Telecommunication Competition and Interconnection

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Abstract

This paper describes the theory and practice of interconnection and competition in the field of Telecommunications. In detail, the chapter on competition will promote the Haryadi Index to replace the Herfindahl-Hirschman Index, and on the description of the interconnection described the advantages and disadvantages of the Interconnection method compared to the Net Neutrality Law.

1. Competition Law of Telecommunication Industry

Competition law is a law that promotes or seeks to maintain market competition by regulating anti-competitive conduct by companies. Competition law is known as anti-trust law in the United States, and as anti-monopoly law in China and Russia. In previous years it has been known as trade practices law in the United Kingdom and Australia. In the European Union, it is referred to as both antitrust and competition law.

Competition law, or antitrust law, has three main elements:

- 1) Prohibiting agreements or practices that restrict free trading and competition between businesses. This includes in particular the repression of free trade caused by cartels.
- 2) Banning abusive behavior by a firm dominating a market, or anti-competitive practices that tend to lead to such a dominant position. Practices controlled in this way may include predatory pricing, tying, price gouging, refusal to deal, and many others.
- 3) Supervising the mergers and acquisitions of large corporations, including some joint ventures. Transactions that are considered to threaten the competitive process can be prohibited altogether, or approved subject to "remedies" such as an obligation to divest part of the merged business or to offer licenses or access to facilities to enable other businesses to continue competing.

This paper only describes one of the factors that determine the success of Competition Law to achieve sustainability of the telecommunications industry, that by maintaining a fair level of competition.

1.1. Existing Formula to calculate the Index and determine the Competition Level: Herfindahl-Hirschman Index

The formula for calculating the Herfindahl-Hirschman Index is presented in the following equation 1:

$$H = \sum_{i=1}^N S_i^2 \quad (1)$$

Where S_i is the market share of firm in the market, and N is the number of firms. Thus, in a market with two firms that each have 50 percent market share, the Herfindahl index equals $0.25+0.25 = 0.5$.

The Herfindahl Index (H) ranges from $1/N$ to one, where N is the number of firms in the market. Equivalently, if percents are used as whole numbers, as in 75 instead of 0.75, the index can range up to 1002, or 10,000.

Competition Level Determination

- An H below 0.01 (or 100) indicates a highly competitive industry.
- An H below 0.15 (or 1,500) indicates an unconcentrated industry.
- An H between 0.15 to 0.25 (or 1,500 to 2,500) indicates moderate concentration.
- An H above 0.25 (above 2,500) indicates high concentration.

1.2. The New formula promoted since April 2016: Haryadi Index

1.2.1. Haryadi Index Formula

The "Temporary Name" of the Formula is Haryadi Index, then proposed to be called as "the Harmony in Gradation" or "the Fairness over Inequality", is currently proposed for use in all branches of science.

The formula of Haryadi Index:

$$HI(N) = \frac{1}{N \left\{ \sum_{i=1}^N S_i^2 + \sum_{i=1}^N \sum_{j=1}^N (S_i - S_j)^2 \right\}}; i > j \quad (2)$$

Where: N = the number of firms or providers, and S_j = Provider's or firm's Market share

Examples of the Formulas as follows:

$$HI(2) = \frac{1}{2 \{ S_1^2 + S_2^2 + (S_2 - S_1)^2 \}} \quad (3)$$

$$HI(3) = \frac{1}{3 \{ S_1^2 + S_2^2 + S_3^2 + (S_2 - S_1)^2 + (S_3 - S_1)^2 + (S_3 - S_2)^2 \}} \quad (4)$$

$$HI(4) = 1 / [4 \{ S_1^2 + S_2^2 + S_3^2 + S_4^2 + (S_2 - S_1)^2 + (S_3 - S_1)^2 + (S_4 - S_1)^2 + (S_3 - S_2)^2 + (S_4 - S_2)^2 + (S_4 - S_3)^2 \}] \quad (5)$$

$$HI(5) = 1 / [5 \{ S_1^2 + S_2^2 + S_3^2 + S_4^2 + S_5^2 + (S_2 - S_1)^2 + (S_3 - S_1)^2 + (S_4 - S_1)^2 + (S_5 - S_1)^2 + (S_3 - S_2)^2 + (S_4 - S_2)^2 + (S_5 - S_2)^2 + (S_4 - S_3)^2 + (S_5 - S_3)^2 + (S_5 - S_4)^2 \}] \quad (6)$$

