Survey Report on Infrastructure Sharing and Broadband Development in APEC Region

Workshop on Infrastructure Sharing to Foster Broadband Access

APEC Telecommunications and Information Working Group

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Prepared by
Mr. Zhang Yanbin,
Director of New Technology and New Service department,
Telecommunication Science & Technology Information Institute of MIIT,
40 Xue Yuan Road, Beijing China ,100191
Tel: 86-10-62304014,
E-mail：Zhangyb@cci.cn.net

Ms. Shi Lin,
New Technology and New Service department,
Telecommunication Science & Technology Information Institute of MIIT,
40 Xue Yuan Road, Beijing China ,100191
Tel: 86-10-62304014
E-mail：Shil@cci.cn.net.

Ms. Li Shan.
New Technology and New Service department,
Telecommunication Science & Technology Information Institute of MIIT,
40 Xue Yuan Road, Beijing China ,100191
Tel: 86-10-62304125,
E-mail：Lis@cci.cn.net.

Mr. Wang Feng.
New Technology and New Service department,
Telecommunication Science & Technology Information Institute of MIIT,
40 Xue Yuan Road, Beijing China,100191
Tel: 86-10-62304014,
E-mail：Wangf@cci.cn.net.

Produced for
Asia Pacific Economic Cooperation Secretariat
35 Heng Mui Keng Terrace Singapore 119616
Tel: (65) 68919 600 Fax: (65) 68919 690 Email: info@apec.org
Website: www.apec.org

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1. Executive summary

1.1 Background

The survey directly responds to Leaders and Ministers' calls for accelerating regional economic integration in the area of telecommunications services, using information networks and realizing inclusive, innovative and sustainable growth in APEC region.

At the 17th APEC Economic Leaders' meeting in 2009, it was reaffirmed to take ongoing efforts towards using ICT to address socio-economic issues and realizing APEC's goal of achieving universal access to broadband in all member economies by 2015. In the Bangkok Declaration of APEC TELMIN7, it was stated that "ensuring universally accessible ICT infrastructure and services to bridge the digital divide is crucial to our future social and economic prosperity." and "to achieve our common goals, we encouraged intensified efforts to support effective universal service strategies that are appropriate to each economy. These efforts include innovative policies, regulatory frameworks and programs to meet the needs of unserved or underserved communities using ICT in a sustainable manner."

Infrastructure sharing is an effective way to lower the cost of deploying networks to achieve widespread and affordable access to broadband. Considering the diversity and uneven broadband development level in APEC member economies, infrastructure sharing can play an important role by promoting competition, reducing the cost of operators and extending the coverage areas of broadband access especially in developing economies. Furthermore, infrastructure sharing plays an essential role in facilitating environmental protection, reducing resource consumptions, increasing efficiency and achieving sustainable growth.

The workshop on infrastructure sharing to foster broadband access was proposed in TEL41 by China and approved by DSG&LSG and TEL. The sponsoring economies included Canada; China; Hong Kong, China; Malaysia; Philippines; Singapore; Chinese Taipei; and Viet Nam.

Through this workshop, policy makers, regulators, private sector stakeholders and academia both from developed economies and developing economies had an opportunity to share their experiences and explore possible solutions and opportunities for cooperation with regard to infrastructure sharing.

This survey report is one part of the project of Workshop on Infrastructure Sharing to Foster Broadband Access.

1.2 Objectives

The main objectives of this survey are as follows:

1. Investigation of status quo and features of regulatory policies on infrastructure sharing in each economy;
2. Investigation of actual development status quo and features of infrastructure sharing in each economy;
3. Investigation of technical difficulties of infrastructure sharing in each economy;
4. Investigation of each economy's benefit assessment of infrastructure sharing implementation;
5. Sharing of experiences in infrastructure sharing among all economies.

1.3 Methods

- Carry out a compilation of available information and studies on infrastructure sharing and broadband access in APEC region;
- By the study on the information and studies on infrastructure sharing, develop a questionnaire to gather necessary information from APEC member economies on infrastructure sharing and broadband access;
- Deliver the questionnaire to member economies;
- Collect and analyze the feedbacks of the questionnaire from member economies;
- In coordination with Project Overseer, participate in the workshop to report on the survey undertaken and the key findings;
- Submit a survey report to TEL, provide an electronic copy to the APEC Secretariat, and identify other channels for dissemination of report.

1.4 Glossary

Infrastructure sharing: Infrastructure sharing refers to sharing of all or part of elements of telecom networks among operators. Such elements may include ducts, trenches, towers, pole lines, equipment rooms and related power supplies, and also ONU, access node switches, spectrum, etc. - ITU, <Trends in Telecommunication Reform>, 2008.

Active infrastructure sharing: involves sharing the active electronic network elements – the intelligent part in the network – embodied in base stations and other equipment for mobile networks as well as access node switches and management systems for fiber networks;

Passive infrastructure sharing: allows operators to share the non-electronic elements and civil engineering elements of telecom networks;

New-building mode: telecom operators jointly building a new network;

Join mode: new operator sharing the existing carrier's networks;

Integration mode: merging the networks of existing operators and sharing them;

1.5 Execution of the survey

Establishment of the Project Study Team: According to the requirements for the project implementation plan in the Project Proposal and with a view to improving the achievement and effectiveness of this survey, the project undertaker established a project implementation team comprising professional researchers and a special management team for supervision of the project implementation.

Devising of questionnaire: The Project Team completed the Infrastructure Sharing Questionnaire in APEC Region according to the collected information on development of the broadband market and network infrastructure sharing in the APEC region as previous study achievements.

Distribution of questionnaires: The Project Study Team sought comments of the Project Supervision Team (PST) on the questionnaire, finalized it after revision according to the PST's feedback and distributed the final questionnaire to all APEC economies.

Feedback of completed questionnaires: By the end of April 2011, 10 economies submitted 11 questionnaire feedbacks which included 2 from Thailand NTBC and TOT. Participating economies accounted for 48% of all APEC economies. They are Australia; Brunei; Canada;

China; Hong Kong, China; Japan; Singapore; Chinese Taipei; Thailand; Viet Nam.

Participating in the workshop: The Project Study Team made a preliminary analysis and conclusion of the feedback information by the completed questionnaires from 10 economies, sorted out the essentials in the survey and made a presentation in the workshop about the network infrastructure sharing in the 43rd APEC TEL conference.

Completing the survey report: the Project Study Team completed the final survey report after making an analysis and conclusion of the feedback information by the completed questionnaires from 10 economies.

2. Regulatory Policies on Infrastructure Sharing in APEC Region

2.1 Regulatory Body

According to the feedback of the survey, all the 10 economies investigated have regulators to supervise various sharing behaviors of network infrastructure. The specific regulators are as shown in the following table.

