INTERNATIONAL CIVIL AVIATION ORGANIZATION

SEVENTH MEETING OF THE PERFORMANCE BASED NAVIGATION TASK FORCE (PBN/TF/7)

Bangkok, Thailand, 1 – 3 September 2010

Agenda Item 7: Feasibility of Establishing a regional RAIM Prediction System

TECHNICAL AND OPERATIONAL REQUIREMENTS FOR APAC REGIONAL RAIM PREDICTION SYSTEM

(Presented by Thailand)

SUMMARY

GNSS is considered a main navigation infrastructure supporting PBN operations. It is now also becoming a critical component of surveillance system, such as ADS-B. Unpredicted outage of GNSS services can cause undesired interruptions on aircraft operations. ICAO Annex 10 and ICAO PBN manual require States and ANSPs to provide timely warnings of GNSS RAIM outages. RAIM prediction results are needed daily by pilots, flight dispatchers, air traffic controllers and airspace planners.

This working paper discusses a proposal for technical and operational requirements of a regional RAIM Prediction System. A common, standardized regional RAIM prediction services can prove to be an effective solution that will enhance seamless air traffic operation, while providing cost-effective investment solution.

1. Introduction

1.1 Implementations of PBN and GNSS facilitate more efficient use of airspace and more flexibility for operational procedure. They cooperatively result in enhanced safety, access, capacity, predictability, operational efficiency, fuel economy, and environmental sustainability.

1.2 Implementation of PBN is strongly supported by major aviation stakeholders, including ICAO, IATA, and CANSO. On April 1, 2009, a joint industry declaration in support of PBN implementation was issued calling upon all leaders of the civil aviation community to fully support implementation of PBN into the air navigation system in accordance with the ICAO provisions and established timetable.

1.3 GNSS is considered the main navigation infrastructure supporting PBN operations. GNSS provides highly accurate and high-integrity navigation and positioning services for aircrafts. GNSS also enables on-board monitoring and alerting capability which are required for Required Navigation Performance (RNP) operations.

1.4 Unpredicted outages of GNSS services can cause undesired interruptions on aircraft operations. Safety impacts may become more severe during approach phase of flights especially if pilots are not aware of such outages.

1.5 ICAO APANPIRG at its 20th meeting was reminded that GPS prediction service was a necessary part of GNSS approvals to allow for the fluctuations in service availability. Concern was also raised over possible future GNSS outages due to satellite constellation anomalies and other factors.

1.6 GNSS is presently not only used for navigation but also becoming a critical component of surveillance system, such as ADS-B, plus many aviation applications that depend on accurate timing, for example SSR radar.

2. Requirements for Receiver Autonomous Integrity Monitoring

2.1 Receiver Autonomous Integrity Monitoring (RAIM) provides integrity monitoring of GNSS satellites for aviation applications. RAIM utilizes redundancy of satellite signal measurements combined with aircraft barometric altitude equipments to detect any faulty satellite signal based on satellite geometry and probability analysis.

2.2 ICAO Annex 10 and ICAO PBN manual require States and Air Navigation Service Providers (ANSPs) to provide timely warnings of GNSS RAIM outages. A pre-flight GNSS RAIM prediction analysis is required by the FAA for flights intending to use RNAV/RNP routes and departure and arrival procedures while using GPS as the sole navigation source.

2.3 RAIM prediction results are needed daily by pilots, flight dispatchers, air traffic controllers and airspace planners. The use of appropriate RAIM prediction services is considered as a necessary part of GNSS approvals. Pilots and air traffic controllers need such information to ensure proper flight planning during possible service unavailability.

2.4 RAIM prediction is required for en-route, terminal area, and approach operations. RAIM prediction algorithms for different types of GNSS receivers and avionic configuration are also different.

3. Regional RAIM Prediction Services

3.1 Because RAIM service prediction algorithms use pre-determined satellite orbit and maintenance schedule to assess future outages, one single RAIM prediction system can technically provide a RAIM prediction service for the whole world or an entire region.

3.2 However, it is still within States' responsibilities to provide RAIM outage information to airspace users and aviation stakeholders. All safety-related information provided by a RAIM prediction service will need to be recognized and authorized by State before it can be used.

3.3 With these reasons, it is thus not cost effective for each State to invest on an individual RAIM prediction system. Moreover, various implementations of RAIM prediction services may result in inconsistency of RAIM prediction information provided by various States. This may cause operational problems especially during en-route operation over international airspace.

3.4 A common, regional RAIM prediction service for region such as South-East Asia can prove to be an effective solution. By harmonizing RAIM prediction information among States, the regional RAIM prediction service will **enhance seamless air traffic operation**, while **providing a cost-effective investment solution**. A regional RAIM project will also provide a **forum for States to share their knowledge and experiences**.

3.5 ICAO APANPIRG Decisions 20/38 and 20/39 task the ICAO PBN Task Force to examine the feasibility of establishing a regional RAIM prediction system and invite ICAO to develop guidance materials on establishing common implementation rules and technical standards for GNSS reporting and prediction requirements.

3.6 The 46th DGCA Conference encouraged States to support and place priority on the ICAO Task Forces and work programmes for the Asia-Pacific. Proposals on specific mechanisms, such as a regional RAIM prediction service, could also be looked into.

3.7 The APEC GNSS Implementation Team (GIT), a team established under the Asia-Pacific Economic Cooperation (APEC) Transportation Working Group, during its thirteenth meeting in 2009, has expressed its willingness to work cooperatively with ICAO PBN Task Force to support the establishment of a regional RAIM prediction service. This willingness to support the ICAO regional RAIM activity has been reiterated during the fourteenth meeting for the APEC GIT in June 2010 and has been reaffirmed by the adopted APEC GIT Strategy for 2010-2015 as shown in Attachment 2.