And so on

1.2.2. The weakness of the Herfindahl-Hirschman Index that can be overcome by the Haryadi Index

The Herfindahl or Herfindahl-Hirschman Index (HHI), which is exactly the form of “the Harmony” of the Haryadi Index formula, unfortunately, cannot produce a consistent index for the different number of providers or firms since the HHI formula does not contain the “the Gradation” element. On the other hand, the Haryadi Index will provide a consistent index, since it has both “the Harmony” and “the Gradation” elements, so the resulting index is always consistent, independent of the number of providers, the index = 1 indicates a perfect level of competition, index = 0.75 always shows the boundary between fair and unbalanced level of competition, while index = 0.50 indicates the boundary between unbalanced competition level and unfair competition.

I have provides an internet-calculator, so that experts of the related sciences can examine the feasibility of the theory which is at the link address: <https://www.haryadi.org/competition-level-calculation-in-the-industry/> .

1.2.3. Competition Level Determination

Competition level determination refer to Table I

TABLE I INDEX AND LEVELS DETERMINATION	
HI (“Haryadi” Index)	Fairness Level
HI = 1.00	Perfect
HI = 0.75 – 0.99	Fair
HI = 0.50 – 0.74	Unbalanced
HI < 0.50	Almost no <i>fairness</i>
$HI \leq \{(N-1)/2N\}$	No <i>Fairness</i> at all

1.2.4. Case Study

There are 11 mobile communication providers in Indonesia, which consists of three dominant providers and eight very small providers. The calculation of the level of competition that takes into account all providers will result in the level of competition is very unfair, because it should any very small providers that do not merged yet into one dominant provider. Thus, the calculation involves three dominant providers only.

Market information on the three dominant providers in Indonesia in the period 2009 - 2013 is shown in Table II. Note: since 2015 there has been a big change, in which the dominant operator into four operators, as the operator increases "Hutchison 3", whose market share has soared over the last 4 years.

Table II

Market Information on the Three Dominant Providers in Indonesia (2009 – 2013)

	Revenue (Trillion Rupiah)		
	Telkomsel	Indosat	XL
2009	44.4	18.8	13.9
2010	45.6	19.8	17.6
2011	48.7	20.5	18.9
2012	54.5	22.4	21.3
2013	60.0	23.9	21.4

Calculation Example:

As an example, here is shown the calculation the index and the level determination of the Mobile Communication Competition in 2009:

Markets: Telkomsel = 44.4 T, Indosat = 18.8 T and XL = 13.9 T; Total = 44.4 T + 18.8 + 13.9 T = 71.1 T

Market Shares: Telkomsel = 44.4 T/71.1 T = 0.576, Indosat = 18.8 T/71.1 T = 0.244, and XL = 13.9 T / 71.1 T = 0.180.

Haryadi Index formula for N = 3 refer to equation (4)

$$HI(3) = \frac{1}{3\{S_1^2 + S_2^2 + S_3^2 + (S_2 - S_1)^2 + (S_3 - S_1)^2 + (S_3 - S_2)^2\}}$$

$S_1 = 0.576$, $S_2 = 0.244$, $S_3 = 0.180$.

Thus, Haryadi Index = 0.48 → refer to table II: the level of competition = unfair, but much closed to the lower limit of the unbalanced level.

In the mobile communication industry consists of only three providers, the level of unfair competition does not necessarily lead to any companies to do a merger. Contrarily, the merger could only be done after a couple of years of the competition level are very unfair. But, if the merger had to be done, we must calculate, whether the level of the competition is fair or not.