Table 1 Regulatory Body for Infrastructure Sharing in Some APEC Economies

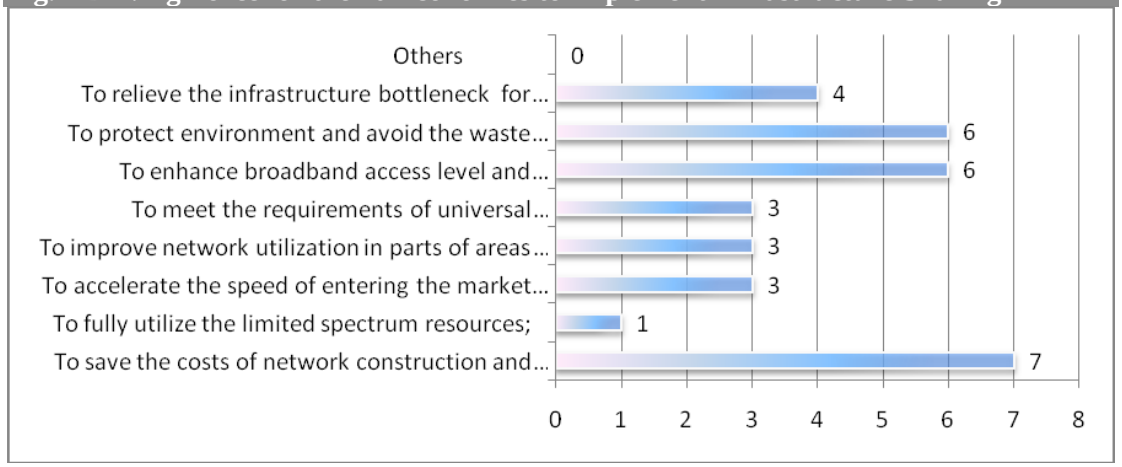
Economy	Regulatory Body
Australia	Australian Competition and Consumer Commission
Brunei	Authority for Info-communications Technology Industry of Brunei Darussalam (AITI)
Canada	Canadian Radio-television and Telecommunications Commission (CRTC) and Industry Canada
China	Ministry of Industry and Information Technology of the People Republic of China (MIIT)
Hong Kong, China	Office of the Telecommunications Authority (OFTA)
Japan	Ministry of Internal Affairs and Communications
Singapore	Infocomm Development Authority of Singapore (IDA)
Chinese Taipei	Technologies Administration Department for Infrastructure Sharing and Planning Department for LLU of NCC
Thailand	The National Broadcasting and Telecommunication Commission (NBTC)
Viet Nam	Ministry of Information and Communications

2.1.1 Driving force for infrastructure sharing

According to the survey, “To save the costs of network construction and maintenance” became a leading driving force for infrastructure sharing as stated in the completed questionnaires from seven economies. For instance, it is specifically pointed out in the Promotion of Telecom Infrastructure Sharing, a regulatory document by the Chinese regulator that “MIIT have decided to vigorously promote the sharing of the telecom network infrastructure in response to actual conditions of the telecom restructuring and a new round of upcoming network construction with a view to further implementing the Scientific Outlook on Development and the requirements for construction of a resource saving and environment friendly society, reducing the consumption of land, energy and raw materials, protecting the

natural environment and landscape, reducing the telecom reconstruction and improving the utilization rate of the telecom network facilities".

Fig. 1 Driving Force for the 10 Economies to Implement Infrastructure Sharing



In addition, "To protect environment and avoid the waste of resources" and "To enhance broadband access level and reduce the digital divide" were also considered main driving forces for infrastructure sharing. This was consistent with the ambitious broadband development goal proposed at the ministerial conference of the telecom and information technology of APEC forum in 2010, namely, "by 2010, APEC will realize the coverage of the broadband network in all parts of APEC region and will conduct cooperation in the fields of education, medical care, environmental protection, disaster treatment, etc. so as to enhance the effects of the information technology and communications technology." It is thus clear that infrastructure sharing was considered an important means to improve broadband access level and narrow digital divide in each economy.

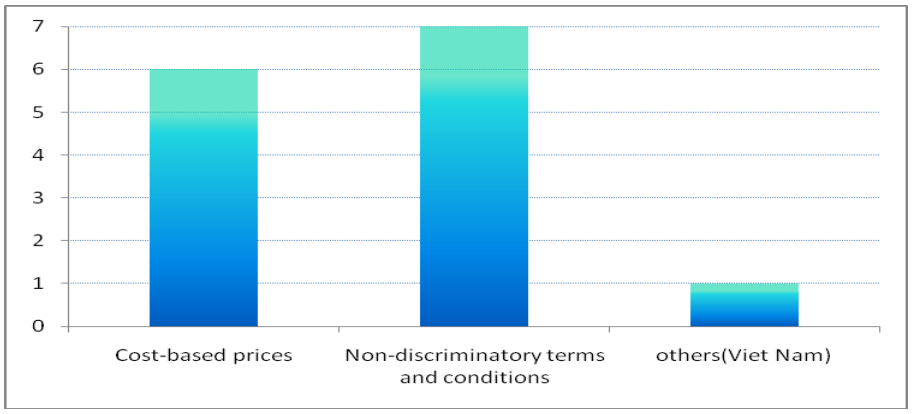
Moreover, some economies consider that infrastructure sharing was an important means to "relieve infrastructure bottleneck for new entrants' access". For instance, Singapore highlighted that infrastructure sharing is important in helping to facilitate the entry of new service providers by ensuring access to bottleneck or essential facilities. Viet Nam had mentioned that the essential facilities mean facilities of a public telecommunications transport network or service that are exclusively or predominantly provided by a single or limited number of suppliers, and cannot feasibly be economically or technically substituted in order to provide a service.

2.1.2 Principles and conditions for formulation of regulatory policies

As the network infrastructure may lead to the reduction of the telecom operator's network construction costs and can also relieve the new entrants of discrimination due to the infrastructure bottle, we carried out a survey into the principles and conditions of each economy's regulator in formulating regulatory policies.

According to the feedbacks, there are five economies choose "Cost-based prices" and "Non-discriminatory terms and conditions", which are Australia; China; Singapore; Chinese Taipei; Viet Nam. So, the survey result is six feedbacks selected the option of the "Cost-based prices", while seven feedbacks selected the option of the "Non-discriminatory terms and conditions". Both have become the main principles and conditions considered by regulators in formulating policies on the infrastructure sharing. Especially, Viet Nam had taken into account the "technical conditions to provide services" in formulating regulatory policies.

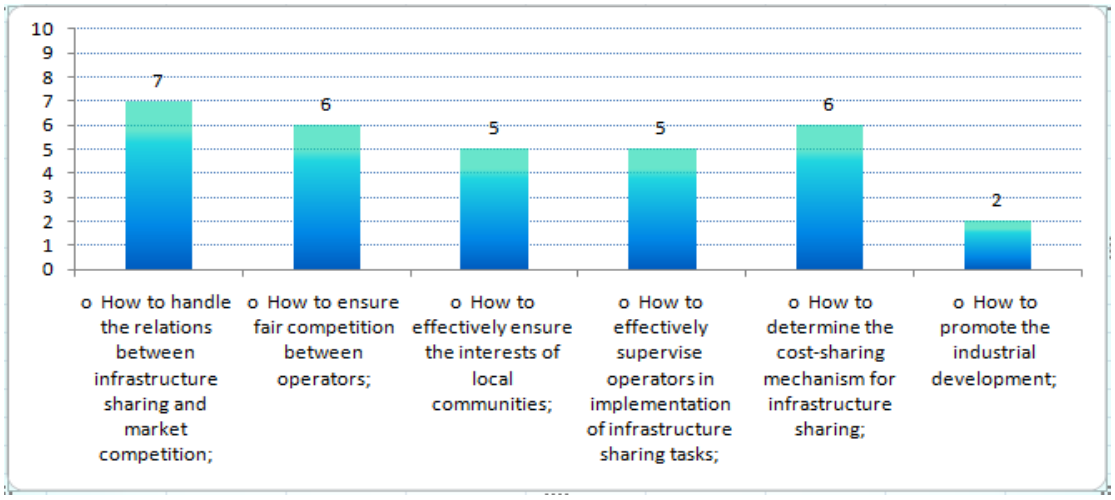
Fig. 3 Principles and Conditions of Each Economy's Regulator in Formulating Regulatory Policies



2.1.3 Challenge in formulating policies on the infrastructure sharing

According to the completed questionnaires, "How to handle the relations between the infrastructure sharing and market competition" is the major challenge for the regulator when formulating policies on the infrastructure sharing.