4. Current PBN Manual RAIM Prediction Requirements

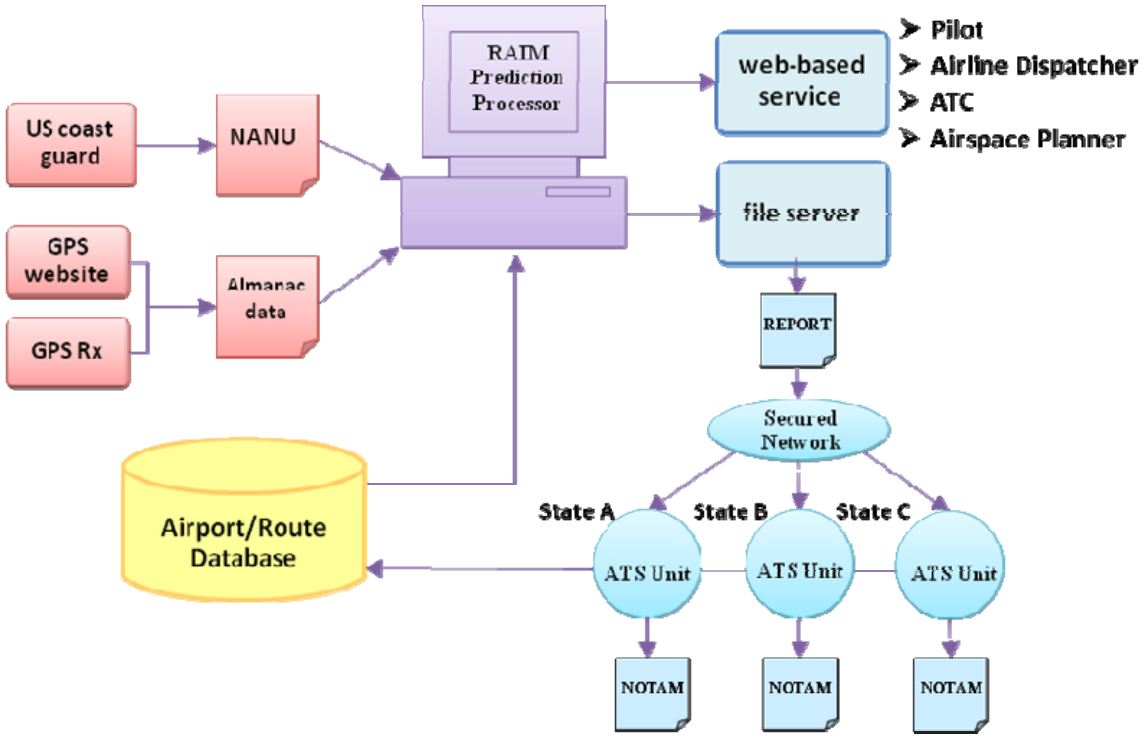
4.1 The PBN Manual contains numerous requirements for various forms of GNSS prediction plus requirements for ANSP providers to 'monitoring the status of GNSS and issue timely warnings of outages'. (Section 1.2.7). For example RNP 10 requires FDE availability prediction program must be used. (Paragraph 1.3.4.2.1.4). For RNAV En-route RAIM levels are required and can be verified either through NOTAMs (where available) or through prediction services. The operating authority may provide specific guidance on how to comply with this requirement (e.g. if sufficient satellites are available, a prediction may not be necessary). Operators should be familiar with the prediction information available for the intended route. (Paragraph 2.3.4.3.1).

4.2 The following factors influence both status monitoring and RAIM prediction and these can differ between aircraft:

- the receiver RAIM algorithms of different receivers;
- the satellites in view can be a different set;
- the receiver mask angle can vary;
- integration with other sensors/aids (DME/DME, baro, inertial) may or may not be available
  to the navigation system.

4.3 The current approvals for the use of GPS as a primary means of oceanic and remote navigation require the operator to have a separate (to the receiver) receiver specific prediction system that takes into account the requirements of the flight.

5. **Possible System Architecture for a Regional RAIM Prediction System**



6. **Minimal Technical and Operational Requirements for a Regional RAIM Prediction System**

6.1 *Basic Common Denominator* - Noting the differences among different RAIM algorithms on-board different aircraft, a regional RAIM prediction system provided by a service provider, such as an ANSP, should provide a "basic common denominator" RAIM prediction service for "basic" GNSS receivers, such TSO-129 (Fault Detection) and TSO-145/146 (Fault Detection and Exclusion).

6.2 *Prediction Period* – A regional RAIM prediction system shall provide prediction for RAIM outage and number of GNSS-satellite availability for a 72 hour period using the latest available GPS NANU.

6.3 *Terminal/Operation Operation*s - A regional RAIM prediction system shall support aircraft operations within the terminal airspace based on RNAV-1, RNP-1 and RNP APCH (with/without Baro-VNAV) navigation specifications. The system shall calculate the predicted RAIM availability for a 72 hour period for specific Aerodromes. The algorithms can be used in Terminal mode addressing the RAIM requirements for GNSS receivers operating in Terminal operations (±1NM) or in Approach mode addressing the RAIM requirements for GNSS receivers operating in Approach operations (±0.3NM). Both the Fault Detection (FD) and Fault Detection and Exclusion (FDE) algorithms shall be provided. The Terminal/Approach Tool shall calculate the predicted RAIM availability at the Aerodrome Reference Point (ARP) for baro (pressure altitude) aided and non-baro aided GNSS user equipment at 1 minute intervals or better.

6.4 *En-route Operations* - A regional RAIM prediction system shall support aircraft en-route operations based on RNAV-10, RNAV-5 and RNP-4 navigation specifications. The system shall calculate the predicted RAIM availability for points along a defined route using either the RAIM algorithm in En-Route mode or the Terminal mode. A route is defined by a series of

waypoints selected, or input, by the user or recorded within a database. Both the Fault Detection (FD) and Fault Detection and Exclusion (FDE) algorithms shall be provided.

7. Actions by the Meeting

7.1 The Meeting is invited to:

a) note the importance and requirements for RAIM prediction services for GNSS and PBN operations;
b) note that Thailand through AEROTHAI is willing to serve as a project coordinator for this important regional activity; and
c) endorse the minimal technical and operational requirements for a regional RAIM prediction service as shown in Section 6 of this Working Paper.

7.2 States are invited to:

a) to work cooperatively with ICAO PBN Task Force and the APEC GIT to establish a regional RAIM prediction service.

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Attachment 1 - Final Report
The 14th Meeting of the APEC GNSS Implementation Team (GIT/14)
21-24 June 2010, Seattle, Washington USA

1. GENERAL

1.1 The 14th Meeting of the Asia Pacific Economic Cooperation (APEC) GNSS Implementation Team (GIT/14) was hosted by the United States at the Marriott Renaissance Hotel from 21- 24 June 2010. The GIT/14 meeting included a Public/Industry Forum in order to incorporate the views of the private sector.

1.2 The meeting was attended by 80 experts from twelve (12) APEC economies (Chile, Peoples Republic of China, Indonesia, Japan, Republic of Korea, Malaysia, Mexico, Chinese Taipei, Peru, Russia, Thailand, and the United States), and one (1) intergovernmental organization (the International Committee on the Global Navigation Satellite System with an official guest status), one participant from the European Commission with an official guest status and one non-governmental organization (The International Federation of Surveyors) with an official guest status. A list of attendees is provided in Appendix A of this report.

1.3 There were 12 economies reports and 17 presentations which were presented under Agenda Item 9 and at the Public/Industry Forum. The working language was English.

2. OPENING OF GIT/14

2.1 Ms. Maureen Walker introduced Ms. Linda Deboldt, City Engineer and Director of Engineering at the Seattle Public Utilities for a brief welcome. Ms. Deboldt expressed appreciation to the delegates for coming to Seattle and expressed the support of the State of Washington for their work to promote GNSS-related activities.

2.2 Ms. Karen Van Dyke, United States Department of Transportation, Research and Innovation Technology Administration and Mr. Noppadol Pringvanich, Engineering Manager, AEROTHAI, opened the GIT/14 meeting, and extended a warm welcome to all participants.

2.3 Ms. Van Dyke welcomed the participants to GIT/14, and reminded them of the successful GNSS Technological Innovation Summit hosted by AEROTHAI in conjunction with the 12th APEC GIT meeting. Noting the success of that Summit and the continuing need to incorporate the views of the private sector into the work of the APEC GIT, the United States is including a public industry forum within the GIT/14. She indicated that all participants have been provided with the draft APEC GIT draft strategy developed at the APEC GIT/13 meeting in Singapore and have been asked to include comments on the strategy in their presentations and comments. This would assist in improving the draft Strategy in the hope that it could be adopted by the end of the APEC GIT/ 14 meeting.