If carried out a merger between Indosat and XL, the calculation becomes as follows:

Market: Telkomsel = 44.4 T, Indosat + XL = 18.8 T + 13.9 T = 32.7 T; Total = 71.1 T

Market Share: Telkomsel = 44.4 T/71.1 T = 0.576, Indosat + XL = 32.7.8 T/71.1 T = 0.424.

Haryadi Index formula for N = 2 refer to equation (3)

$$HI(2) = \frac{1}{2\{S_1^2 + S_2^2 + (S_2 - S_1)^2\}}$$

$S_1 = 0.576$, $S_2 = 0.424$.

Thus, Haryadi Index = 0.935 → refer to table I: the level of competition = fair.

For comparison, if the calculation is using the Herfindahl-Hirschman Index:

- i. Competition index of the condition that there are 3 operators: $HHI = 0.576^2 + 0.244^2 + 0.180^2 = 0.42$.

- ii. Competition index of the condition that there are 2 operators (if two smallest market share in the merger): $HHI = 0.576^2 + 0.424^2 = 0.511$.
- iii. Conclusion: Competition index calculation does not show significant difference.

2. Interconnection Theory and Practice

2.1. Definition

Interconnection can be defined as the commercial and technical arrangements under which service providers can connect their equipment, network and services to enable customers to have access to the customers, services and networks of other service providers." ITU, "Interconnection: Regulatory Issues" Fourth Regulatory Colloquium, Geneva 19-21 April 1995. Interconnection means the physical and logical linking of public communications networks used by the same or a different undertaking in order to allow the users of one undertaking to communicate with users of the same or another undertaking, or to access services provided by another undertaking. Services may be provided by the parties involved or other parties who have access to the network. Interconnection is a specific type of access implemented between public network operators

Interconnection is:

- "the linking with suppliers providing public telecommunication transport network and services in order to allow the users of one supplier to communicate with the users of another supplier and to access services provided by another supplier"
- These definitions refer to interconnection as a procedure by which telecommunications networks and services are linked in such a way that they can function as a coherent system. The focus is on the any-to-any rule, meaning any subscriber in any network having access to any other subscriber in a different network.

2.2. The Interconnection Arrangement

An interconnection arrangement is a legally binding agreement between interconnecting carriers. It is a contract that stipulates the obligations and responsibilities of each contracting party with regards to interconnect services. The contract is in most cases a very long document sometimes over 500 pages, with different sections and annexes, which specify commercial, technical, operational and dispute settlement interconnection terms. Despite the variations in each interconnection agreement, it is possible to highlight elements that are usually incorporated in most interconnection agreements.

- Elements of an interconnection agreement.
  - 1. Interpretive and general provisions.
  - 2. The scope of interconnection.
  - 3. Points of interconnection and interconnection facilities.
  - 4. Network and facility changes.
  - 5. Traffic measurement and routing.
  - 6. Infrastructure sharing and collocation.
  - 7. Billing.
  - 8. Quality of service, performance and trouble reports.
  - 9. Interchange and treatment information.
  - 10. Equal access and customer transfer.
  - 11. Ancillary services.
  - 12. Termination.
  - 13. Other provisions.

2.3. The interoperability

"It is the ability of two or more systems to interact in concert with one another, in accordance with a prescribed method, to achieve a predictable result; the ability of diverse systems made by different vendors to communicate with each other so that users do not make major adjustments to account for differences in products or services; and compatibility among systems at specified levels of interaction, including physical compatibility" (reference: Kerrey B. (1995) Communication Interoperability Act of 1995 U. S. Senate, S. 710).

- Competitive voice, data, and wireless carriers need access to "last mile" facilities to deliver services to end-users. Interconnection arrangements are a prerequisite for the deployment of a wide variety of services ranging from basic telephony to Internet multimedia services provided on information and communication technology (ICT) networks including mobile, Internet, IP-based networks, satellite and cable TV. Interconnection could be seen as the means for carrier-to-carrier interaction and interoperability.
- All carriers need access to each other's back-office systems to fulfill number portability mandates and to exchange the forms and messages involved in filling customer orders. Interconnection makes it possible for multiple networks to work as a single system. This allows users to have end-to-end services. It allows

telecommunications users to enjoy seamless telecommunications services irrespective of the network to which they are connected.