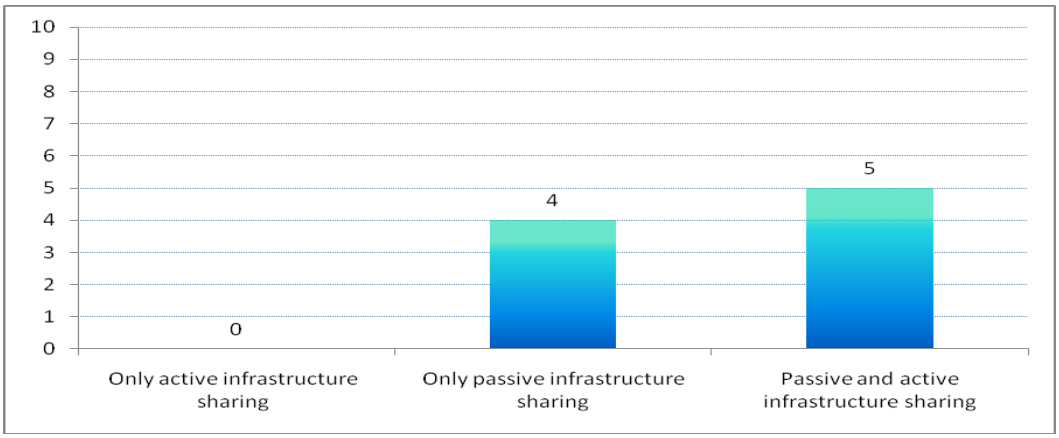
Fig.4 Challenge in Formulating Policies on the infrastructure sharing



2.1.4 Sharing items stipulated in regulatory policies

According to the report of "Six Degrees of Sharing", ITU, 2008, the infrastructure sharing can be categorized into active facility sharing and passive facility sharing. In this regard, we carried out a survey into the policies of each economy on "active infrastructure sharing" and "passive infrastructure sharing". According to the survey, four completed questionnaires showed that regulatory policies were formulated "only on passive infrastructure sharing" while five completed questionnaires showed that regulatory policies were formulated on both "active infrastructure sharing and passive infrastructure sharing". On the whole, nine completed questionnaires (except Japan not answer this question) showed that their regulators imposed regulatory policies on "the passive infrastructure sharing". As a result, the regulator of each investigated economy focused on "the passive infrastructure sharing".

Fig. 5 Regulatory items of Each Economy's Regulator on Infrastructure Sharing

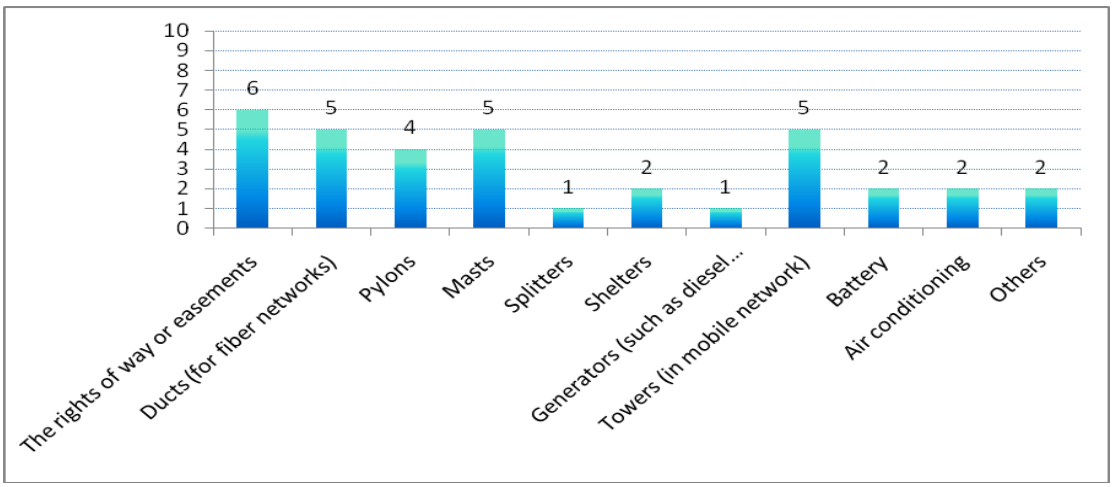


2.1.5 Regulatory policies on passive infrastructure sharing

As the passive Infrastructure sharing is the focus of economy regulator and covered many aspects, including the "right of way or easements, ducts (for fiber network), pylon, masts, splitter, shelter, generators (e.g. internal combustion engine generator), etc.", we conducted a survey on the items of the shared passive infrastructure as stipulated by the regulator of each economy. As shown in the survey, the right of way or easements and tower became the main mandatorily shared items as per the requirements of the regulator, accounting for 55% of the completed questionnaires.

In addition, some feedback mentioned that the regulator required LLU. For instance, according to the feedback of Thailand, "Thailand's telecom regulatory authority currently requires an operator to share its local loop: bit stream access, line sharing, and full unbundling. Such operator subject to local loop unbundling obligation must be classified as sharing significant market power in fixed-line market. Infrastructure sharing is not currently applied to a mobile operator in Thailand."

Fig. 6 Mandatorily Shared Passive Facilities as Required by the Regulator of Each Economy



2.1.6 Regulatory policies on active infrastructure sharing

According to the survey, we found that all of the economies didn't impose mandatory regulations on the items of the active infrastructure sharing except Australia and Canada. It is clear that regulatory generally not mandatory active infrastructure sharing. For instance, Hong Kong, China stated in its feedback that "we do not stipulate how the active network elements are shared among operators. It is solely a commercial agreement of the operators concerned to share the relevant network elements."

However, Canada stated that it stipulated what items in the "software (core network systems like billing)" and "mobile network roaming" shall be shared.

2.1.7 Stimulus policies on the infrastructure sharing

As infrastructure sharing can increase the coverage of the broadband network of each economy and narrow the digital divide among different parts in each economy, we conducted a survey on whether each economy enacted stimulus policies on the infrastructure sharing.

According to the feedbacks, three economies showed that they enacted the relevant stimulus policies. For example, Chinese Taipei enacted "Telecommunications Act, Regulations Governing Mobile Communication Business, Regulations for Administration on Fixed Network Telecommunications Business, Regulations Governing the 3G Mobile Telecommunications Service, and Regulations on Wireless Broadband Access Services" to stimulate the development of infrastructure sharing. Singapore provided government funding to deploy a Next Generation Nationwide Broadband Network. Thailand mentioned its relevant policies in the "National Broadband Plan".

2.2 Case Studies

2.2.1 Canada

In Canada, the liabilities for the infrastructure sharing based on the telecom network are shared by the telecom regulator (CRTC) and the spectrum license issuer (Industry Canada). CRTC is responsible for supervision of the infrastructure sharing, including the application of each party of the agreement for arbitration procedure for settlement of disputes between them.

CRTC has made the relevant stipulations on the infrastructure sharing, including sharing of poles, ducts and stranded wires.

CRTC has also made relevant stipulations on provision of unbundled fixed loops, broadband and other services by traditional operators for new entrants. The relevant discussions about these stipulations can be found in Telecom Decision-making 2008-17 and Revised Definitions of Wholesale Services and Basic Services (Mar 2008).

In the Radio Communications Law, Industry Canada has made stipulations on the conditions for issuance of the operation license, including entrusted roaming service and sharing of the antenna tower and sites; the licensee must respond to the request of any other licensed operator for the site sharing and provide the roaming arrangement within 30 days; unless the infrastructure sharing involves the economy security or only satisfies the enjoyment of individuals, each party of the agreement must share the facilities as long as it is technically feasible. If no agreement can be reached between both parties within 30 days, the dispute arising therefrom will be settled by the control authorities through their mandatory procedure.

In addition to the relevant stipulations, CRTC also authorizes the use of deferred account capital to extend the scope of the broadband service, especially to those areas without access to the relevant services. Industry Canada also proposes various funding schemes.