3. AGENDA ITEM 1: ADOPTION OF THE AGENDA

3.1 Mr. Noppodal Pringvanich drew attention of the GIT/14 to the draft agenda and obtained their approval. He noted that Ms. Sharafat Gadimova, from the Secretariat of the International Committee on the Global Navigation Satellite System (ICG), was present at this meeting based on the request of the last meeting to exchange views with the ICG so that APEC could add value to the work underway in that international body.

4. AGENDA ITEM 2: REVIEW OF THE APEC TRANSPORTATION MINISTERIAL STATEMENT, TERMS OF REFERENCE AND DRAFT GIT STRATEGY FOR 2010-2015

4.1 Mr. Pringvanich relayed the outcome of the 6th APEC Transportation Ministerial meeting held at the Philippine International Convention Center in Manila from 27 – 29 April, 2009, as it relates to the topic of GNSS.

4.2 At APEC GIT/13, the participants reviewed the GIT Terms of Reference which includes intermodal transportation applications of GNSS technology. The GIT/13 agreed on the following Terms of Reference to be forwarded to Intermodal Experts Group (IEG) and the APEC Transportation Working Group (TPTWG) for its consideration:

1) **Facilitate Global Navigation Satellite System (GNSS) applications to support seamless intermodal transportation** to enhance safety, security, and sustainability in line with the APEC Transportation Ministerial Directives
2) **Identify actions to facilitate and collaborate on implementations of GNSS applications for transportation in the APEC region**, complementing, but not duplicating, the work of the International Civil Aviation Organization (ICAO), the International Maritime Organization (IMO), and the International Committee on GNSS (ICG)
3) **Provide a public/industry forum** to address GNSS technologies related to transportation issues that will benefit the APEC region (including non-APEC economies and international organizations)

4.3 The draft strategy for the APEC GIT for future action from 2010 – 2015 was available for consideration of the delegates. At GIT/13, the APEC GIT updated its strategy for the adoption of measures to include GNSS technologies in the development of seamless intermodal transportation systems. The strategy was accepted by the GIT/13 as an advanced draft and expected to be finalized at GIT/14.

5. AGENDA ITEM 3: OVERVIEW – INTERMODAL EXPERT GROUP

5.1 Mr. Walter Kulyk, Co-Chair of the Intermodal Experts Group (IEG), was unable to attend the APEC GIT/14 meeting so Ms. Van Dyke provided an update to the meeting from the perspective of the IEG Chair. The IEG Chair wanted to welcome all participants to this event and provide a challenge to the audience to come away from GIT/14 with an enhanced awareness of the importance of GNSS to an effective intermodal transportation system involving all modes, including those involving aviation, highways and transit, freight rail, and maritime.

5.2 The IEG Chair also wanted to encourage the many public and private sector officials in this event to help influence their colleagues and leaders in their respective economies and sectors of industry to effectively use GNSS technology as an aid to help reduce congestion, increase energy efficiency, and enhance safety and livability.

5.3 The IEG Chair wanted to underscore his commitment toward the GIT's goals and his strong encouragement to GIT to continually review its mission and objectives to ensure that it acutely addresses APEC's goals and ultimate aim of economic improvement.

5.4 Finally, the IEG Chair challenged the GIT to develop several strong Project Concept Ideas during its deliberations this week and intersessionally that can be discussed at the next APEC Transportation Working Group meeting later this year in Japan.

6. AGENDA ITEM 4: APEC SECRETARIAT REPORT ON KEY APEC DEVELOPMENTS

6.1 The APEC Secretariat reported on key APEC developments such as APEC 2010 priorities, including implementation of Regional Economic Integration program and development of the APEC Growth Strategy. Key outcomes of the Senior Officials Meeting (SOM) and APEC committees meetings were presented, in particular new ECOTEC Framework and implementation of Supply Chain Connectivity Initiative with particular emphasis to Transportation sector. APEC Secretariat encouraged GIT to adopt Medium Term Strategy for 2010 – 2015 and informed about dates and venues for next TPTWG and Transportation Ministerial meetings.

7. AGENDA ITEM 5: PANEL ON GNSS CONSTELLATIONS

7.1 Ms. Van Dyke noted that at the APEC/GIT 13, interest was expressed in learning more about the developing GNSS systems and about a newly established international body, known as the International Committee on GNSS. At GIT/13. The U.S. agreed to put together a panel of experts from GNSS service providers for APEC/GIT 14. The following experts presented updates on their GNSS constellations.

7.2 Mr. Raymond Clore of the U.S. Department of State, Office of Space and Advanced Technology, served as moderator.

7.3 China - Mr. Zhi Qin, Senior Engineer, Civil Aviation Administration of China (CAAC), presented an update on Compass and Beidou.

Dr. Lu Xiaocun, National Time Service Center, China Academy of Science sent a presentation about the system development status of Compass to the meeting. Unfortunately Dr. Lu did not get her visa on time and was unable to be present at the meeting. Mr. Qin Zhi, Senior engineer of ATMB CAAC, was kindly asked by the meeting arranger to give a condensed presentation at the meeting. This presentation explained the Compass status and steps forward which include the Basic principles, System General Description, System Deployment, Applications, Compatibility and Interoperability, and Conclusion.

Four satellites of the Compass Global Satellite System have been launched already. Two launches occurred in 2010 – one on January17th and one on June 2nd. Compass will provide high quality open services free of charge from direct users, and worldwide use of Compass is encouraged. China will widely and thoroughly communicate with other countries on satellite navigation issues to facilitate the development of GNSS technologies and the industry.

In conclusion, it was highlighted that currently Compass is developing as planned. As an important GNSS, Compass seeks a win-win development with other systems through active cooperation and mutual benefits. Compatibility and Interoperability (C&I) is the development trend of GNSSs, and also a good way for Compass to better serve the world. Compass is willing to achieve C&I with other GNSSs through more communications and coordination.

During the question period, some economies asked clarification because of the name confusion between Compass and Beidou. They are the same system, but referred differently based on

language (English and Chinese). The short message capability was mentioned as one of unique function in Compass. Finally, confirmation of the next launch time was requested.

7.4 Japan: Report from JAXA – Satoshi Kogure, QZSS Project Team/Satellite Applications and Promotions Center.

QZSS is a Japanese regional Space-based PNT System aiming to enhance GPS capability in Asia Oceania region and have a high level interoperability with GPS as well as future international common signals. Proto-Flight test of QZS-1 and end-to-end verification, including ground system have been completed and QZS-1 has been shipped to the launch site. The first satellite (QZS-1) will be launched this summer or early fall.

The "Multi-GNSS demonstration campaign" was proposed in order to promote securing interoperability and compatibility amongst GNSS systems and applications contributing to sustainable regional economic growth. The first regional Workshop was held at Bangkok, Thailand on January 25-26, 2010. Four discussion groups were established for future joint experiments:

1. Multi-GNSS observation network
2. Disaster Mitigation and Management
3. Precise Positioning
4. ITS

JAXA has just started a procurement for multi-GNSS receivers for the multi-GNSS observation network. The second regional workshop plans to be held Nov. 21-22, 2010 in Melbourne, Australia.