Although the immediate concern for an interconnection policy is to ensure fair competition between incumbent operators and new entrants, the foremost objective of interconnection is to satisfy the needs of end-users. The ultimate beneficiaries of a fair interconnection policy are customers:

2.4. The Network Externality

- **Network externality** can be defined as the cost or benefit that a network user derives from an additional person using the same network. Network externality is positive when a new user represents benefits for old users. It is negative if the additional user represents a cost. Interconnection in the telecommunications sector represents high network externalities.
- **Subscriber externality** is related to network access. Interconnection between networks immediately multiplies the number of possible connections among customers. It benefits consumers by ensuring an expanded choice of telecommunications services. Interconnection ensures full connectivity of the network allowing all customers to communicate with each other. Telecommunications ensures ubiquity, the ability to reach and to be reached by all network users.

2.5. Interconnection Procedure in the USA

- The 1996 Telecommunications Act provides for competition in local exchange and exchange access services. The Act allows local telephone companies, long distance companies and cable companies to enter each other's markets and compete against one another. Section 251 and 252 of the 1996 Act mandates a duty to interconnect and sets forth specific requirements for interconnection.
- In order to facilitate negotiations, the FCC established a set of minimum standards including a pricing methodology for interconnection based on Total Element Long Run Incremental Cost (TELRIC). In addition the FCC identified a minimum list of network elements that the incumbent must unbundle including the local loop, local and tandem switching capacity and interoffice transmission facilities. The FCC has also made determinations on technically feasible points of interconnection. At a minimum, incumbent Local Exchange Carriers must provide interconnection at the line-side of a local switch, the trunk-side of a local switch, the trunk interconnection points for a tandem switch, and central office cross-connect points. For a general

overview of US interconnection procedure see the United States contribution to the APEC working group on interconnection

2.6. The Reference Interconnection Offer Approach

- Many regulatory frameworks require the incumbent carrier or dominant players to publish a reference interconnection offer. The RIO contains important information about how the incumbent intends to provide interconnection. The offer generally does not contain all the details, but an easy and straightforward summary of the proposed offer. There are exceptions, however. In Singapore, the RIO and its annexes, approved by the national regulatory authority, the Info communication Development Authority (IDA) is hundreds of pages in length.
- In most cases a general interconnection offer should be submitted to the regulator for approval. If the regulator approves the offer, the RIO becomes binding on the incumbent or major operators. If the regulator does not approve the RIO, the regulator may either resubmit the RIO to the incumbent for further reconsideration, or the regulator can make the necessary amendments to the offer before approving it. RIOs are frequently subject to review on a regular basis, usually once a year when they may be modified by the regulator.
- The use of RIOs offers many advantages for new entrants, especially since most jurisdictions require publication of the incumbent's RIO. The new entrant comes to the negotiation table with a clear idea about the incumbent's offers and terms. Areas not covered in the RIO are usually prone to milder controversies than areas covered under the RIO.

2.7. Dispute Settlement

- One of the distinctive features of interconnection negotiations is the existence of asymmetric bargaining power between the interconnection seekers and the interconnection providers. There are important commercial interests at stake in each interconnection negotiation. Each party has different needs and different priorities. Each has an incentive to maximize its profit and minimize its losses. In addition, even when the legislative and regulatory framework for interconnection is sufficiently detailed, the framework cannot cover and address all the issues that might arise in interconnection negotiations. Disputes between parties and the failure to reach an acceptable agreement are commonplace.