2.2.2 China

Over the past decade, the Chinese communications industry has seen a rapid development, leading to a great improvement of the network coverage and capacity of the mobile communications. At the beginning of 2009, China issued an operation license for the 3G mobile communications respectively to the three basic telecom operators, i.e. China Telecom, China Mobile and China Unicom. With a new round of investment in the construction of the mobile communications network, the sharing of the network infrastructure will become a prerequisite for cost reduction, environment protection and construction of an environment friendly, people-oriented and landscaped society.

In Oct 2008, MIIT, along with other regulators, issued the Urgent Circular on Promotion of Joint Construction and Sharing of Telecom Infrastructure, which specifically points out that "MIIT have decided to vigorously promote the joint construction and sharing of the telecom network facilities in response to actual conditions of the telecom restructuring and a new round of upcoming network construction with a view to further implementing the Scientific Outlook on Development and the requirements for construction of a resource saving and environment friendly society, reducing the consumption of land, energy and raw materials, protecting the natural environment and landscape, reducing the telecom reconstruction and improving the utilization rate of the telecom network facilities".

1. The following stipulations are made on the specific items of the infrastructure sharing:

For the sake of fair competition, the base stations as scare resources should be shared. It is required that in the network construction since 2009: existing iron towers and pole lines must be shared; new iron towers and pole lines must be established jointly; other base station facilities (iron towers, roofs, equipment rooms, interior distribution systems, special transmission lines for base stations, power supplies, etc.) and transmission lines (ducts, pole lines, optic cables, etc.) must be jointly constructed and shared if conditions allow.

2. As for how to share the network infrastructure, means of direct sharing of the existing infrastructure can be adopted. When renting a third party's facilities, conclusion of an exclusive agreement is prohibited.

3. Establishing a clear management and assessment mechanism for infrastructure sharing.

To ensure a reliable implementation of the infrastructure sharing, the relevant management mechanisms shall be established at both the economy government level and the local government level.

- A leading group for network sharing of the economy telecom network infrastructure comprising the leaders of MIIT, leaders of SASAC and principals of each basic telecom operator (restructured China Telecom, China Mobile and China Unicom, the same below) (hereinafter referred to as the Leading Group) shall be established to guide and coordinate the economy-wide telecom network infrastructure sharing and decide the relevant major issues.

- The Communication Administration of each province shall organize the establishment of a provincial coordination agency for network infrastructure sharing, and may require the participation of the telecom operators at the provincial level (or at the level of autonomous region or municipality directly under the Central Government) as well as participation of the relevant administrative authorities of the local government and

experts. The Provincial Coordination Agency is responsible for imposing requirements for infrastructure sharing within the province as well as coordinating and deciding the relevant issues therein.

- As for safeguard measures, it is required to establish the following mechanisms:

  - Dispute settlement mechanism: operators can settle the disputes arising from the sharing by the following means: commissioning a third party agency to make an assessment or arbitration based on an agreement; applying to the Provincial Coordination Agency for coordination and adjudication; submitting the dispute to the Leading Group if the Provincial Coordination Agency cannot decide.

  - Price determination principle: operators consult with one another and the relevant agencies coordinate and decide on the fees on sharing in accordance with the following principles: rental prices shall be based on costs, with certain additional profits; if there are regulations on the guide prices of the government, such regulations shall apply.

  - Construction and maintenance agreement: operators shall specify their respective work and responsibilities by signing an agreement. Multiple modes can be adopted for construction and maintenance, such as the first requester taking the lead, the greatest demand party taking the lead, job division based on zonings and entrustment of the relevant work to a third party.

  - Establishment of basic database: the Communication Administration of each province (or autonomous region or municipality directly under the Central Government) shall gradually establish the resource database for telecom network infrastructure, open it to the basic telecom operators, so as to facilitate sharing between them and verify the information previously submitted by the operators.

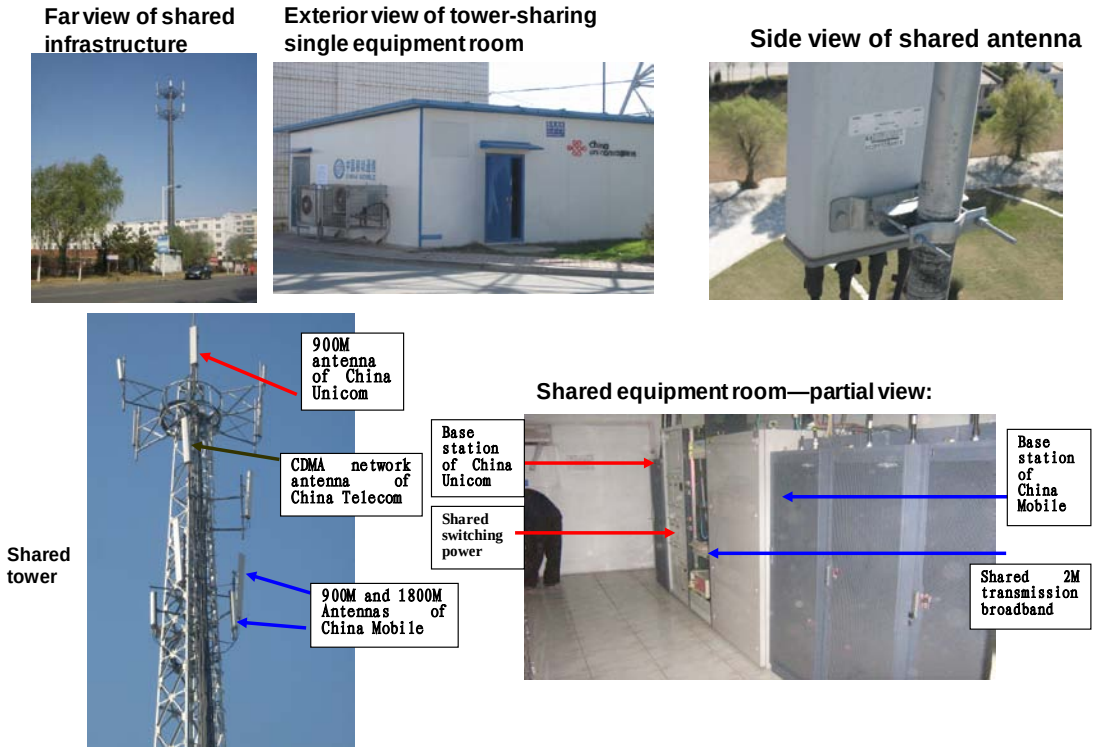
4. Developing the relevant supporting polices.

To assist in the promotion of the network infrastructure sharing, other governmental departments of China developed supporting policies for the network infrastructure sharing. Instances are as follows:

In Jul 2009, MIIT issued the Provisional Regulations on Engineering Technology for Joint Construction and Sharing of Telecom Infrastructure;

In 2009, the State Electricity Regulatory Commission of China (SERC) and MIIT jointly issued the Circular on Power Supply for Joint Construction and Sharing of Telecom Infrastructure.

Fig. 10 Schematic of the Infrastructure sharing among Telecom Operators of China



2.2.3 Hong Kong, China

The Office of Telecommunications Authority, Hong Kong (OFTA) encourages operators to reach an infrastructure sharing agreement through voluntary negotiation. If operators cannot reach a business agreement of their own accord, OFTA can require the relevant operators to seek coordination or cooperation according to Article 36AA of Chapter 106 of the Telecommunications Rules. OFTA makes the following stipulations on the network (or base stations) sharing:

> (1) The Authority may direct a licensee to coordinate and cooperate with another licensee specified by the Authority in the public interest to share the use of any facility owned or used by it.
>
> (2) Prior to issuing a direction in the public interest under subsection (1), the Authority shall provide a reasonable opportunity for the licensee, and any other interested party, to make representations on the matter and shall give consideration to all representations made before he decides whether or not to issue the direction.
>
> (3) In considering a direction in the public interest to share a facility, the Authority shall take into account relevant matters including, but not limited to-
>
> > (a) whether the facility is a bottleneck facility;
> >
> > (b) whether the facility can be reasonably duplicated or substituted;
> >
> > (c) the existence of technical alternatives;
> >
> > (d) whether the facility is critical to the supply of service by the licensees;

(e) whether the facility has available capacity having regard to the current and reasonable future needs of the licensee or person to whom the facility belongs;

(f) whether joint use of the facility encourages the effective and efficient use of telecommunications infrastructure;

(g) the costs, time, penalties and inconvenience to the licensees and the public of the alternatives to shared provision and use of the facility.