7.5 European Union: Report from the European Commission on Galileo, Jean-Yves Roger - European Commission DG for Energy & Transport-EU satellite navigation programmes-International Relations

The Galileo Implementation Plan is to have an Initial Open Service, Search and Rescue Service, and Public Regulated Service with a minimum of 18 satellites in 2014 and to have all services fully available in 2015/2016 with 30 satellites.

It also was presented that the Galileo Open Service Signal-in-Space ICD was released March 31, 2010.

7.6 Russia:. GLONASS Policy and Status Update, Mr. Alexey Korostelev, Director of International Cooperation Department, the Federal Space Agency, the Russian Federation and Dr. Mark Shmulevich, Head of Business Development, Russian Space Systems Corp. provided an update on the GLONASS current status and policy.

At present GLONASS provides 100% coverage of the Russian territory and 98% global coverage. By the end of 2010 with 24 satellites in operation 100% global availability will be reached. Russia guarantees provision of GLONASS civilian navigation services all over the world free of charge. GLONASS performance is improving. The system continues transmitting existing FDMA signals and it will transmit an additional CDMA signal after deploying new GLONASS-K satellites. GNSS compatibility and interoperability is a priority.

7.7 United States: Update on GPS Policy and Constellation Update – Robert Hessin, Deputy Director, National Space-based PNT Coordination Office

The United States continues to provide and remains committed to GPS service globally, as specified by appropriate standards, free of charge. There are 30 operational satellites today, including seven Block IIR-M satellites now offering L2C, the second civil signal. The United States launched the first of 12 Block IIF satellites on May 27th, which will provide improved accuracy and a third civil signal, L5, for aviation safety-of-life application. The U.S. continues to progress toward GPS III, with a prospective first launch in 2014 and promising a fourth, interoperable signal, L1C.

8. AGENDA ITEM 6: PANEL ON STATE OF WASHINGTON APPLICATIONS

8.1 The Co-chairs introduced and moderated a panel on transportation applications in the State of Washington.

8.2 High Precision Network Corrected GNSS and Structural Integrity Monitoring of Dams and Bridges, Gavin Schrock-State of Washington. Mr. Schrock highlighted the ways that the State of Washington set up its Washington National Reference Frame Network, drawing on existing resources and including the end users. University servers also became a key part of the network. The overall project has saved the state millions of dollars.

8.3 State Transportation ITS Initiatives – Smart Plows Highlighted, John Thomson, State of Washington. Management of highway assets and improvement of real time data to road administrators are just a few of the benefits referred to by this speaker. The Washington Reference Frame Network has contributed to savings in the budget.

8.4 Plate Tectonics – Studies in Real Time, Dr. Tim Melbourne, Director, Geodesy Lab, Central Washington University

Dr. Melbourne explained the importance of GNSS to seismic predictive capabilities and the importance of this for transportation.

9. AGENDA ITEM 7: REPORT ON THE 13TH MEETING OF THE APEC GIT

9.1 Mr. Pringvanich summarized that the 13th APEC GIT Meeting, which took place in Singapore in July 2009, began with a review of the APEC Transportation Ministerial in order to align GIT initiatives with that Statement. He updated the group on the Action Items adopted at that meeting. The APEC/GIT 13 meeting noted that:

a) the IEG Chair would continue to coordinate with the GIT Co-Chairs, on an intersessional basis, on outstanding matters such as identification of points of contact from all transport modes with GNSS responsibility within each economy;
b) GIT activity was brought to the attention of all economies and all Expert Group representatives at the plenary meeting since GNSS applications may be relevant to all transportation modes in APEC;
c) the Maritime Experts Group requested a briefing on maritime situational awareness at TPT-WG/31;
d) the 32nd TPT-WG meeting was held on July 2009 in Singapore. A report of GIT activity, including the Summit, was presented to the IEG during the TPT-WG/32.

9.2 The APEC/GIT 13 meeting also noted that:

a) Mr. Noppadol Pringvanich, Engineering Manager from AEROTHAI, Thailand was nominated by Chinese Taipei and seconded by Malaysia, the Philippines and the

Peoples Republic of China. Subsequently, the meeting unanimously elected him as the new GIT Co-Chair.

b) Reports at the GIT/13 were received from Thailand, Republic of Korea, the People's Republic of China, India, Japan, Malaysia, the Philippines, Singapore, Chinese Taipei, Thailand and the United States;

c) The GIT/13 endorsed a proposal to survey and assess current deployment of applications for surface transportation using GNSS and the proposal was circulated for comment during the inter-sessional period where additional co-sponsors were obtained; and

d) The GIT/13 discussed its vision, mission, goal and objectives and amended its terms of reference. A draft Strategy was tabled and discussed and referred to host economies for consideration at a future APEC/GIT 14 meeting.

10. AGENDA ITEM 8: PRESENTATION ON THE NEW PROJECT SUBMISSION AND MANAGEMENT PROCESS

10.1 The APEC Secretariat explained a new project submission and management process, APEC project quality criteria, reporting system, etc. The objective of the new process is to de-link priority & quality by introducing Concept Notes.

11. AGENDA ITEM 9: ECONOMY REPORTS ON INITIATIVES/ACTIVITIES ON GNSS IMPLEMENTATION/COMMENTS ON DRAFT STRATEGY

11.1 Chile

Mr. Jorge Carrasco, Head of the Air Traffic Service Department, Direccion General de Aeronautica Civil in Chile updated the Team on the use of GNSS in Chile. Chile is working on developments by pairing with the user community. This is having a positive impact in Chile, because it is increasing safety and reducing CO_2 emissions and noise abatement.

11.2 People's Republic of China

Mr. Qin Zhi, Senior Engineer from Air Traffic Management Bureau of CAAC, reported on an update of their GNSS activities progress since the last GIT meeting and comments on the draft strategy.

Updated activities on GNSS implementation include Ground Based Augmentation System (GBAS) trials and implementation in China; China Ground-based Regional Integrity Monitoring System (GRIMS); and the RAIM Availability Prediction System for Civil Aviation of China. The status of these projects and consideration of next steps was explained. He also explained that the Civil Aviation Administration of China pays more attention to GNSS implementation activities and tries its best to provide applications of GNSS in accordance with the requirements of ICAO and Asia/Pacific Implementation Planning. At the same time, they are considering development of a long-term strategy for the Future ATM and CNS structure, including the future air navigation strategy in China.

With the publication of CAAC AC-91-FS-2010-01R1 (RNP Terminal and Approach) on Mar. 1, 2010 and the Performance-Based Navigation Implementation Roadmap Version 1.0 in October, 2009, it will enhance the RAIM and PBN capabilities with the plan to consider the Chinese

Compass system as to be one of future satellite constellation choices. A future version of RAIM also can consider use of the Chinese COMPASS/BeiDou navigation satellite system. These projects should get enough validation and verification, and will be enabled to further enhance accuracy, continuity, integrity, availability and functions of GNSS system, in order to satisfy the global civil aviation demands for satellite navigation.

