Special Report

New Business Prospects Created by Qasi-Zenith Satellite Systems
- A summary of interim report by New Satellite Business Study Consortium-

1. About the New Satellite Business Study Consortium

With the rapid advancement of computer and digital communication technologies, so called "IT revolution" has been in progress in a global scale. The IT revolution symbolized by mobile telephones and Internet has been rapidly penetrating not only to industrial, economical and administrative activities but also to individual lives and causing diversified changes to people's life styles.

Particularly the telecommunications in a mobile environment have become a part of daily life. It is conceivable that people's needs toward better utility, comfortableness and economy would be further expanded. Under these circumstances, in order to respond to people's desire for further advancement of information network society with IT technologies, it would be a highly meaningful endeavor to nurture a mobile telecommunication environment of the next generation through the combination of "Quasi-Zenith Satellite(QZS)" systems and terrestrial networks where the QZS systems possess features such as simultaneousness, wide coverage and robustness against disaster.

Based on the above concept, representatives from six organizations got together and created a consortium named "New Satellite Business Study Consortium" with the participation of more than twenty organizations encompassing a wide range of private and government entities such as R&D institutions, users, service providers, system manufacturers, and a think tank. Mr. Yasuo Otaki, president of Telecomm Engineering Center, was elected as chairman of the consortium.

The consortium had its general meeting in January 23, March 15 and April 10 and

the interim report was authorized.

Three working groups, namely Business Model Study WG, Technology Study WG and Orbit and Frequency Study WG were created within the consortium for the specialized studies.

2. Summary of the interim report

2.1 Investigation of needs and applications

(1) Rationale for introducing Quasi-Zenith Satellite(QZS) systems

First of all, a comparison between QZS and other telecomm. infrastructures were made as shown in Fig.1. At year 2005 to 2006, both mobile and fixed communication infrastructures would be fully deployed within residential areas. However, the infrastructure covering the area outside of residential area ,particularly roads, will remain to be deployed beyond 2006. And it would be possible for the QZS systems to realize the infrastructure that covers mountainous area with less cost than the other systems.(refer Fig.1)

Fig. 1 Comparison of infrastructure construction costs

(2) Flow of business model study

In the business model working group, the study was proceeded in such a way that the working group keeps its cooperation with other two working groups and feeds back the information to the working group in order to improve the precision of the study.

(1)Extraction of potential applications

(2)Consideration of business model

(3)Demand analysis of QZS systems

(4)Evaluation of business viability of QZS systems

In this study the following merits of the QZS systems were identified;

- **Since a satellite in the QZS constellation is seen at almost zenith, the communication links using QZS would suffer much less interruption than those using Geo Synchronous Satellites and thus provide better services for mobile users in bi-directional communication, broadcasting and positioning .**
- **Since the QZS systems can establish communication links as long as the sky is open in the zenith direction, it should become attractive to the potential service providers aiming for a wide variety of mobile terminals such as on board terminals and PDA's.**

(3) Extraction of applications

Potential applications were extracted and classified into three categories: "applications that can make full use of QZS strength", " applications that can possibly make use of QZS systems" and " applications that are viable only if they can piggyback the QZS system deployed for other primary applications". Table 1 summarizes potential applications in theses three categories.

Table 1 Application list

	Utilize full strength of QZS	Possibly utilize QZS strength	Piggyback applications
(1)Telematics	Info. service to automobile Theft notification Remote diagnosis Probe-car system	Map delivery	
(2)Rear seat applications	Music delivery Original broadcasting Re-transmission of terrestrial broadcasting		
(3)PDA applications	Position notification Emergency notification Re-transmission of terrestrial broadcasting	Info. service to PDA Map delivery Music delivery	
(4)Applications for air planes and ships		Info. service to small boats Emergency notification	Airplane Internet On line - shopping,