(4) Where another licensee reasonably requests to share a facility, the licensee shall endeavour to come to an agreement with the requesting party on the conditions, including but not limited to providing for fair compensation to the licensee for the provision, use or sharing of the facility.

(5) A shared facility may include a building, place or premises that is exclusively occupied and operated by one of the parties to the sharing agreement.

(6) If the parties do not reach an agreement within a reasonable time, and the Authority requires shared use of the facility, then-

(a) the Authority may determine the terms and conditions for the shared use of the facility;

(b) the determination under paragraph (a) shall include terms and conditions providing for fair and reasonable compensation payable in all the circumstances of the case for the shared use of the facility;

(c) the compensation referred to in paragraph (b) shall include the relevant reasonable costs attributable to the provision, use or sharing of the facility;

(d) to calculate the costs referred to in paragraph (c), the Authority may select from alternative costing methods what he considers to be a fair and reasonable costing method.

(7) For the purposes of this section "facility" includes-

(a) a cable, wire, telecommunications line, duct, pit, tunnel and manhole;

(b) a tower, mast, pole and antenna;

(c) land, buildings and ancillary equipment at sites on which radio communications facilities have been established;

(d) reasonable space within a carrier licensee's exchange buildings or other sites to locate equipment of another licensee required to establish interconnection between the licensee's and that other licensee's network at the exchange or sites;

(e) other installations, including but not limited to in-building risers, cable trays and cable entry points into buildings, reasonably necessary for the efficient provision of a telecommunications network; and

(f) services incidental to the building, place and premises in which the facility is situated that are reasonably necessary or incidental to the efficient operation by all parties to the sharing of the facility.

In addition, OFTA imposes specific requirements on sharing of the equipment in the following environment:

1. Common parts of buildings: power lead-in facilities, telecom and broadcasting equipment (TBE) rooms, shafts, interior coaxial distribution systems, etc.

Fig. 7 Common Parts of the Building

Source: OFTA

2. Infrastructure sharing in public places: sharing such systems as feeders, base stations and WLAN: tunnels, bridges, stations, wharfs, airports, large shopping malls and university campuses.

Fig. 8 Infrastructure Sharing in Public Places

Source: OFTA

3. Mountain-top base station sharing: (in Hong Kong, China mountain tops suitable for setting of base station are quite limited) mainly including antenna towers, equipment rooms, power supply systems, etc. However, the military, government and TV and broadcasting systems are given priority to use mountain-top base stations.

Fig. 9 Mountain-top Base Station Sharing

Source: OFTA

2.2.4 Singapore

In April 2000, the Infocomm Development Authority of Singapore (IDA) released a request for public comments on the proposed Code of Practice for Competition in the Provision of Telecommunication Services ("TCC"). After two rounds of public consultation with the industry, IDA proceeded with the implementation of the TCC in September 2000, in exercise of the powers conferred by Section 26 of the Telecommunication Act .

Reviews of the TCC were conducted in 2003/2004 and 2009/2010 with the release of the 2005 and 2010 versions of the TCC respectively.

Chapter 7 of the TCC has specific requirements on infrastructure sharing, including the following contents: the definition of sharing, standards to determine whether any infrastructure must be shared, procedure for the sharing request, mandatory shared facilities as designated by IDA, and methods of infrastructure sharing.

Sharing means that a Facilities-Based Licensee owning the control right over network infrastructure used to support the provision of telecommunication services, allows other licensees to jointly use the same network infrastructure on non-discriminatory terms and at cost-based prices.

In the TCC, IDA points out that the government has two bases when judging whether infrastructure sharing is required: one is if the facility is deemed to be Critical Support Infrastructure (CSI) and the other is that facilities other than CSI can be required to be shared on public interest grounds.

The criteria for CSI are:

(a)the infrastructure is required to provide telecommunication services;

(b) an efficient new entrant would neither be able to replicate the infrastructure within the foreseeable future, nor obtain it from a third-party through a commercial transaction, at a cost that would allow market entry;

(c) the Licensee that controls the infrastructure has sufficient current capacity to share with other Licensees;

(d) the Licensee that controls the infrastructure has no legitimate justification for

refusing to share the infrastructure with other Licensees; and

(e) failure to share the infrastructure would unreasonably restrict competition in any telecommunication market in Singapore.

Chapter 7 of the TCC specifies several kinds of facilities which must be shared:

(a) radio distribution systems for mobile coverage in train or road tunnels;

(b) in-building cabling (where the occupant elects to take service from another service provider); and

(c) lead-in ducts and associated manholes.

The following four articles are stipulated for the shared facilities:

1. The responsible party for infrastructure sharing shall be a telecom operator engaged in the provision of basic telecom services;

2. The shared objects shall be telecom network infrastructure supporting telecom services, e.g. user access facilities;

3. The infrastructure sharing expenses must be a cost-based price;

4. Non-discriminative infrastructure sharing, which means that the operator providing shared telecom network infrastructure shall treat all the telecom operators requesting sharing fairly; the treatment enjoyed by its subsidiaries, holding companies, subsidiaries, or other affiliates shall not be superior than other non-affiliated telecom operators.

Infrastructure sharing can be implemented in accordance with the following procedure:

- The first step is voluntary negotiation. After an operator applies for infrastructure sharing, it begins to negotiate with the infrastructure owner.

- The second step is dispute resolution. If the infrastructure owner and the applicant cannot reach an infrastructure sharing agreement within 60 days from the application date, the applicant or the infrastructure owner may request IDA to resolve their dispute according to the dispute resolution procedure of the TCC. Before resolution of the sharing dispute, IDA may require the infrastructure owner to provide interim infrastructure sharing.

- The third step is sharing compensation mechanism. If the infrastructure owner considers it impossible to conclude an infrastructure sharing agreement which can compensate for costs, IDA shall have the right to fix a cost-based, non-discriminative rate.

3. Implementation of Infrastructure Sharing in APEC Region

3.1 General Information

According to the survey, all economies have conducted infrastructure sharing both in urban and rural areas. Singapore especially particularly stressed that infrastructure sharing covered the whole economy. Generally, the telecom operator played a leading role during the whole

process of infrastructure sharing, with the reduction of costs on construction, upgrading and operation and maintenance of the network as the objective. The government didn't take part in the negotiations among operators for the agreement on sharing and encouraged the network sharing through consultation.

3.2 Participants in the sharing

Of the investigated economies, the infrastructure sharing largely occurred among traditional telecom operators, accounting for 64% of the completed questionnaires; 55% of the completed questionnaires stated that new entrants in their economies shared the network infrastructure of traditional telecom operators, such as Japan's NTT, KDDI and Softbank and Singapore's SingTel (traditional telecom operator) and StarHub (new entrant),Viet Nam's FBO and SBO(new entrant). In addition, there was infrastructure sharing offered by new entrants in Singapore, such as OpenNet and Nucleus Connect. Therefore, it is concluded that of the investigated economies, the infrastructure sharing largely occurred among traditional telecom operators.