As for the comments on draft strategy, a general view and contact person and some other feedback and comments have been provided such as training needs and educational opportunities, potential cooperation areas, support of ICAO APV, and an education and training program. A suggestion to help each other among the APEC economies has been highlighted here and within APEC economies there should be a mechanisms established. Those economies which currently have a mature-use of GNSS applications should help those economies which have just initiated use of GNSS applications or looking to begin use of GNSS applications. It especially will help them to build up system capability and help them to carry out evaluations and standardization guidance and provide optimum capabilities.

11.3 Indonesia

The Embassy Representative from Indonesia presented a report on behalf of the DGCA of Indonesia. Indonesia has plans to expand Performance-Based Navigation implementation for En-route, Terminal, and Approach operations for a small number of routes and airports.

Enroute
A number of RNAV/RNP airways for en-route are provided for the designated airways by the DGCA. The DGCA has already had plan to expand the area for entire Indonesian airspace.

Terminal

RNAV/RNP use for terminal airspace also will be considered. As the number of aircraft that is equipped with high performance navigation equipment increases, accommodation of such computerized system shall be available for efficient flow of traffic as well as for the safety of operation.

Approach

The PBN-based Instrument Approach Procedures will be designed both for busy major airports, as well as remote airports where navaids are not sufficiently provided (due to geographical conditions) and poor weather conditions are frequent. As far as practicable, the RNAV APCH will be developed to all significant airports by 2016.

In line with the ICAO Regional PBN Implementation Plan, Indonesia was developed the PBN implementation plan, consist of a 3-phased approach; Short Term (2009-2012), Medium Term (2013-2016) and Long Term (beyond 2016).

11.4 Japan

Mr. Michinobu Utsunomiya, Special Assistant to the Director, Office of Aeronautical Satellite Systems, Air Traffic Services, Engineering Division, Air Traffic Services Department, Civil Aviation, Bureau, Ministry of Land, Infrastructure, Transport and Tourism.

MSAS was commissioned on Sep. 27, 2007. MSAS is providing services for ER/RNP and has high availability and continuity by dual PRN system. A prototype CAT-I GBAS has been

developed by Electronic Navigation Research Institute (ENRI) and was successfully delivered from NEC in March 2010.

The prototype CAT-I GBAS will be installed at Kansai International Airport and evaluation tests will begin in 2010.
RAIM & MSAS prediction is conducted by the CNS coordinator in ATMC and RAIM & MSAS NOTAM is issued from AISC to the aircraft operator. There are two kind of prediction. Scheduled predictions are to be daily by 1500UTC which cover 48HR prediction window and special predictions are conducted in case of special circumstances like sudden changes in the status of GPS satellites. JCAB has plans for performance improvement of MSV that is graphical information of the prediction results and distribution by the web as additional information on text NOTAM.

RAIM and RAIM Prediction is conducted by the GNSS coordinator. The coordinator requests NOTAM issuance at AIC.

11.5 Republic of Korea

Dr. Gi-wook Nam, Korea Aerospace Research Institute (KARI) presented current GNSS activities in Korea in the areas of aviation, land transport and land environment.

Aviation - A GBAS Test Bed at Jeju Airport is underway to develop algorithms for improved accuracy and detection of anomalies. A GBAS Implementation Plan and set up the GBAS approval process will be in by 2014. A cost/benefit study of the SBAS system is underway. Korea supports the idea of sharing reference stations. It was mentioned that it was difficult to install ILS due to terrain. In the long term the Republic of Korea hopes to install CAT II/III by 2020.

Land Transport - $10 billion/year is lost to congestion. Many research projects are underway for ITS which requires stringent requirements in terms of accuracy and integrity. Land environment is difficult and Korea cannot meet the requirements with GPS alone. Required technologies include error correction methods and sensors in user equipment. Signal acquisition equipment needs improvement as well. A GNSS Test Bed for Land Transport is going to be built to simulate various GPS signal environments. The master station has been built And this testbed should be completed
next year.

A National Agenda Program is underway. This project will work to solve national issues by developing satellite-based position tracking technology for public safety improvement and disaster management. UAVs will collect information which would be sent through GEOs to a center, where a rescue mission could be sent. Additional work is being done on height monitoring; anti jamming against SBAS; detection of car accidents, tracking of hazardous materials; and tsunami monitoring.

Finally, the Republic of Korea announced that its government’s support to enhance the GIT website.

11.6 Malaysia

Mr. Lim Yong Heng (Wayne), Malaysia Department of Civil Aviation provided a status report of PBN/GNSS Application in Malaysia.

The Government of Malaysia has embarked in technical programs and implemented GNSS infrastructure to ensure the users are fully benefitting from the application of latest satellite

technology. In marine transport sector, a national DGPS system SISPELSAT was installed primarily as a navigational-aid for vessels navigating within the shore of Peninsular Malaysia. In aviation sector, Malaysia has implemented a PBN RNAV /RPN 10 over Bay of Bengal and South China Sea for en-route segment to ensure flight safety over oceanic areas. For RNAV SIDs and STARs together with GNSS RNAV Non Precision Approach (NPA) at KLIA are expected to be fully completed by 2010. GBAS are planned to be installed at major international airports by 2011. In the land navigation sector, GNSS is applied for vehicle tracking, fleet management, and intelligent transportation system. Development of infrastructure in this sector is very much needed. Department of Survey and Mapping Malaysia (JUPEM) is given the responsibility to provide a surveying infrastructure throughout the country via MyRTKnet a real-time survey technology of for the improvement of its many services and dissemination of various geodetic products.

In summary, the country needs to strategize its adoption of GNSS services in order to fully capitalize its benefits. A closer relationship between GNSS users, industries and the Government is needed. A clear directions on GNSS initiatives in the National Space Policy is much necessary.

11.7 Mexico

Mr. Guido Alejandro González Franco, Deputy Director of Reference Frames for the Instituto Nacional Des Estadisica y Geografia in Mexico.

The GNSS reference frame of Mexico and its related activities were presented, including the change of positions in time derived mainly from tectonic plate theory, GNSS center of processing used to identify change of station positions and know station rates, also the geoid model need to transform a GNSS height to a Mean Sea Level Height was shown. In general, the topic related to APEC reference frames, which was a topic discussed in the meeting and was important to planning of transportation systems.

11.8 Peru

Mr. Percy P. Gamboa, CORPAC S.A, presented the initiatives/activities on GNSS in the Peruvian Aviation Sector.

- Using the GNSS for Flight Testing Radio Navigation systems in order to monitor its accuracy.
- Regional SBAS Test-Bed trials and studies were carried out in CAR/SAM region (Caribbean and South America) sponsored by FAA, ICAO and CAR/SAM countries, since 2001 until 2008.
- The first RNP (Required Navigation Performance) Approach (GNSS and Baro-VNAV) procedure was authorized at Cusco Airport in 2008, as a procedure that provides a DA (Decision Altitude) lower than actual IFR (Instrumental Flight Rule) approaches.
- Other 10 RNAV procedures (5 arrivals, 5 take off) are being implemented for 04 Peruvian Airports.
- ADS-B trial was carried out in 2009, sponsored by ICAO and Thales, using an ADS-B station in Lima (Jorge Chavez International Airport), Peru. Results about ADS-B coverage and position validation were presented.