		Pound net sensor **Life save boat com link**	**banking**
(5)Business applications	**Path indication** **Emergency warning** **Container management** **Automobile remote maint.** **Land survey**	**Shipping instruction** **Management of outside equipments** **Power line check**	
(6)Positioning applications	**GPS augmentation data**	**GIS related systems**	
(7)Public applications	**Traffic info. delivery** **Disaster warning** **Regulation info. delivery** **Wild animal tracing** **Emergency notification** **Remote medicine** **Com. link to helicopter in mountain area** **Info. delivery to mobile workers:** **- public security, national security, road control, disaster and emergency control, maritime security com.**	**Data delivery to electric bulletin board** **Traffic flow control based on parking meter data** **Instantaneous shut off of infrastructure during a big earth quake** **Volcano monitoring** **Remote monitoring of infrastructure** **Environment monitor-air pollution** **Aquisition and delivery of weather info.**	**Remote control of unmanned airship** **Monitoring of river level**

Note)"Karaoke", distant learning, Internet, weather information service and road information service are counted as a part of the content for "original broadcasting"

(4) Estimation of demand for QZS systems and required communication capacity

Based on the list of potential applications shown in the previous section, their business models were made and their demand and required communication capacity were estimated. Here satellite life is assumed to be 12years. The following user volume was estimated based on the data from Nomura Research Institute. Numbers within parenthesis indicate the volume of end users at 12th year.

- **Automobile driver (10.24M) (12.4% of total number of vehicle in Japan)**
- **PDA user (0.89M)(10% of mobile Internet users)**
- **Small boat (0.48M)**
- **Corporate mobile worker (0.96M)**

・ **Public mobile worker (0.385M)**

Fig. 2 depicts an example of information providing service

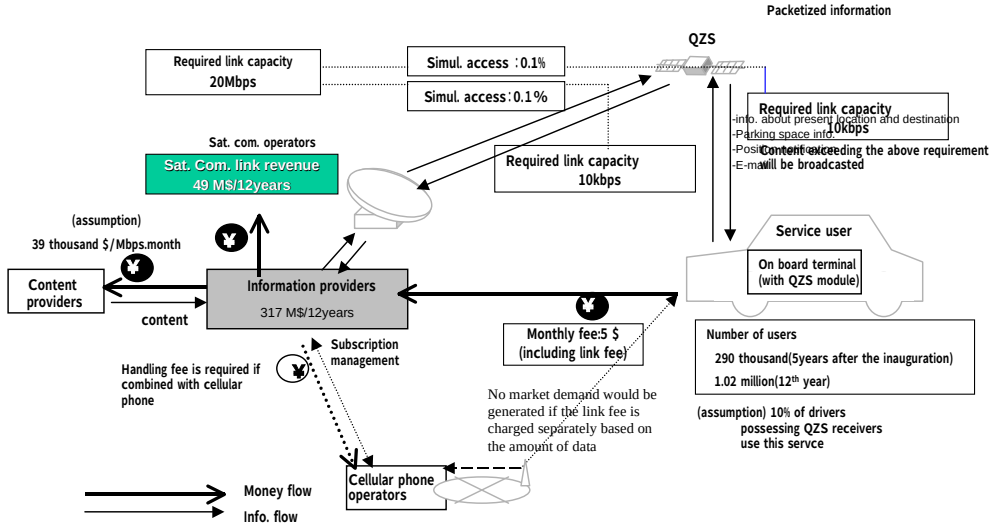


Fig. 2 Business model example(information providing service for automobiles)

(5) Sales earned by satellite communication operators and domestic service operators

It was estimated that the sales earned by satellite communication operators would be 1.449 billion $(1$=100yen) for the 12year span. Among this, sales from private sector is 687 million$, public sector sales is 573 million$ and oversea sales would be 202 million$.

It was assumed that the oversea market would follow the domestic market with 6 year delay.