Fig. 11 Participants in the Infrastructure Sharing

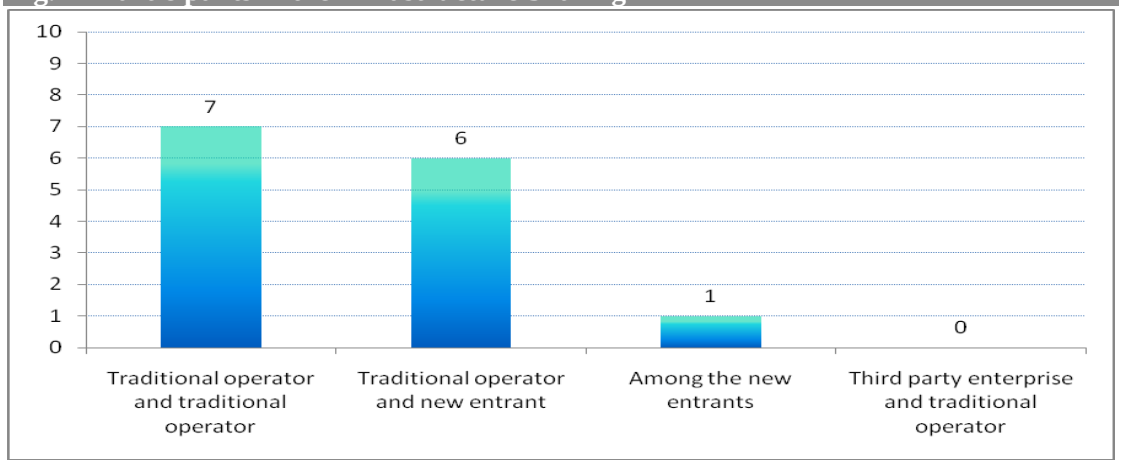


Table 2 Some examples

Economy	Type of Operators	Operators Name
Australia	Between traditional operators and new entrants	Telstra&Hutchison, and Vodafone & Optus
Brunei	Among traditional operators	TelBru
Canada	Between traditional operators and new entrants	N/A
China	Among traditional operators	China Mobile, China Telecom and China Unicom
Hong Kong, China	Between traditional operators and new entrants	N/A
Japan	Among traditional operators	NTT(Nippon Telegraph and Telephone Corp.), KDDI, Softbank, etc
	Between traditional operators and new entrants	NTT, KDDI, Softbank, etc

Singapore	Among traditional operators	SingTel and StarHub Cable Vision
	Between traditional operators and new entrants	SingTel (traditional) and StarHub (new entrant)
	By new entrants	OpenNet and Nucleus Connect
Chinese Taipei	Among traditional operators	Chunghwa Telecom, Taiwan Mobile, and FarEasTone
Thailand	Among traditional operators	CAT, TOT, UIH and DTAC
Viet Nam	Among traditional operators	All FBO operators
	Between traditional operators and new entrants	FBO and SBO

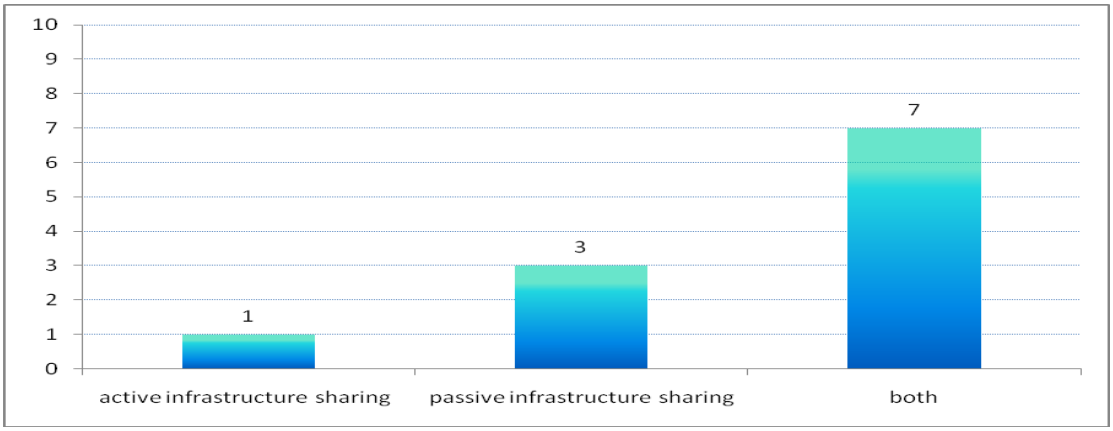
3.3 Shared network infrastructure

According to the survey, all infrastructure sharing network occurred between 2G network and 3G network, which indicates that as a huge investment was required for establishment of new mobile networks, telecom operators tried to share the existing 2G network infrastructure when deploying 3G network so as to relieve the capital pressure.

According to the survey, most investigated economies replied that their regulators made stipulations mainly on the passive infrastructure sharing, yet made no mandatory stipulations on the active infrastructure sharing. In fact, about 90% of the participating economies adopted the passive infrastructure sharing. It is thus clear that the passive infrastructure sharing formed the majority of the network infrastructure sharing.

However, we also find in this survey that there were both passive and active infrastructure sharing in seven economies which are Australia; Brunei; Hong Kong, China; Singapore; Chinese Taipei; Thailand(both feedbacks of NTBC and TOT) and Viet Nam accounting for 70% of all the investigated economies. It can be concluded that a certain percentage of telecom operators adopted the active infrastructure sharing during the network sharing.

Fig. 12 Items of the Infrastructure Sharing among Telecom Operators in Each Economy



3.4 Management of the shared network infrastructure

As for the management of the ownership of the shared network infrastructure assets,

according to the completed questionnaires, most of infrastructure sharing entities chose to independently manage the shared network infrastructure during the infrastructure sharing, accounting for 44% of the total.

As for the maintenance of the shared network infrastructure, according to the findings, sharing operators intended to jointly maintain the shared infrastructure. However, sharing operators in some economies chose to independently operate and maintain their respective shared infrastructure, such as China; Chinese Taipei; Thailand and Viet Nam.

Australia and Hong Kong, China especially pointed out on this issue that the management and maintenance modes for the infrastructure sharing needs to be decided by the sharing operators through negotiation. For instance, Hong Kong, China stated that "for fixed network infrastructure, it is totally up to the operators concerned to agree at an approach in managing the shared infrastructure elements. Usually it is managed by the owners of the shared network facilities. As to the mobile network, a site manager will be assigned by the regulator to manage and maintain the common facilities such as antenna, cablings and poles installed at the shared base station site. All the mobile network operators concerned will share the cost of using common facilities and maintenance fees."

Australia also elaborated on this issue that "where infrastructure is shared pursuant to mandatory access requirements, the access provider is generally required to maintain the infrastructure. Where infrastructure is shared pursuant to a commercially negotiated agreement, then the maintenance arrangements will be determined by the agreement."

However, some entities in a few economies rented an independent third party's network infrastructure. For instance, operators needing to share facilities in Singapore rented the infrastructure owned by a third-party infrastructure provider, "e.g. Intrawave who owns and operates a leaky coaxial cable radio distribution system in an underground train line for 2G and 3G mobile services."

3.5 Sharing Mode

As for the modes of the Infrastructure Sharing between operators, according to the findings, it was possible for network sharing entities to adopt each of the join mode, new-building mode and integration mode except Viet Nam. Therefore, telecom operators chose the cooperation mode more based on their own markets and operation demands when working with other operators on sharing of network infrastructure.

According to the findings, it was possible for the sharing entities to adopt each mode and the three modes respectively accounted for 62.5%, 25% and 25% of the completed questionnaires. It can be figured out that telecom operators choose the mode of joint construction and sharing of network infrastructure with other operators more from the angles of market and operation and based on their own existing network distribution and service promotion demands.