Different scenarios for dispute resolution mechanisms

- There are four traditional venues for settling interconnection disputes:
  - Settlement by the general courts of law;
  - Settlement by specialized competition organs;
  - Settlement by arbitration;
  - Settlement by a national telecommunications regulatory body.
- The following discussion focuses mainly on the last option to highlight the importance and the advantages related to this choice, which is being widely used in most countries that have adopted a sector specific regulation approach. Alternatives to formal interconnection dispute resolution, such as industry self-regulation and other consensus building mechanisms are described in the next section.
- When interconnection is subject to commercial negotiation, disputes are usually settled by the courts based on general commercial or competition law (where the latter exists). A major shortcoming of this approach is that it results in lengthy and costly litigation. In addition, in most cases general courts of law have little experience handling complex technical interconnection issues and ordering acceptable interconnection terms. The experience of New Zealand described above is a case in point.
- Commercial arbitration is voluntary unless the parties agree to make compulsory arbitration a term of their interconnection agreement. Parties must mutually agree on the venue, the procedure and the choice of the arbitrator. In addition, when either party has an incentive to delay resolution of the dispute, they may use the flexibility offered by arbitration to postpone a decision.

2.8. Financial and Commercial Terms of Interconnection

There are any different approaches of charging for interconnection services.

2.8.1. Bill and Keep

- Under this approach, operators terminate each other's traffic without charging for interconnection services. The carrier that bills the customer keeps the full retail amount collected.
- This method has been used in many countries for
  - Interconnection of fixed network local calls.
  - Interconnection between fixed and mobile operators where mobile calls are billed on the receiving party pays basis.
  - Internet interconnection.

- Bill and keep, also known as sender keeps all, is an easy to implement mechanism and spares operators the need for complex cost studies and ongoing transfer of settlement accounts. However, the system can only be sustained if several conditions are met:
  - There is a balance in traffic flows between interconnecting carriers.
  - The network costs are similar.
  - Carriers agree to a mechanism to compensate for any imbalance of traffic.

Without such conditions, the bill and keep approach can result in slowing the development of the network of new entrants whose traffic volume is in most cases lower than the incumbent.

2.8.2. Price sharing

- Under this mechanism, the charge for interconnection is based on the retail price charged to the end users, subject to discounts agreed between carriers. The retail price of each interconnected call is shared among carriers according to a pre-determined percentage. Although easy to implement this approach works only in cases where prices are capped and not related to cost. The main drawback of this approach is that it hinders the reduction of retail prices towards cost.

2.8.3. Revenue Sharing

- In this case the operators pay a percentage of the revenues derived from interconnected services based on an agreed percentage. Additional charges may also be added. In many cases, regulators prescribe revenue sharing until competition is fully established.
- In Korea, interconnection between fixed and mobile networks started on a revenue sharing basis. The regulatory regime stipulated that cellular suppliers would take 70% of the revenue from the calls terminated in their networks while the fixed carriers would retain only 30%. This arrangement was used on a transitional basis until the build out phase of the mobile network was completed. Starting in 2000, the revenue sharing mechanism was replaced by cost based arrangements.

2.8.4. Cost based Approaches:

- Of all charging approaches, cost based interconnection charges have been singled out as the best method for promoting a competitive environment. The World Trade Organization (WTO) Reference Paper on Regulatory Principles (see Module 1) enshrines the principle of cost based interconnection. Likewise, the principle of cost based interconnection constitutes an important cornerstone of the interconnection framework within the Asia Pacific Economic Cooperation (APEC) and within the

European Union. It has been incorporated into the regulatory regimes of a growing number of developing countries including Botswana, Jordan and Malaysia. The importance and benefits of cost-based interconnection has been highlighted earlier in the module related to the principles of interconnection. Cost-based interconnection tends to reflect the economic costs of interconnection and is the method most compatible with competitive markets. Cost based interconnection prices allow economically efficient pricing, which can be fair to both incumbents and new market entrants, and encourage competitive entry.