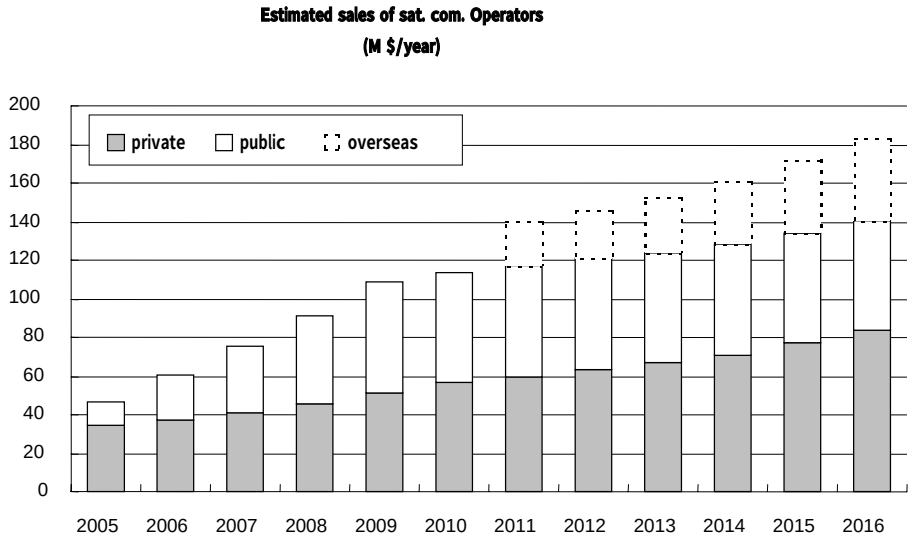


Fig. 3 Estimated sales of satellite communication operators

It was estimated that the total sales of services provided to private sectors would amount to 4.746 billion $ for the 12 year span.

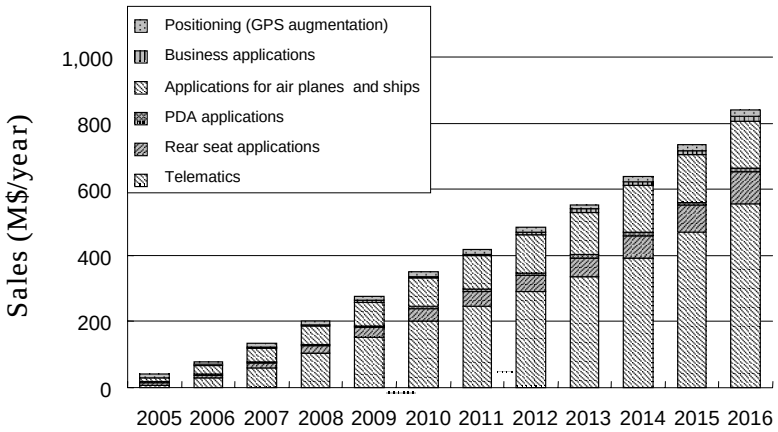


Fig.4 Sales of domestic service providers

(6) Required communication capacity

Communication capacity required to achieve all the applications considered would be approximately 301Mbps at the 12th year of the service. And this should be a realizable number.

(7) Effect on new market and employment creation

It was estimated that the QZS systems would create 17billion $ of new market for the first 5 years of service while it would be 61billion $ for 12 year span. And the new employment associated with these market would be 12 thousand jobs for the first 5 years and 18 thousand jobs for the 12 year span. (see Fig. 5)

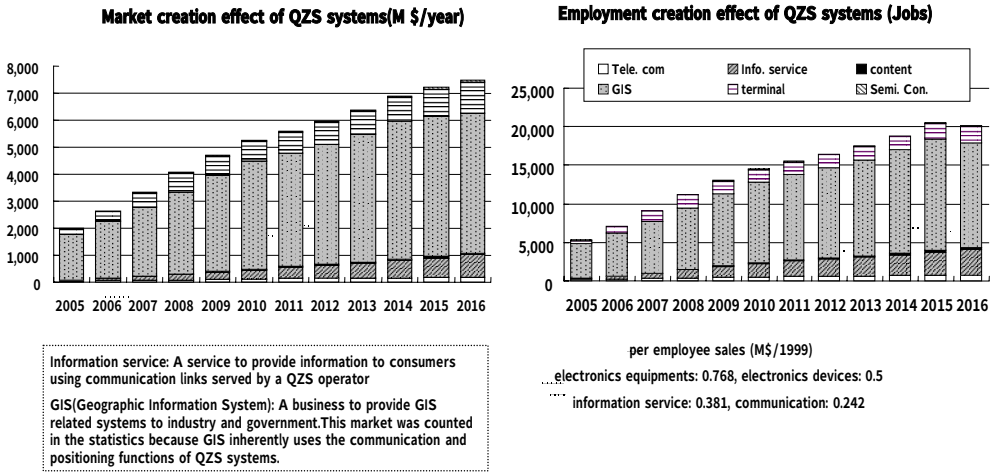


Fig. 5 New market and employment creation effects

Although the potential services and associated numbers might be subject to modification according to the further studies, it can be said that the prospect of business viability using QZS systems have been obtained.