Table 3 Operation Modes for Infrastructure Sharing among Operators in Some APEC Economies

Economy	Operation mode	Titles of entities in infrastructure sharing	Description
Brunei	Join mode	TelBru and B-Mobile and DST	
Canada	Join mode	N/A	
China	Integration mode and	China Mobile,China Telecom and China	The existing iron towers and pole lines should be open to sharing.

	new-building mode	Unicom	Integration mode. To build new iron towers or new pole lines on the same site of the existing iron towers or pole lines are prohibited. New-building mode.
Hong Kong, China	Join mode	N/A	The existing 3G carriers are required to make available an aggregate of at least 30% of its network capacity to the qualified MVNOs or Content Service Provider (“CSP”) upon request
Japan	Join mode	NTT Docomo, KDDI, Softbank, etc	
Singapore	New-building mode	SingTel Mobile, StarHub Mobile and M1	
Chinese Taipei	Integration mode	Chunghwa Telecom, Taiwan Mobile, and FarEasTone	
Thailand	Join mode	CAT, DTAC, True Move, and UIH	
Viet Nam	Others	——	The sharing may be only on a small part of networks.

4. Survey of technical issues in infrastructure sharing

In addition to regulatory policies, implementation items and operation modes on infrastructure sharing, this survey also covered technical problems possibly encountered by each economy during the process thereof. According to 11 completed questionnaires from 10 economies, except Australia and Canada, all the other economies replied to this question. We hereby work out the following summary based on their replies:

4.1 Technical problems no longer an obstacle or a difficulty for infrastructure sharing

During the infrastructure sharing, due to the newly added electromagnetic transmission equipment, electromagnetic radiation would have an impact on the environment and cause interference among different systems; tower sharing would also bring about a series of technical problems regarding the tower structure, its load bearing, and feeder arrangement. However, according to the findings, technical problems have been no longer an obstacle or a difficulty for infrastructure sharing. Hong Kong, China pointed out in its questionnaire that “usually, the problems encountered by operators in infrastructure sharing are usually not technical in nature.”

As ICT is developing fast today, any ICT manufacturer is able to provide complete technical solutions according to the sharing demands of the telecom operator. It can fully solve the problems possibly encountered during the infrastructure sharing by offering various sharing

technologies or transforming the existing systems and equipment, including technical problems and difficulties during joint construction and sharing of towers and transmission resources, and sharing of base station equipment room, base station roof, indoor distributed system and power equipment.

4.2 Security became a major concern in infrastructure sharing

According to the findings, security of shared infrastructure became a major concern of infrastructure sharing. This happened in Brunei; China; Hong Kong, China; Singapore; Chinese Taipei; Thailand and Viet Nam which accounts for 70% of all investigated economies.

Currently, resources shared by telecom operators in each economy include towers, base stations, pole lines, transmission lines, and indoor distributed systems. A precondition for network facility sharing is that the security of equipment, network and supporting infrastructure should be guaranteed, As infrastructure are different in properties, they face different security problems, which are summarized as follows:

1. Security problems on sharing of towers

Security problems relating to towers include the structure safety, lightening protection, electromagnetic compatibility, electromagnetic radiation and electromagnetic interference. The structure safety is mainly about the load bearing and wind load of the iron tower while the electromagnetic interference mainly refers to the interference among different systems to be shared.

2. Security problems on sharing of base stations

Base stations are divided into two main parts, i.e. the equipment room and the roof. Considerations for the security of the equipment room mainly include the capacity safety, load-bearing safety, equipment room environment safety, power load safety, lightening protection, etc.; main considerations for the roof are the load-bearing safety and isolation safety.

3. Safety of sharing of transmission lines

The shared transmission lines mainly includes ducts and optical cables which mainly involves the capacity safety and maintenance safety.

5. Survey and analysis of economic and social benefits from infrastructure sharing

Analysis of benefits (including social benefits and economic benefits) from sharing of network infrastructure has always been a major concern of the industry. As the infrastructure sharing varies in frame mode, shared items and operation modes, it is very difficult to obtain the same result in the analysis of benefits from sharing of network infrastructure.

According to the analysis and conclusion of the survey, most of the investigated economies held that the infrastructure sharing can have a positive impact on universal service, environmental protection, reduction of network construction costs, as well as acceleration of new entrants' entry into the market and preparation time. In general, each investigated economy held a positive attitude toward the economic and social benefits from infrastructure sharing.

5.1 Analysis of social benefits from infrastructure sharing

All investigated economies acknowledged the social benefits from sharing of network infrastructure, holding that the infrastructure sharing would have a positive impact on environmental protection and realization of universal service. Except Japan, all the other investigated economies which held that the infrastructure sharing can have a positive impact on the following, accounting for 90% of all the investigated economies. The specific aspects are as follows:

- The infrastructure sharing can have a positive impact on the quick enhancement of the service capacity of telecom operators;

Some economies particularly added this point in their questionnaires. For instance, Hong Kong, China pointed out that "it allows the new entrants to launch their services and extend service coverage in a shorter time than if they have to roll out their networks. Besides, the "open network" requirement facilitates competition at the content and service level." Viet Nam indicated that the positive influence that are "New services, improvement of the Quality of service, affordability of the broadband service."

- The infrastructure sharing can have a positive impact on the telecom market competition;

Some economies particularly added this point in their questionnaires. For instance, Australia pointed out that "infrastructure sharing enables competing telecommunications providers, including new entrants, to compete more effectively with incumbent telecommunications providers, who control a significant amount of infrastructure which is not economically feasible to replicate."

- The infrastructure sharing can have a positive impact on improvement of the network coverage ability and universal service level;

For instance, Singapore added: "For example, improved coverage of mobile services in underground train and road tunnels can be achieved through sharing of leaky coaxial cable radio distribution systems".

For instance, Viet Nam added: "the infrastructure sharing will be quick rolling out the networks and Wide spread of the coverage, especially in quick rolling out the networks (3G) and wide spread of the 3G coverage."

- The infrastructure sharing can have a positive pact on environmental protection and reduction of resource waste;

For instance, Chinese Taipei added: "Sharing building entrance conduit can avoid destroying the building outward appearance, sharing telecommunications room can avoid wasting the building space and save energy."

For instance, Hong Kong added: "For fixed network, infrastructure sharing minimizes the requirement for road opening and installation of network cablings, thus causing less inconvenience to the public and less impact to our environment."

For instance, Brunei added: "Our Town and Control Department insist on tower sharing to eliminate eyesore to the environment."

For instance, Viet Nam added: "the infrastructure sharing will reduce the numbers of base stations, the Electromagnetic interference and radiation."

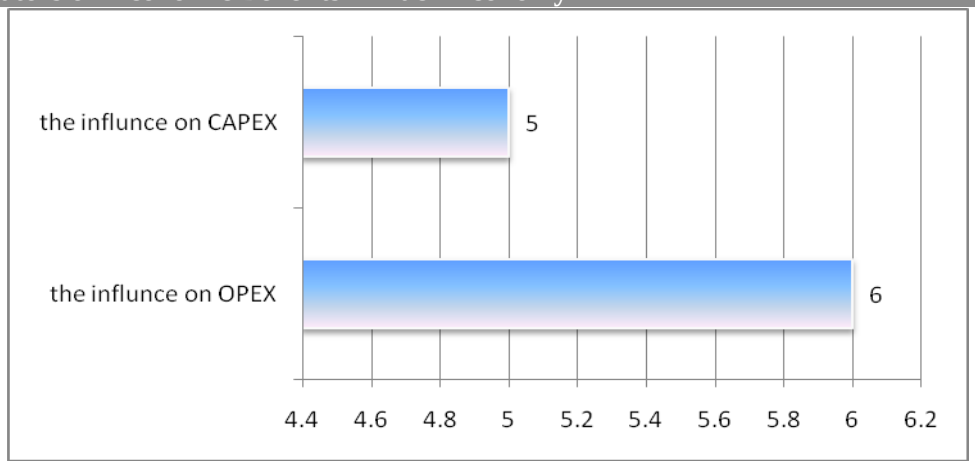
5.2 Analysis of economic benefits of infrastructure sharing

Economic benefits from infrastructure sharing are more reflected in the check of the operational costs of telecom operators, mainly in the following aspects:

- Exerting an influence on CAPEX and OPEX of telecom operators

Telecom operators choose the infrastructure sharing largely for the purpose of reducing the costs on the network construction and maintenance. According to the findings, all economies held that the infrastructure sharing can exert an influence on the costs on the network construction and maintenance of telecom operators. However, as the network cost calculation itself is very complex, which is particularly the case for the 3G and broadband network and moreover, cost reduction of infrastructure sharing is related to regulatory policies, cooperative operators and sharing programs, the cost calculation would be more complex and it's impossible to get an accurate percentage.

