i>
India	Contract in 4Q2018 and service readiness in 1Q2019.	BBIS first, then BIS States		staged approach	CBA, safety case
Indonesia	Contract in 2Q2019 and Service readiness in 3Q2019	AFTN, AMHS, ADS-B and voice			CBA

Appendix A - CRV Implementation Table

State/ Administration	Intended date for CRV cut-over	Applications targeted	Envisaged SLA (peers)	Migration scheme	Prerequisites/ dependencies
Japan	Contract signed in Nov.2017 and service readiness in 1Q 2018 for Fukuoka	Data first: With: Hong Kong 4Q2019 USA 3Q2018; Singapore 3Q2019; China 2Q2020		staged approach	
Malaysia	Contract to be signed 1Q 2019 and service readiness in 4Q2019	AFTN, AMHS, ADS-B and ATS voice		staged approach	New ATC center operational in 2020
Myanmar	As early as convenient	AFTN, AMHS, ADS-B and voice			CBA
New Zealand	Contract in May2018 and service readiness in 3Q 2018	AFTN, AMHS and voice			CBA attractive if all counterparts join in
Philippines	Contract signed in March 2018 and service readiness in 2Q2018	Data (AMHS) and voice		staged approach	Success transition to the New ATM centre in 4Q2018
Republic of Korea	Contract in 2Q2019 and service readiness in 4Q 2019	Data (AMHS), AIDC and VoIP		staged approach	
Singapore	Contract in 3Q2018 and service readiness in 4Q2018	1/ AFTN/AMHS 2/ Voice/AIDC/ADS-B With: Australia June2019; Japan 3Q2019 Thailand 2Q2019; India 2019.		staged approach	CBA attractive if all counterparts join in

Appendix A - CRV Implementation Table

State/ Administration	Intended date for CRV cut-over	Applications targeted	Envisaged SLA (peers)	Migration scheme	Prerequisites/ dependencies
Sri Lanka	As soon as CRV is available	AMHS connectivity with Mumbai, Singapore and Male. Direct Speech facilities with Chennai, Trivendrum, Mumbai, Male, Jakarta, Melbourne, Singapore		Phased approach with the implementation of CRV	CBA
Thailand	Contract in 3Q 2018 and service readiness in 4Q2018	Data first Then voice, subject to safety case: China 2Q2019 Hong Kong 2Q2019; Singapore 2Q2019; India 2019		Staged approach	

Appendix A - CRV Implementation Table

State/ Administration	Intended date for CRV cut-over	Applications targeted	Envisaged SLA (peers)	Migration scheme	Prerequisites/ dependencies
United States	Contract in May 2018 and service readiness in 3Q 2018	1/ AFTN to AMHS over IP with Australia 2/ other FIRs as opportune (French Pol., Samoa, Philippines, Indonesia, PNG etc) 3/ ATFM, AMHS with attachment 4/ AMHS with Japan, Fiji and New Zealand 5/ BBIS with Fiji, Australia and Japan 3Q2018 (for only AMHS)		Staged approach	

Appendix B – APAC IPv4 Address Plan

Appendix B

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

<i>Administrative Domain</i>	–	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.
<i>Autonomous System</i>	–	A connected group of one or more IP prefixes, run by one or more network operators, which has a single, clearly defined routing policy.

<i>Intra-domain (interior gateway) routing protocol</i>	–	Protocols for exchanging routing information between routers within an AS.
<i>Inter-domain (exterior gateway) routing protocol</i>	–	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.
<i>Local Internet Registry</i>	–	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.

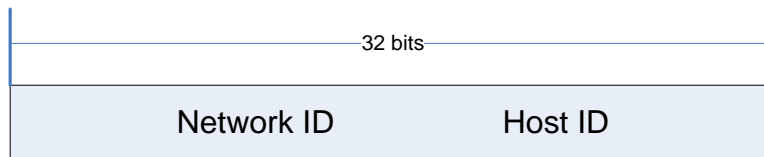


Figure 2-1. IPv4 Address Format

The original IP addressing scheme divided the Network ID from the Host ID in 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 by 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) Configuring 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:

IPv4 Address			
10	Region	State / Territory	Host's
0 0 0 0 1 0 1 0	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 1
1st. Byte	2nd. Byte	3rd. Byte	4th. Byte