2.2 Study and identification of issues on space communication systems

(1) Technical issues and the need for space verification experiments

Although the benefit of high elevation angle satellite communication made possible by QZS systems have been well recognized, it is most necessary to develop technologies to enable this system such as satellite positioning and orbit control and to make certain its reliability through the careful verification processes. In the

followings, conceivable technical issues are addressed.

(2) Identification of technical issues

(1) Total system

Technical issues derived from business considerations; this will include cooperation with US GPS, seamless connection with terrestrial systems and redundant system structure.

(2)Communication networks

Technical issues needed to properly control the satellite link and this will include; communication protocol that can handle a vast number of users, communication method to ensure the security and satellite handover scheme.

(3)User earth stations

Development of user terminals with compact, low cost and high utility characteristics.

(4)Satellite systems (mission systems)

Technology to control antenna radiation pattern for QZS systems.

Development of multi beam antenna.

(5)Satellite systems(bus systems)

Technical issues derived from the orbit characteristics of QZS and they include; control technology for high power, orbit control, attitude control and thermal control.

(6)Others

On orbit verification of applications

On orbit verification of positioning system using QZS

Selection of proper orbit parameters that would contribute to the efficient use of frequency resource, beam allocations, reduction of interference and proper selection of frequency bands.

2.3 Identification of issues on legal and international coordination aspects

(1) Overall view of international cooperation on orbit and frequency resource

It is well known that radio systems, particularly satellite communication systems, inherently reach its energy beyond international borders and thus the spectrum as well as satellite orbits are world's limited resources. In order to facilitate the equitable and efficient use of these resources an international organization named ITU(International Telecommunication Union) has been in operation.

Under ITU whole spectrum is regulated regarding allocated countries, type of services, sharing criteria between different systems and coordination procedures.

The regulations are subject to review and modifications and this can be only

possible at the World Radiocommunication Conference(WRC) which is held every two to three years.

(2) Current situation of radio regulations regarding QZS systems and actions towards WRC03

The orbit/frequency study working group has investigated the current situation of frequency band between 1GHz to 30GHz in terms of frequency allocation, services and sharing criteria. Although QZS is classified as non-GSO satellite a study is under way in trying to come up with a way to reflect the properties of QZS into the regulations.

Currently non-GSO satellites can be coordinated with GSO satellites in Ku and part of Ka band provided that non-GSO satellites keep the epfd(effective power flux density) limit as well as applying RR22.2. Where RR22.2 states that non-GSO satellite systems shall not cause unacceptable interference to GSO systems in the FSS and BSS service operating in accordance with these Regulations. However, considering the fact that epfd was originally developed for LEO(Low Earth Orbit) or MEO(Medium Earth Orbit) constellations where a large number of satellites cover global service areas, thorough discussions would be necessary on the appropriateness of applying the same criterion to the QZS systems where distinct differences exist in certain aspects. These differences include the fact that the separation angle between QZS and GSO systems becomes considerably large as compared with GSO and GSO cases. Also these discussions are expected to lead to less stringent constraints for the use of QZS systems.