Fig. 13 Survey Results of Influence of the Infrastructure Sharing among Telecom Operators on Economic Benefits in Each Economy



- Accelerating entry of telecom operators into market

Operators confronted many problems in the network construction, especially the selection of site locations which becomes increasingly difficult under the current circumstances. The infrastructure sharing simplified the selection process of site locations, greatly quickened the pace of the network construction and accelerated the operators' entry into the market. On the other hand, the infrastructure sharing enabled the integration of forces of several operators so it could greatly increase the speed of the network construction and put the network into operation within a shorter period of time. The infrastructure sharing could boost the enthusiasm of operators and make the network deployment completed at an early date.

According to the findings, all investigated economies held that the infrastructure sharing can accelerate the entry of operators into the market.

- Improving the service level of operators

According to the completed questionnaires, the telecom regulator of Thailand held that infrastructure sharing would alleviate the burden of some SPs in construction and operation of network infrastructure, make them pay more attention to service level and facilitate innovation of services and improvement of service quality.

Table 4 Description in Some APEC Economies' Questionnaires on Accelerating Operators' Entry into Market and Improving Their Service Level through the Infrastructure sharing

Economy	Statements
Australia	Infrastructure sharing can help extend the network coverage of competing telecommunications providers, especially in low density rural and regional areas. An example is mandatory sharing of mobile transmission towers, which has assisted Australia's three mobile networks to extend their coverage to approximately 94%, 96% and 98% of Australia's population.
Brunei	Faster roll-out for rural areas and existing tower usually provide heights for mobile operators hence increase coverage.
Hong Kong, China	It allows the new entrants to launch their services and extend service coverage in a shorter time than if they have to roll out their networks. Besides, the "open network" requirement facilitates competition at the content and service level.
Singapore	improved coverage of mobile services in underground train and road tunnels can be achieved through sharing of leaky coaxial cable radio distribution systems.
Chinese Taipei	Infrastructure sharing can reduce the preparation time for telecommunications service and expand the telecommunications service area rapidly. At the same time, infrastructure sharing can reduce the cost and increasing the usage of facilities.
Thailand	Entities (existing, service providers and entrants) desiring to provide services and innovation can lease network capacity with open access so that do not need to be burdened with the operational detail of network management.
Viet Nam	Quick rolling out the networks and Wide spread of the coverage.

6. Conclusion

According to analysis of the findings on the infrastructure sharing in APEC region, we hereby conclude the following points.

6.1 The infrastructure sharing will conserve resources, protect user interests, promote market competition and improve network coverage

- The infrastructure sharing will help conserve resources.

As the site location resources are increasingly insufficient, the infrastructure sharing will exert a positive impact on avoidance of resource waste, conservation of limited land resources, reduction of energy consumption and provision of telecom services in remote areas.

It is specifically pointed out in the policy comments of China that the infrastructure sharing aims to conserve the land and resources, reduce the repeated construction of telecom facilities and improve the utilization rate of the telecom network facilities. The infrastructure sharing also conforms to the demands of the sustainable development put forward by APEC.

- The infrastructure sharing will protect user interests.

It is increasingly difficult for telecom operators to optimize the network in the downtown area or densely populated areas. For the reason of refusing additional electromagnetic radiation for health protection, local residents often resist the installation of towers or antennas by telecom operators in the above areas. Therefore, telecom operators cannot optimize the network capacity and quality of service in these areas. China thought that the infrastructure sharing will reduce the additional electromagnetic radiation, protect the right of users and effectively lessen the opposite opinions encountered by telecom operators during the network optimization and upgrade.

- The infrastructure sharing will promote market competition.

The infrastructure sharing will restrict monopolistic competition of the traditional telecom operators due to possession of infrastructure and promote the fair market competition. The regulators of the economies tried to consider non-discriminative principle in formulating policies on the infrastructure sharing.

- The infrastructure sharing will extend the network coverage.

The infrastructure sharing has greatly reduced the costs of the network construction and increased the network deployment speed for telecom operators and will obviously extend the network coverage. In addition, it can also improve the service provision capability and speed.

For the government, the infrastructure sharing will help realize the requirement of universal services of broadband access, narrow digital divide among regions and improve the information level of each economy especially in remote areas.

6.2 The infrastructure sharing may intensify the market competition and increase the costs on the network infrastructure expansion.

According to the findings, the infrastructure sharing can really bring benefits to the operators in terms of the network deployment and fast service rendering, but also can have other adverse impacts, which are described as follows:

- Entry of the new entrants will intensify the market competition.

According to the completed questionnaires, except Brunei; China and Chinese Taipei, all other economies held that as the infrastructure sharing lowered the threshold of the market access for new entrants, the market competition would become fiercer with the entry of new entrants. The telecom regulator of Thailand pointed out that the infrastructure sharing lowered the entry threshold of the new entrants, leading to more participators and more intense market competition.

- The costs on the upgrade, expansion and maintenance of the shared infrastructure are constantly rising with increase of the users and services

As operators have an increasing share of user market, the demands for the network service capability become higher so that the difficulty of network expansion and maintenance will

constantly increase. For instance, Brunei held that the infrastructure sharing would increase the upgrade and expansion costs of the network.

- It may occur that some individual telecom operators violate the fair competition principle by making use of the infrastructure sharing

During the infrastructure sharing, it may occur that a few telecom operators reach some consensus and tacit agreement, exercise price monopoly and violate the fair competition principle of the telecom market.

Survey Report on Infrastructure Sharing and Broadband Development in APEC Region

Prepared by

Mr. Zhang Yanbin,
Director of New Technology and New Service department,
Telecommunication Science & Technology Information Institute of MIIT,
40 Xue Yuan Road, Beijing China,100191,
Tel: 86-10-62304014,
E-mail：Zhangyb@cci.cn.net.

Ms. Shi Lin,
New Technology and New Service department,
Telecommunication Science & Technology Information Institute of MIIT,
40 Xue Yuan Road, Beijing China,100191,
Tel: 86-10-62304014
E-mail：Shil@cci.cn.net.

Ms. Li Shan,
New Technology and New Service department,
Telecommunication Science & Technology Information Institute of MIIT,
40 Xue Yuan Road, Beijing China ,100191
Tel: 86-10-62304125,
E-mail：Lis@cci.cn.net.

Mr. Wang Feng,
New Technology and New Service department,
Telecommunication Science & Technology Information Institute of MIIT,
40 Xue Yuan Road, Beijing China ,100191,
Tel: 86-10-62304014,
E-mail：Wangf@cci.cn.net.

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Asia Pacific Economic Cooperation Secretariat
35 Heng Mui Keng Terrace Singapore 119616
Tel: (65) 68919 600 Fax: (65) 68919 690 Email: info@apec.org
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