Test bed trials increased participants knowledge about GNSS. The first RNP approach procedure based in GNSS was authorized at Cusco Airport in 2008. The need for better mathematical equations to address the ionosphere was noted.

11.9 Russia

Mr. Alexey Korostelev, Director of International Cooperation Department, the Federal Space Agency, the Russian Federation represented proposals concerning convergence and harmonization of national projects on the utilization of various GNSS applications aimed at improved land transportation safety and security for the benefit of APEC economies.

At present with developing APEC economics, trade and culture relations between nationals are also improving. People are travelling a lot crossing economies borders. There is a need to take care of them, so they will feel secure and safe all over the world.

Some economies have already started to develop national projects to reach these goals. All emergency response systems have the same purposes - to ensure safety and security of transportation, rapid notification, and quick rescue and help. The earlier a person gets the first aid after an accident the more probably he or she will stay alive. Emergency response systems are based on GNSS technology utilization, but not all are identical.

The Russian side proposed to hold workshops to discuss existing national projects in the field of safety on roads such as e-911 in the U.S., e-Call in Europe, and ERA-GLONASS in Russia with exchanging and sharing implementation experience, and identifying possibility of their compatibility and interoperability, developing Minimum Set Data standards, data transfer protocol (format), network operator interface, requirements for data collection centers. The APEC economies could also agree to establish a common notification procedure.

The FIG Representative noted that with regard to cross-border transport, at the Multi-GNSS meeting, UN ESCAP identified trucks being delayed at the border in regional trade was raised in Bangkok. Japan noted that the next meeting on the Multi-GNSS project will be in Australia in November 2010.

11.10 Chinese Taipei

Mr. Jonathan Jin and Dr. James Shau-Shiun Jan presented their implementation status of GNSS projects in Taipei FIR airspace. Mr. Jonathan Jin gave the first part of the presentation which updates their ADS-B implementation in Taipei FIR, and it showed that the benefits gained from the ADS-B implementation including near-100% FIR ADS-B surveillance, supplement/backup to current radar, and data to support ATM Automation Tools. The second part of presentation given by Dr. James Shau-Shiun Jan provided a summary of their GNSS augmentation system development and implementation activities. As indicated in his talk, a GBAS prototype, Integrity Monitor Test bed (IMT), was developed to facilitate the implementation of GBAS in Taipei FIR, and a Wide Area Differential GNSS (WADGNSS) was also implemented to provide SBAS-like service to non-aviation users. Additionally, Chinese Taipei invites all delegates of this APEC GIT/14 meeting to attend the International Symposium of GPS/GNSS 2010 which will be held in Taipei from October 25 to 28, 2010.

Dr. Jaching Chou presented update of GNSS applications in intelligent transportation systems (ITS) and supply chain visibility. First, Dr. Chou gave briefing of GNSS applications of ITS in GIT/12 on the aspects of positioning, navigation, and timing. Then real time bus information can also be also accessed via iPhone. Traffic data can be delivered to drivers using radio data system (RDS) with traffic message channel (TMC) service according their current location. A Telematics trial was also perform in 2009, a system service center communicate with other traffic data providers, such as nation traffic information center, freeway administration, and cities using XML. Information is further processed and transmitted to drivers using WiMax communication to provide location base service (LBS), so point of interest (POI) such as theater, school, restaurant, etc., which were near by, will be displayer. Finally, projects adopting GNSS to improve supply

chain visibility were demonstrated. For air cargo tracking, passive RFID technology together with GNSS, GPRS, and IATA (International Air Transport Association) FSU (freight status updates) message are used to monitor a shipment from TaoYuan airport of Chinese Taipei to Olathe city, Kansas, USA in real time. For container tracking, active RFID technology together with GNSS, WiMax, Zigbee were tested in Port of Keelung.

11.11 Thailand

Mr. Noppadol Pringvanich presented the current progress on the GNSS and Performance Based Navigation (PBN) implementation for aviation in Thailand.

In June 2009, the Thailand National Working Group for PBN & GNSS approved the Thailand PBN Implementation Plan. This Plan aims to provide aviation stakeholders with appropriate guidance and timelines to allow proper preparation and equipage for PBN implementations within Bangkok Flight Information Region (FIR). The Plan is aligned with the Asia/Pacific Regional PBN Implementation Plan developed by ICAO Asia/Pacific PBN Task Force and the 2007 ICAO Assembly Resolutions. It also provides assessments of fleet readiness status and CNS infrastructure, which results in selection of appropriate PBN navigation specifications and implementation strategies for En-route and Terminal Area operations. For short-term implementation, RNAV 10, RNAV 5 and RNP 4 are being considered as appropriate navigation specifications for en-route applications. Moreover, RNAV 1 is considered the appropriate navigation specification for terminal area procedures, such as SIDs and STARs. For approach operations, RNP APCH with Baro-VNAV is the preferred navigation specification.

Regarding actual implementation, since February 2009, the Department of Civil Aviation has approved full operation of RNP Approach Procedures for Phuket International Airport. These procedures enhance safety and efficiency in the approach operation and resolve the offset problems caused by the limitation of installation sites of conventional navigation aids. Moreover, RNP APCH Procedures for Hat Yai and Samui airports have been designed and successfully flight validated by AEROTHAI. RNP APCH Procedures for Hat Yai are scheduled to fully operate in December 2009. These RNP APCH Procedures help enhance the level of safety and efficiency in approach and landing operations to Hat Yai International Airport, especially to Runway 08, of which no instrument approach procedure with conventional navigation aids was feasible. For Samui airports, RNP APCH procedures have been operated since May 2010. They provide safe and flexible flight paths into the airport with limited terrain. Additionally, RNAV 1 SIDs/STARs and RNP approaches are now being developed for Suvarnabhumi, Don Mueang, Chiang Mai and Krabi.

11.12 United States

11.12.1 Ms. Alice Wong provided an overview of FAA's Next Generation of Air Transportation (NextGen) which will make air travel more convenient and dependable, while ensuring that all flights are as safe, secure, and as hassle-free as possible. NextGen is a "system of systems" with integration of new systems, new procedures, new aircraft performance capabilities, renewable fuels, new supporting infrastructure, and reduce aviation's impact on the environment.

NextGen intends to improve air traffic services delivery. NextGen technologies and procedures, along with airspace redesign, have already enabled more direct routes and operation, using less fuel and reducing emissions. NextGen includes new communication, navigation, surveillance and weather technologies with an increased use and reliance on satellite-based navigation and surveillance systems such as Performance-Based Navigation (PBN) operations based on the GPS and Automatic Dependent Surveillance-Broadcast (ADS-B) capability. It also includes digital communications to share aviation data between facilities and stakeholders. It will move toward

more strategic air traffic management of flights and traffic flows from today's tactical control of air traffic movement.

In order for NextGen to be successful, FAA has successfully engaged in harmonization with key strategic partners via bilateral and multilateral work groups. The latest 2010 NextGen Implementation Plan incorporated recommendations from the RTCA Task Force 5 Report with stakeholders/industry's prioritization and enhancement for the transition. The Implementation Plan can be found on http://www.faa.gov/nextgen.