Any efforts regarding the regulations should be made in close cooperation with the government and the immediate target was set for WRC03 in June 2003

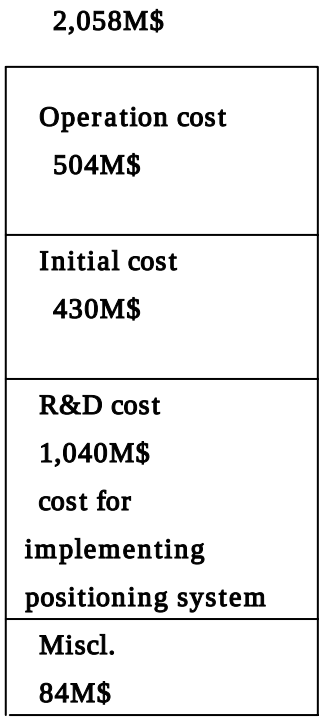
(3) Method of frequency and orbit selection

The orbit and frequency study working group has already summarized the current regulatory situation regarding the use of QZS systems in all frequency bands. For selecting the specific frequency bands and orbit parameters it was recognized that the study must be done interactively among three areas, namely (1)feasibility on regulatory matters, (2)technical feasibility and (3)business viability. And therefore the study has been carried out in keeping close cooperation with other two working groups, business model study WG and Technology study WG.

2.4 Evaluation of business viability for QZS systems

(1) Cost of implementing the QZS system

It was estimated that the total cost for realizing the QZS system would be 2.058billion $(1$=100¥) over the 12 year span. Fig.6 shows the rough break up of the cost.



Initial cost : 430M$
Ground systems : 300M$
Spare satellite(on the ground) : 130M$
Operation cost : 504M$
Satellite operation : 252M$
Ground system maintenance : 252M$
R&D cost : 1,040M$
Satellite system, payload, rocket : 940M$
Public system development : 100M$
Miscellaneous : 84M$
Public system maintenance : 84M$

Fig. 6 Total cost for QZS system

(2) Evaluation of business viability

Calculations using data available so far indicated that the single year break even could be achieved in four years after the service inauguration and all time break even in six years. It was also shown that 481M$ all time profit could be achieved in 12 years (301M$ for domestic market only).

2.5 Considerations on cooperation among industry, government and academia

(1) Necessity of government-industry cooperation towards the viable business

While applications possible only by QZS systems possess market creating effect and social benefits, large amount of initial investment, R&D cost and the cost associated with the realization of positioning capability would cause heavy burden to the private sectors. Therefore it becomes necessary for both private and government to work cooperatively in R&D and operation aspects. The estimated volume of GIS market is ;

Market creation effect : 46billion $/12 years

Employment generating effect : 14,000 jobs at 12th year

Furthermore, a communication/broadcasting infrastructure capable of covering almost 100% of roads is quite suitable for an emergency communication

infrastructure and thus provide the social incentive for its introduction. The benefit derived from this system would be equivalent to 2.5billion $.

2.6 Where the international cooperation should be heading to and its specific plans

An effort needs to be put in order to establish international cooperation between countries situated above 30 olatitude such as Korea, China, Australia and New Zealand in which the QZS systems can provide distinctive advantage. For those countries, it was estimated that 12 billion $ of new market and 140 thousand jobs would be created for a period of five years starting from 2011. This estimation is based on the assumption that oversea market will start to catch up six years after the inauguration of the domestic service in 2005.

3. Summary

The study consortium will continue its work for deepening the studies and plans to finalize the report by the end of June. Also an effort to gain support and cooperation from relevant organizations in Japan is underway so that a concerted effort by private and government sectors can be possible. Particularly, the consortium is working closely with organizations such as Keidanren(the Japanese Federation of Economical Organizations) and SJAC(Society of Japanese Aerospace Companies).

It is our hope that activities on QZS systems could contribute to the vitalization of Japanese industries by providing new employments and markets.

Secretariat, New Satellite Business Study Consortium

Author: New Satellite Business Study Consortium

New Satellite Business Study Consortium is a voluntary group consists of major Japanese companies and governmental institutions in the areas of telecommunications and broadcasting as well as application services and users. The consortium was inaugurated in January 2002, and its primary objective is to carry out the comprehensive studies on communication infrastructure using a class of satellite constellation known as Quasi-Zenith Satellite(QZS) systems. The consortium was founded based on a belief that the high elevation angle property of QZS would greatly contribute to today's highly advanced IT society through its suitability to mobile use environment and potential for the efficient use of frequency and orbit resource.