2.8.4.1. Fully Allocated Cost

- The allocated cost approach is a rule that allocates and distributes total network costs to network services. Under this approach, the total cost for providing service, including historical and depreciated investment costs, is divided by the volume of service provided.
- By using this method, the new entrant is supposed to contribute to the cost of capital assets determined according to their original cost, taking into account depreciation rules in addition to an allowed rate of return. Historical cost amounts for the purchase and installation of facilities and equipment as well as personnel costs are usually determined from accounting records.
- This method has been mainly criticized on the grounds that it does not provide a reliable method to measure costs because it is based on historical accounting of costs. Historical accounting does not reflect changes in current and future costs and may reflect operational or technological inefficiencies of the incumbent. These inefficiencies are passed on to the interconnecting operator.

2.8.4.2. Long Run Forward Looking Incremental Costs

- Long run incremental pricing models are based on the calculation of the costs of providing an additional unit of service over the long run. Forward-looking cost analyses attempts to identify costs that will be incurred during some real or theoretical future period. This avoids the pitfall of including excessive embedded costs in rates imposed on end users of competitors. An incremental cost is the extra cost added to an existing base of costs required to provide a defined additional increment of a given service. Focusing on the incremental cost of establishing interconnection is often seen as the most economically efficient means of determining the impact of a competitor's interconnection on the incumbent operator's costs of service.

- Incremental costs are based on forward-looking approaches rather than on historic approaches. In other words they anticipate actual and future costs using current technology and best performance standards and do not rely on costs incurred in the past. In economic terms, the short run incremental cost of telephone service usage-the extra cost imposed on a carrier by a single additional telephone call or minute of use-is virtually zero. In the long run, however, the presumption is that all network facilities and operations are optimally configured to account for the precise volume of anticipated traffic. Viewed over the long term, then, an incremental telephone call yields an incremental extra investment and extra operating cost.
- Incremental costs do not include costs that are unchanged by the new increment like shared costs. Consequently incremental costs do not allow operators offering interconnection to recoup all of the costs incurred in providing interconnection. However, regulators generally allow a mark-up to the final cost estimate to allow for the recovery of common costs.
- Level of interconnection charges would be based on long run forward looking incremental cost or one of its variants. The forward-looking approaches better reflect the working of competitive markets. The approach also has the advantage of determining rates that facilitate competition because it provides analytical tools that help determine the cost that would be found in competitive markets based on the current costs of an efficient operator employing modern technology. Simply put, LRIC charging requires the incumbent to charge for access to its network at prices based on the assumption of what the network would look like if it were built today in the most efficient manner.
- This approach has been implemented in many countries with different variations:
  - **Long Run Average Incremental Cost (LRAIC)** - under this approach, the increment is defined as the total service. The approach includes allowance for fixed costs specific to the service concerned. In other words, the LRAIC approach differs from LRIC in that it includes all types of costs related to a certain increment including the cost of capital equipment and not only the costs for adding one additional increment. LRAIC does not include costs shared by several increments. The European Commission recommended that interconnection charges in European Union Member States be calculated using LRAIC. It is also used in Hong Kong, India and Singapore.

- **Total Element Long Run Incremental cost (TELRIC)** - The FCC developed the TELRIC charging approach to implement the interconnection provisions of the 1996 Telecommunications Act. This approach includes the incremental cost resulting from adding a specific network element in the long run. The price of a network element includes the forward looking costs attributed directly to the provision of services using that element, which include a reasonable return on investment plus a reasonable share of the forward looking joint and common costs. For a comparison between TELRIC and LRAIC see Morten Falck Review of Network Economics Vol. 1, Issue 2-September 2002.
- **Total Service Long Run Incremental Cost (TSLRIC)** - This approach measures the difference in cost between producing and not producing a service. The main characteristic of TSLRIC is that the increment is the total service. In other words, it is the total service that provides the floor for the calculation of the interconnect charge

2.8.5. Fixed and Variable Charges:

- The terms fixed and variable charges refer to whether costs vary with the network usage. Fixed costs refer to costs that do not change regardless of network usage. These costs are generally known as non-traffic sensitive costs.
- Examples of fixed costs include capital investment in major facilities and equipment of the interconnection suppliers as well as labor. Variable costs vary according to the level of usage of the network. Measuring usage can be performed in terms of volume of traffic or circuits or capacity. An example of a variable cost includes costs related to switching.
- This difference in cost can be reflected in an interconnection charge, which may include both fixed and variable costs. In other words, an interconnection charge can contain a fixed portion for fixed costs and a variable portion in the form of a usage charge such as a per-minute charge for interconnect traffic carried.