11.12.2 Deb Lawrence of the FAA provided an update of the WAAS services, including the pending loss of a WAAS GEO satellite and efforts to accelerate production of a new geo by October 2010. She noted that expanding networks into southern hemisphere could allow global coverage of land masses and additional constellations allow even greater coverage with fewer stations.
Regarding LAAS, the FAA is working to finalize the CAT I operational implementation at Newark, as well as to finalize CAT III standards for user equipment and avionics, and develop CAT III ground facility prototype, CAT III avionics prototype to validate requirements and interoperability.

11.12.3 Andrew Hansen, Volpe National Transportation Systems Center, provided a description of the FAA operational tool that provides prediction of GPS navigation availability during the flight planning process. This included a description of a web-based graphical GPS RAIM prediction system.

11.12.4 Rudy Persaud, Federal Highway Administration, U.S. Department of Transportation addressed the meeting on Reaching out to Users – Civil GPS Interface Committee – State and Localities Subcommittee.

11.2.5 Tim Klein, U.S. Department of Transportation RITA NDGPS Coordinator/Senior Policy Advisor, provided an overview of the Nationwide Differential GPS (NDGPS) network and a description of applications for surface transportation, public safety, precision agriculture, and severe storm forecasting.

12. AGENDA ITEM 10: VIEW OF INTERNATIONAL ORGANIZATIONS

12.1 Ms. Sharafat Gadimova, Programme Officer, International Committee on GNSS Executive Secretariat, of the UN Office for Outer Space Affairs in Vienna summarized developments in the International Committee on GNSS (ICG) since the 4th meeting which was sponsored by the Russian Federation in St. Petersburg in September of 2009. She provided information on the International GNSS Service which will be hosting the Asia Reference Framework in 2010 in Asia.

Following the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III), held in 1999, the United Nations General Assembly endorsed the "Vienna Declaration: Space Millennium for Human Development." The Vienna Declaration called for action to improve the efficiency and security of transport, search and rescue, geodesy and other activities by promoting the enhancement of, universal access to and compatibility among, space-based navigation and positioning systems. The International Committee on Global Navigation Satellite Systems (ICG) held its first meeting in Vienna in November 2006 to review and discuss matters relating to global navigation satellite systems (GNSS) and their applications. The ICG work plan includes compatibility and interoperability; enhancement of performance of GNSS services; information dissemination and capacity building; interaction with national and regional authorities and relevant international organizations; and coordination. The ICG members cooperate,

as appropriate, on matters of mutual interest related to civil satellite-based positioning, navigation, timing and value-added services.

The United Nations Office for Outer Space Affairs, as the Executive Secretariat of the ICG develops a wide range of activities focusing on capacity building, specifically, in deploying instruments for the international space weather initiative (ISWI), developing a GNSS education curriculum, and utilizing regional reference frames that support sustainable development, particularly in developing nations.

13. AGENDA ITEM 11: DISCUSS POTENTIAL NEW PROPOSALS

The GIT/14 adopted the Strategy for 2010-2015. In addition, the meeting called for four concept papers to be developed the following four economies.

USA Regulatory Roadmap-Draft
JAPAN Multi GNSS Constellation
THAILAND Regional RAIM Prediction system
KOREA SBAS Cooperation Opportunities

In addition, the following action items were agreed to at the meeting:

ACTION ITEM GIT/14-1: Co-chairs to provide welcoming remarks and a description of GIT to the APEC GIT website.

ACTION ITEM GIT/14-2: The United States volunteered under Section 4.1 of the APEC GIT strategy to request biographies from APEC participants to form the core of a directory of experts. The Republic of Korea agreed to place the information, once compiled, on the APEC GIT website.

ACTION ITEM GIT/14-3: A new initiative under Section 4.2 of the APEC GIT strategy was added to support the Multi-GNSS demonstration project.

ACTION ITEM GIT/14-4: The co-chair recommended a new initiative be added to Section 4.2 of the APEC GIT strategy calling for cooperative efforts to share reference station data, with an outstanding question being what data, how to collect it, and how it should be shared.

ACTION ITEM GIT/14-5: The co-chair noted that under Initiative 4.1.3 of the APEC GIT strategy, the United States had just completed a final draft of the 2010 Federal Radionavigation Plan (FRP) and would share this APEC delegations when it is finalized. The 2010 FRP will include operational performance requirements. The 2010 FRP will be distributed to all members and members should communicate intersessionally with the United States or bring comments to the next GIT meeting as input to the 2012 FRP.

ACTION ITEM GIT/14-6: Support the regional RAIM prediction system with ICAO PBN Task Force.

14. AGENDA ITEM 12: NEXT MEETING

The meeting noted the venue and period of past meetings as below:

- GIT/1 in Los Angeles, U.S.A., February 2002
- GIT/2 in Brisbane, Australia, September 2002

- GIT/3 in Kobe, Japan, February 2003
- GIT/4 in Chiang Mai, Thailand, October 2003
- GIT/5 in Taipei, Chinese Taipei, March 2004
- GIT/6 in Phuket, Thailand, October 2004
- GIT/7 in Bali, Indonesia, February 2005
- GIT/8 in Seoul, Korea, October 2005
- GIT/9 in Penang, Malaysia, April 2006
- GIT/10 in Manila, the Philippines, October 2006
- GIT/11 in Tokyo, Japan, June 2007
- GIT/12 in Bangkok, Thailand, May 2008
- GIT/13 in Singapore, July 2009
- GIT/14 in Seattle, USA, June 2010

The Transportation Working Group is planning to meet in Brisbane, Australia in May 2011. The Representative from the FIG noted that while he was not speaking for Australia, the biennual IGNSS meeting also would be held in May 2011 in Brisbane and would be a good venue to hold the GIT/15. He would approach Australia on this point.

The co-chairs encouraged another economy to consider hosting the GIT/16 to facilitate planning by the economies.

15. AGENDA ITEM 13: ADOPTION OF REPORT

15.1 The APEC GIT accepted in general terms the report of its 14th Meeting as shown in this document, however the document would remain open for economies to review and revise.

15.2 The APEC GIT requested the report to be tabled at the Head of Delegation (HOD) Meeting and the closing Plenary Session of TPTWG/33 to be held in Japan.

16. AGENDA ITEM 14: CONCLUDING REMARKS

16.1 Mr. Noppadol Pringvanich, as Co-Chair of the APEC GIT, expressed gratitude to the United States and the State of Washington for a smooth running meeting and warm hospitality extended to the participants. Mr. Pringvanich and Ms. Van Dyke thanked all of the administrative support which had been excellently provided to the meeting and they thanked all the participants for their active involvement in discussions during the meeting.