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	00001010.	0010	0000.000	00000.00000001
			Last	10.32.31.254	00001010.	0010	0000.000	11111.11111110
2	Bangladesh	10.32.32.0 / 19	First	10.32.32.1	00001010.	0010	0000.001	00000.00000001
			Last	10.32.63.254	00001010.	0010	0000.001	11111.11111110
3	Bhutan	10.32.64.0 / 19	First	10.32.64.1	00001010.	0010	0000.010	00000.00000001
			Last	10.32.95.254	00001010.	0010	0000.010	11111.11111110
4	Brunei Darussalam	10.32.96.0 / 19	First	10.32.96.1	00001010.	0010	0000.011	00000.00000001
			Last	10.32.127.254	00001010.	0010	0000.011	11111.11111110
5	Cambodia	10.32.128.0 / 19	First	10.32.128.1	00001010.	0010	0000.100	00000.00000001
			Last	10.32.159.254	00001010.	0010	0000.100	11111.11111110
6	China	10.32.160.0 / 19	First	10.32.160.1	00001010.	0010	0000.101	00000.00000001
			Last	10.32.191.254	00001010.	0010	0000.101	11111.11111110
7	Hong Kong, China	10.32.192.0 / 19	First	10.32.192.1	00001010.	0010	0000.110	00000.00000001
			Last	10.32.223.254	00001010.	0010	0000.110	11111.11111110
8	Macao, China	10.32.224.0 / 19	First	10.32.224.1	00001010.	0010	0000.111	00000.00000001
			Last	10.32.255.254	00001010.	0010	0000.111	11111.11111110
9	Democratic people's Republic of Korea	10.33.0.0 / 19	First	10.33.0.1	00001010.	0010	0001.000	00000.00000001
			Last	10.33.31.254	00001010.	0010	0001.000	11111.11111110
10	Fiji	10.33.32.0 / 19	First	10.33.32.1	00001010.	0010	0001.001	00000.00000001

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 .	0010	0001 . 001	11111 . 11111110
11	India	10.33.64.0/19	First	10 . 33 . 64 . 1	0 0 0 0 1 0 1 0 .	0010	0001 . 010	00000 . 00000001
			Last	10 . 33 . 95 . 254	0 0 0 0 1 0 1 0 .	0010	0001 . 010	11111 . 11111110
12	Indonesia	10.33.96.0/19	First	10 . 33 . 96 . 1	0 0 0 0 1 0 1 0 .	0010	0001 . 011	00000 . 00000001
			Last	10 . 33 . 96 . 254	0 0 0 0 1 0 1 0 .	0010	0001 . 011	11111 . 11111110
13	Japan	10.33.128.0/19	First	10 . 33 . 128 . 1	0 0 0 0 1 0 1 0 .	0010	0001 . 100	00000 . 00000001
			Last	10 . 33 . 159 . 254	0 0 0 0 1 0 1 0 .	0010	0001 . 100	11111 . 11111110
14	Kiribati	10.33.160.0/19	First	10 . 33 . 160 . 1	0 0 0 0 1 0 1 0 .	0010	0001 . 101	00000 . 00000001
			Last	10 . 33 . 191 . 254	0 0 0 0 1 0 1 0 .	0010	0001 . 101	11111 . 11111110
15	Lao People's Democratic Republic	10.33.192.0/19	First	10 . 33 . 192 . 1	0 0 0 0 1 0 1 0 .	0010	0001 . 110	00000 . 00000001
			Last	10 . 33 . 223 . 254	0 0 0 0 1 0 1 0 .	0010	0001 . 110	11111 . 11111110
16	Malaysia	10.33.224.0/19	First	10 . 33 . 224 . 1	0 0 0 0 1 0 1 0 .	0010	0001 . 111	00000 . 00000001
			Last	10 . 33 . 255 . 254	0 0 0 0 1 0 1 0 .	0010	0001 . 111	11111 . 11111110
17	Maldives	10.34.0.0/19	First	10 . 34 . 00 . 1	0 0 0 0 1 0 1 0 .	0010	0010 . 000	00000 . 00000001
			Last	10 . 34 . 31 . 254	0 0 0 0 1 0 1 0 .	0010	0010 . 000	11111 . 11111110
18	Marshall Islands	10.34.32.0/19	First	10 . 34 . 32 . 1	0 0 0 0 1 0 1 0 .	0010	0010 . 001	00000 . 00000001
			Last	10 . 34 . 63 . 254	0 0 0 0 1 0 1 0 .	0010	0010 . 001	11111 . 11111110
19	Micronesia	10.34.64.0/19	First	10 . 34 . 64 . 1	0 0 0 0 1 0 1 0 .	0010	0010 . 010	00000 . 00000001
			Last	10 . 34 . 95 . 254	0 0 0 0 1 0 1 0 .	0010	0010 . 010	11111 . 11111110
20	Mongolia	10.34.96.0/19	First	10 . 34 . 96 . 1	0 0 0 0 1 0 1 0 .	0010	0010 . 011	00000 . 00000001
			Last	10 . 34 . 127 . 254	0 0 0 0 1 0 1 0 .	0010	0010 . 011	11111 . 11111110
21	Myanmar	10.34.128.0/19	First	10 . 34 . 128 . 1	0 0 0 0 1 0 1 0 .	0010	0010 . 100	00000 . 00000001
			Last	10 . 34 . 159 . 254	0 0 0 0 1 0 1 0 .	0010	0010 . 100	11111 . 11111110