2.8.6. Peak and off peak charges:

- The interconnection charge paid by the interconnection seeker can be averaged (uniform) or may vary depending on traffic volume. Averaging and de-averaging are often implemented in retail prices, e.g., when retail prices reflect a different rate for peak hours that is higher than the rate for off-peak hours. De-averaged prices are

mainly designed to increase network use in off peak hours and decrease congestion in peak hours, improving network efficiency and saving carriers the expense of upgrading their network to meet the demands of peak loads.

- It is important that the peak/off peak differentials in retail prices be reflected in interconnection charges. Failure to do so could result in unfair competition for both parties. If the interconnection charge is averaged it becomes easier for new entrants to compete for peak load customers because they can offer services at prices lower than the peak prices of the incumbent. On the other hand, new entrants would be unable to compete for off peak customers. In both cases competition is curtailed.

2.8.7. Bundled vs. Unbundled charges

- The term bundled interconnection charges means that the interconnection seeker pays a single price for a standard set of interconnection functions whether used or not. Unbundled charges means that the new entrant only pays for the component(s) of the interconnection package it needs for interconnection services. The interconnecting carrier is not required to pay for components and functions that it will not use to provide services to its customers.
- Unbundling is increasingly recognized as an important regulatory requirement. With the adoption of the WTO Reference Paper on Regulatory Principles, unbundling requirements have become an internationally agreed interconnection principle.
- Charging for unbundled access can have far reaching implications for the success of fair competition. Unbundled access frees new entrants from additional charges, it facilitates new entry and helps promote the benefits of competition.

2.9. Technical Aspects of Interconnection

- The success of interconnection requires parties to initiate pre-interconnection procedures. Sufficient information about network specification of both the interconnection seeker and the interconnection provider is required to ensure technical compatibility of both networks. It is important for both operators to know the type of switching, routing, transmission, signaling protocols and number of circuits used in each network. Transparency principles require that these elements be addressed early in the interconnection agreement process. While recognizing that technical conditions differ according to the type of interconnection, this module will highlight common technical aspects rather than focus on complex technical details.
- This module deals with four technical aspects of interconnection:
  - Points of interconnection;
  - Other key technical issues;
  - Unbundling;
  - Collocation.
- Definition: a point of interconnection (POI) can be defined as the physical location at which two networks interconnect. Under the World Trade Organization (WTO) Reference Paper on Regulatory Principles, interconnection with a major supplier should be ensured at any technically feasible point in the network. The Asia Pacific

Economic Cooperation (APEC) interconnection framework also highlights this requirement as the first interconnection principle.

- Requiring interconnection at any technically feasible point is a very important competitive safeguard for new entrants. This requirement ensures that the new entrant has the ability to choose suitable locations for points of interconnection rather than accept less convenient interconnection points. If major suppliers limit the number and location of interconnection points the new entrant may be forced to offer less attractive services. The term "technically feasible point" has been interpreted differently by different countries.
- In the United States, the obligation to offer interconnection at any technically feasible point is mandated by article 251C (2) of the 1996 Telecommunications Act . In implementing this article, the FCC concluded that at a minimum incumbent local exchange carriers must provide interconnection at the line side of the local switch, the trunk side of a local switch, the trunk interconnection points of a tandem switch and central office cross-connect points in general." Interconnection Order, paragraph 210.