- END -

Attachment 2 - Asia Pacific Economic Cooperation Global Navigation Satellite System Implementation Team

Responding to the call of Ministers responsible for transportation in the APEC region, who recently met in Manila, the Philippines to continue the progress of work designed to achieve safe, secure and efficient transportation networks as well as realize the primary goals of free and open trade and liberalized investment in the region;

Interested in providing the APEC region with seamless and environmentally friendly transportation systems through innovation and use of advanced technology;

Desiring to reduce congestion, enhance transport safety and security and achieve effective sustainability;

Noting that the Ministers called for the enhancement of seamless interconnectivity of the different modes within the transportation system to ensure safe, secure and efficient movement of people and goods while improving the conservation of natural resources and reducing environmental impacts such as the effects of greenhouse gas emissions; and

Noting that satellite-based position, navigation, and timing services can serve as a critical infrastructure to enhance safety, security, sustainability and efficiency for all modes of transportation;

Emphasizing the belief that the development and implementation of selected integrated technologies are important to the successful management and operation of intermodal transportation, including Intelligent Transportation Systems (ITS) and Global Navigation Satellite Systems (GNSS);

Instructing the Working Groups to include activities addressing the ITS and the GNSS, encouraging international standards development through liaison with the ISO, workforce development training and improved supply chain management processes in an energy and environmentally sustainable way, while building upon the work of relevant regional and international multilateral organizations and minimizing duplication of efforts;

Building upon the GNSS Technological Innovation Summit held in Bangkok in May 2008; and

Drawing upon the revised Terms of Reference adopted at the 13th meeting of the GNSS Implementation Team

We, the APEC GNSS Implementation Team, do hereby adopt the following strategy and action program for the 2010 - 2015 timeframe.

Strategy for the Adoption of Measures to include GNSS Technologies in the development of Seamless Transportation Systems
2010 – 2015

1. Introduction

The leading APEC economies are aware that inefficient and congested traffic systems adversely affect economic development. They are also aware that APEC members can benefit from the exchange of experiences and a more effective collaboration on the application of GNSS technologies to the existing and divided modes of transportation. The APEC GNSS Implementation Team should, therefore work together on developing mechanisms to identify solutions and play a proactive role in highlighting technological advances that can reduce congestion and emissions from outdated transport systems.

2. Existing Regional Policies and Instruments Guiding and Complementing the Strategy

Following the principles established by the APEC in the definition of its actions, this strategy will be based on reinforcing alliances and partnerships and promoting joint actions with existing organizations.

2.1 Local Instruments (within each economy)

The APEC economies count on mechanisms established for application of advanced technology to traffic management. These mechanisms are extremely diverse among different economies, a factor to take permanently into account. The institutional responsibilities of the civil air, road, maritime and rail bodies and institutions are not the same.

The APEC GNSS Implementation Team is identified by this differentiated and complementary character to these mechanisms and establishes adaptability and flexibility as principles of its action.

2.2 Multilateral Organizations

- World Bank
- Inter-American Development Bank
- Asian Development Bank
- United Nations Development Program
- International Committee on Global Navigation Satellite Systems
- International Civil Aviation Organization
- International Maritime Organization
- International Standards Organization
- International Telecommunication Union

2.4. International non-government organizations

- International Association of the Institutes of Navigation
- International Symposium on Certification of GNSS Systems and Services
- International Federation of Surveyors
- International GNSS Service
- International Astronomical Union
- International Association of Geodesy
- World ITS Congress

3. Preliminary Strategic lines

The APEC structure for action is based on the promotion of three strategic lines which define its identity and distinguishes it from other regional initiatives:

- ❖ Technical and Economic Cooperation
- ❖ Trade and Investment Liberalization
- ❖ Trade Facilitation

The main objective focuses on the importance and need of cooperation to apply GNSS solutions through the exchange of information and the scaling up of capacities among APEC member economies.

The revised Terms of Reference for the APEC GNSS Implementation Team call for:

4) **Facilitate Global Navigation Satellite System (GNSS) applications to support seamless intermodal transportation** to enhance safety, security, and sustainability in line with the APEC Transportation Ministerial Directives
5) **Identify actions to facilitate and collaborate on implementations of GNSS applications for transportation in the APEC region**, complementing, but not duplicating, the work of the International Civil Aviation Organization (ICAO), the International Maritime Organization (IMO), and the International Committee on GNSS (ICG)
6) **Provide a public/industry forum** to address GNSS technologies related to transportation issues that will benefit the APEC region (including non-APEC economies and international organizations)

4. Strategic Initiatives

4.1 **Facilitate Global Navigation Satellite System (GNSS) applications to support seamless intermodal transportation**

In order to promote GNSS technologies, the GIT must identify users and providers; identify expert government and non-government actors in the field; use opportunities to advise users of GNSS capabilities; and share information on latest developments.

With this remark, the APEC GIT agrees on the following strategic initiatives:

Initiative 1: Identify GNSS points of contact along with experts from government and non-government organizations within each economy.

Initiative 2: Collaborate with Aviation, Maritime and Land Expert Groups on the applications of GNSS technologies for seamless intermodal transportation system, including the request of Maritime Expert Group to explore the capability of Automatic Identification Systems (AIS) and the benefits for maritime situational awareness.

Initiative 3: Facilitate research and development to identify operational performance requirements (e.g. accuracy, integrity, availability and continuity) for applications in all modes of transport.

Initiative 4: Identify training needs and educational opportunities in the APEC region regarding GNSS technologies for all modes of transportation.

Initiative 5: Enhance the APEC GIT website, hosted by the Republic of Korea, to provide all APEC economies an opportunity to share developments on GNSS activities and share this information to the public to enhance visibility and educational outreach activities.

Initiative 6: Seek APEC funding to host a GNSS booth at future APEC Transportation Ministerial meetings and develop a documentary on the uses of GNSS in APEC economies.

4.2 Identify actions to facilitate and collaborate on implementations of GNSS applications for transportation in the APEC region

In order to identify actions to facilitate GNSS implementation in the APEC region within the framework of a regional approach, the APEC GIT, in line of the APEC Guiding Principle, seek to complement but not duplicate the work of the ICG, ICAO or the IMO.

With this remark, the APEC GIT agrees on the following strategic initiatives:

Initiative 1: Identify potential human capacity building projects regarding GNSS technologies and implementations to enhance technical capabilities of member economies.

Initiative 2: Collaborate with ICG, ICAO and IMO to explore possibilities of supporting their GNSS activities.

Initiative 3: Support International Committee on GNSS Multi-Demonstration Project

Initiative 4: Collaborate with ICAO, IMO and other international organizations to facilitate the establishment of regional RAIM prediction and GNSS signal monitoring service for the APEC region.

Initiative 5: Collaborate with ICAO, IMO and other international organizations to facilitate the establishment of regional augmentation systems capability to support ICAO Assembly Resolution on Approach with Vertical Guidance (APV), and possible expansion of the use of GNSS augmentation systems for all modes of transportation.

Initiative 6: Cooperation of effort to share reference station data.

4.3 Public/Industry Forum

In order to promote GNSS technologies the APEC GIT should provide a public/industry forum to gather all stakeholders' input. This input has been considered a critical component to ensure successful operations and implementations of GNSS.

With this remark, the APEC GIT agrees on the following strategic initiatives:

Initiative 1: Enhance two-way communication channels among government, academics and industry to gather stakeholders' perspective and requirements and best practices for GNSS infrastructure and applications.

Initiative 2: Solicit industry input by developing a questionnaire to submit to the APEC Business Advisory Council to identify applications, users and impediments of GNSS technology in the Asia-Pacific region.

Initiative 3: Follow up to the success of the APEC GNSS Technological Innovation Summit, to seek funding and resources to conduct educational and industrial seminars/conferences on GNSS technologies.

— END —