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	00001010.	0010	0010.101	00000.00000001
			Last	10.34.191.254	00001010.	0010	0010.101	11111.11111110
23	Nepal	10.34.192.0/19	First	10.34.192.1	00001010.	0010	0010.110	00000.00000001
			Last	10.34.223.254	00001010.	0010	0010.110	11111.11111110
24	New Zealand	10.34.224.0/19	First	10.34.224.1	00001010.	0010	0010.111	00000.00000001
			Last	10.34.255.254	00001010.	0010	0010.111	11111.11111110
25	Pakistan	10.35.0.0/19	First	10.35.0.1	00001010.	0010	0011.000	00000.00000001
			Last	10.35.31.254	00001010.	0010	0011.000	11111.11111110
26	Papua New Guinea	10.35.32.0/19	First	10.35.32.1	00001010.	0010	0011.001	00000.00000001
			Last	10.35.63.254	00001010.	0010	0011.001	11111.11111110
27	Philippines	10.35.64.0/19	First	10.35.64.1	00001010.	0010	0011.010	00000.00000001
			Last	10.35.95.254	00001010.	0010	0011.010	11111.11111110
28	Republic of Korea	10.35.96.0/19	First	10.35.96.1	00001010.	0010	0011.011	00000.00000001
			Last	10.35.127.254	00001010.	0010	0011.011	11111.11111110
29	Samoa	10.35.128.0/19	First	10.35.128.1	00001010.	0010	0011.100	00000.00000001
			Last	10.35.159.254	00001010.	0010	0011.100	11111.11111110
30	Singapore	10.35.160.0/19	First	10.35.160.1	00001010.	0010	0011.101	00000.00000001
			Last	10.35.191.254	00001010.	0010	0011.101	11111.11111110
31	Solomon Islands	10.35.192.0/19	First	10.35.192.1	00001010.	0010	0011.110	00000.00000001
			Last	10.35.223.254	00001010.	0010	0011.110	11111.11111110
32	Sri Lanka	10.35.224.0/19	First	10.35.224.1	00001010.	0010	0011.111	00000.00000001
			Last	10.35.255.254	00001010.	0010	0011.111	11111.11111110
33	Thailand	10.36.0.0/19	First	10.36.00.1	00001010.	0010	0100.000	00000.00000001

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 .	0010	0100 . 000	11111 . 111111110
34	Timor Leste	10. 36. 32 . 0 / 19	First	10 . 36. 32 . 1	0 0 0 0 1 0 1 0 .	0010	0100 . 001	00000 . 00000001
			Last	10 . 36. 63 . 254	0 0 0 0 1 0 1 0 .	0010	0100 . 001	11111 . 111111110
35	Tonga	10. 36 . 64 . 0 / 19	First	10 . 36 . 64 . 1	0 0 0 0 1 0 1 0 .	0010	0100 . 110	00000 . 00000001
			Last	10 . 36 . 95 . 254	0 0 0 0 1 0 1 0 .	0010	0100 . 110	11111 . 111111110
36	Vanuatu	10. 36 . 96 . 0 / 19	First	10 . 36 . 96 . 1	0 0 0 0 1 0 1 0 .	0010	0100 . 011	00000 . 00000001
			Last	10 . 36 . 127 . 254	0 0 0 0 1 0 1 0 .	0010	0100 . 011	11111 . 111111110
37	Vietnam	10. 36 . 128 . 0 / 19	First	10 . 36 . 128 . 1	0 0 0 0 1 0 1 0 .	0010	0100 . 100	00000 . 00000001
			Last	10 . 36 . 159 . 254	0 0 0 0 1 0 1 0 .	0010	0100 . 100	11111 . 111111110
38	Afghanistan	10. 36 . 160 . 0 / 19	First	10 . 36 . 160 . 1	0 0 0 0 1 0 1 0 .	0010	0100 . 101	00000 . 00000001
			Last	10 . 36 . 191 . 254	0 0 0 0 1 0 1 0 .	0010	0100 . 101	11111 . 111111110
39	French Polynesia, France	10. 36 . 192 . 0 / 19	First	10 . 36 . 192 . 1	0 0 0 0 1 0 1 0 .	0010	0100 . 110	00000 . 00000001
			Last	10 . 36 . 223 . 254	0 0 0 0 1 0 1 0 .	0010	0100 . 110	11111 . 111111110
40	New Caledonia, France	10. 36 . 224 . 0 / 19	First	10 . 36 . 224 . 1	0 0 0 0 1 0 1 0 .	0010	0100 . 111	00000 . 00000001
			Last	10 . 36 . 255 . 254	0 0 0 0 1 0 1 0 .	0010	0100 . 111	11111 . 111111110
41	Wallis & Futuna Islands, France	10. 37 . 0 . 0 / 19	First	10 . 37 . 0 . 1	0 0 0 0 1 0 1 0 .	0010	0101 . 000	00000 . 00000001
			Last	10 . 37 . 31 . 254	0 0 0 0 1 0 1 0 .	0010	0101 . 000	11111 . 111111110
42	Niue Islands, New Zealand	10. 37 . 32 . 0 / 19	First	10 . 37 . 32 . 1	0 0 0 0 1 0 1 0 .	0010	0101 . 001	00000 . 00000001
			Last	10 . 37 . 63 . 254	0 0 0 0 1 0 1 0 .	0010	0101 . 001	11111 . 111111110
43	Pecan Island, United Kingdom	10. 37 . 64 . 0 / 19	First	10 . 37 . 64 . 1	0 0 0 0 1 0 1 0 .	0010	0101 . 010	00000 . 00000001

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 .	0010	0101 . 010	11111 . 11111110
44	American Samoa , United States	10. 37 . 96 . 0 / 19	First	10 . 37. 96 . 1	0 0 0 0 1 0 1 0 .	0010	0101 . 011	00000 . 00000001
			Last	10 . 37. 127 . 254	0 0 0 0 1 0 1 0 .	0010	0101 . 011	11111 . 11111110
45	Guam, United States	10. 37 . 128 . 0 / 19	First	10 . 37. 128 . 1	0 0 0 0 1 0 1 0 .	0010	0101 . 100	00000 . 00000001
			Last	10 . 37. 159 . 254	0 0 0 0 1 0 1 0 .	0010	0101 . 100	11111 . 11111110
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 .	0010	0101 . 101	00000 . 00000001
			Last	10 . 37. 191 . 254	0 0 0 0 1 0 1 0 .	0010	0101 . 101	11111 . 11111110
47	Midway, United States	10. 37 . 192 . 0 / 19	First	10 . 37. 192 . 1	0 0 0 0 1 0 1 0 .	0010	0101 . 110	00000 . 00000001
			Last	10 . 37. 223 . 254	0 0 0 0 1 0 1 0 .	0010	0101 . 110	11111 . 11111110
48	Northern Mariana Islands, United States	10 . 37 . 224 . 0 / 19	First	10 . 37 . 224 . 1	0 0 0 0 1 0 1 0 .	0010	0101 . 111	00000 . 00000001
			Last	10 . 37 . 255 . 254	0 0 0 0 1 0 1 0 .	0010	0101 . 111	11111 . 11111110
49	Palmyra, United States	10 . 38 . 0 . 0 / 19	First	10 . 38 . 0 . 1	0 0 0 0 1 0 1 0 .	0010	0110 . 000	00000 . 00000001
			Last	10 . 38 . 31 . 254	0 0 0 0 1 0 1 0 .	0010	0110 . 000	11111 . 11111110
50	Wake Islands, United States	10. 38. 32 . 0 / 19	First	10 . 38 . 32 . 1	0 0 0 0 1 0 1 0 .	0010	0110 . 001	00000 . 00000001
			Last	10 . 38 . 63 . 254	0 0 0 0 1 0 1 0 .	0010	0110 . 001	11111 . 11111110
51	Cook Islands	10.38. 64 . 0 / 19	First	10 . 38 . 64 . 1	0 0 0 0 1 0 1 0 .	0010	0110 . 010	00000 . 00000001
			Last	10 . 38 . 95 . 254	0 0 0 0 1 0 1 0 .	0010	0110 . 010	11111 . 11111110
52	Palau	10. 38 . 96 . 0 / 19	First	10 . 38. 96 . 1	0 0 0 0 1 0 1 0 .	0010	0110 . 011	00000 . 00000001
			Last	10 . 38. 127 . 254	0 0 0 0 1 0 1 0 .	0010	0110 . 011	11111 . 11111110

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	00001010.	0010	1111.111	00000.00000001
			Last	10.47.255.254	00001010.	0010	1111.111	11111.11111110

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	00001010.	0001	0011.101	00000.00000001
			Last	10.19.191.254	00001010.	0001	0011.101	11111.11111110

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.

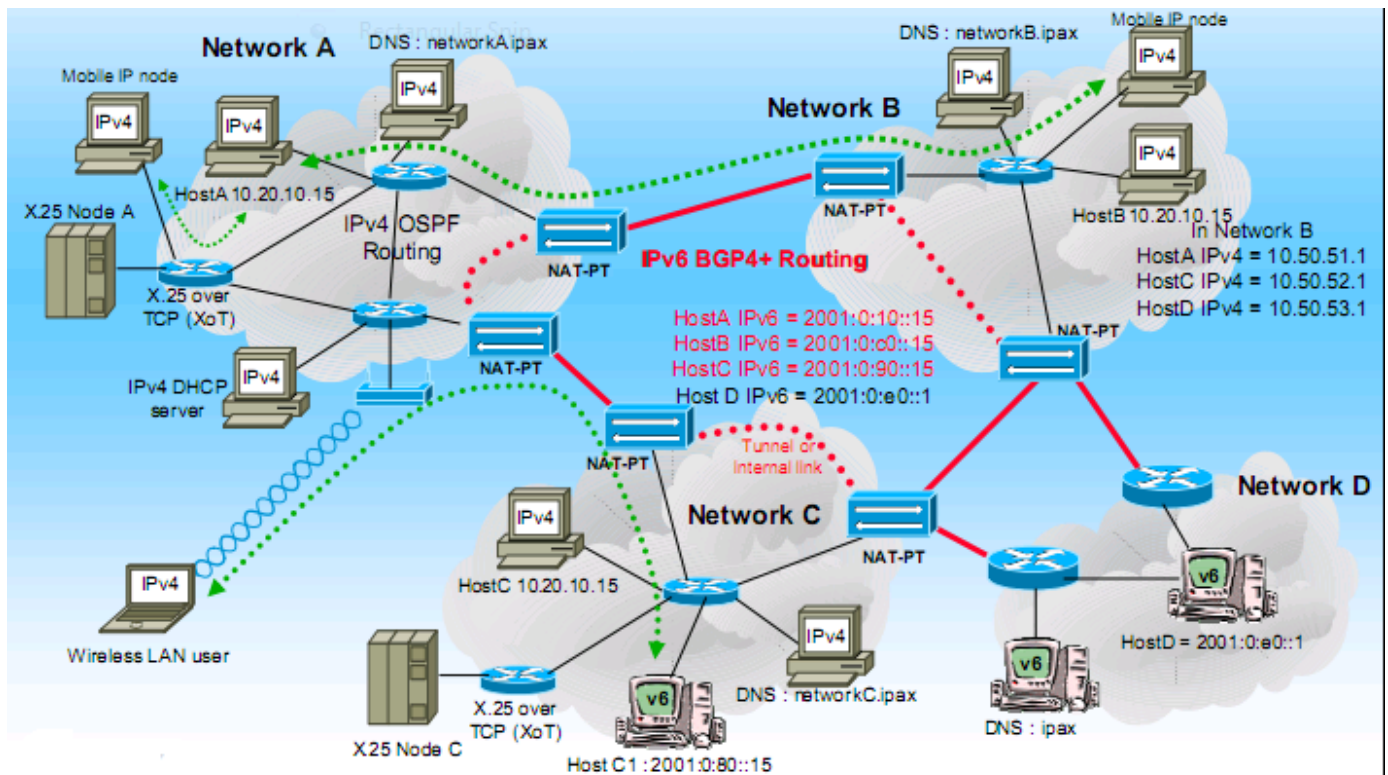
IPv4-compatible address

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 C

No.	State	Network IP Address	Hosts IP addresses					
			Decimal Notation		Binary Notation			
					1 st 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