2.9.1. Dialing Parity and Pre-selection

- If conditions for healthy competition are to be established, telecommunications end users should be able to access the services of new market entrants as easily as they can access those of the incumbent operators. Without equal-or at least comparable-ease of access, new entrants will find it difficult to attract customers. For example, in the early days of long distance competition in Canada and the United States, many customers found it inconvenient to use competitive operators' services because of the need to dial the up to 20 or more extra digits needed to route calls to new entrants' networks.
- United States policy makers addressed that problem by requiring dominant local exchange carriers to offer equal access for long distance carriers to reach potential customers. That regulatory solution also included the instigation of "presubscription" for long distance services, allowing United States customers' calls to be routed automatically to their chosen carriers.
- Today, many incumbent operators and telecommunications equipment manufacturers have redesigned their switches and related software, making them very easily adaptable to the requirements of a multiple-operator environment. Dialing parity is thus fairly painless to achieve with the right software package. Nevertheless,

implementing dialing parity usually requires incumbent carriers in former monopoly environments to alter their operating procedures and reprogram their equipment. There are basically two approaches to providing equal access:

- **Call-by-call customer selection** - Customers select the operator of their choice for each call by dialing a short code or prefix unique to their selected operator. For example, in **Colombia**, customers dial "09" to route national calls through the incumbent operator TELCOM's network, and other two-digit prefixes to route them through competitive operators' networks. The main requirements to provide this type of equal access efficiently are:
  - A numbering plan that allocates available numbers fairly among incumbent operators and new entrants. For example, there should be similar access codes for all long distance and international operators and sufficient blocks of equivalent access numbers for local and mobile operators.
  - Rules requiring incumbent operators to give new entrants access to basic signaling services, including Calling Line Identification (CLI) databases and answer and disconnect supervision functions.
  - Appropriate billing and auditing arrangements, allowing each carrier to bill customers directly or to procure billing services from another carrier or third-party billing agent.
- **Operator pre-selection** - Under this approach, customers pre-select an operator for some or all of their calls. For example, a customer may select a preferred carrier for all long distance and international calling. Pre-selection allows all such calls to be routed automatically to the chosen carrier. The main requirements for this type of equal access are:
  - Switch software features needed to identify each customer's pre-selected carrier and to route and bill all calls accordingly.
  - Appropriate billing and audit arrangements to permit direct billing by each pre-selected carrier or consolidated billing by a single carrier (usually the local access provider, which may bill the end user and then remit payments for long distance calls to the pre-selected long distance carrier).
- The implementation of equal access has been uneven around the world. It is available in many countries-including Argentina, Australia, Canada, Chile, Germany, Hong Kong, Switzerland, and the United States, among others-but it remains unknown throughout many parts of the globe. Moreover, while equal access may be more

common for international and local services, it is rarer for national or long distance calling. In some countries, equal access remains unavailable due to limitations in the installed base of switching and software facilities. In others, equal access is held hostage to delays in implementing a numbering plan that allows equivalent allocation of numbers to competitors. In many countries, regulators have simply not seen equal access as a top priority.

2.9.2. Quality of Interconnection Service

- In the view of many regulatory experts, it is good policy to require incumbent operators to provide a reasonably high quality of interconnection services and facilities. Without such a policy, incumbent operators could easily frustrate their competitors' ability to offer competitive and innovative services. By providing poor-quality interconnection, dominant carriers can degrade the overall offering of the new market entrant. In addition, if a dominant carrier turns up service on its own new customers' circuits within days-but delays connection of a competitor's customers' circuits for months-customers would migrate rapidly to the dominant carrier's offerings.
- Regulators have several practical tools at their disposal to promote high quality interconnection. They include:
  - Establishing interconnection monitoring requirements;
  - Monitoring complaints seriously and establishing significant penalties for undue discrimination in service quality; and
  - Mandating the establishment of an independent, internal "interconnection services group" or business unit within the dominant operator. This unit should have a clear mandate and incentives to offer non-discriminatory interconnection and to monitor service quality. For example, the unit could determine whether new circuits ordered by interconnecting operators were provisioned, on average, within the same number of days as internal orders.

2.9.3. Unbundling

- Unbundling refers to the provision of components on a standalone basis so that interconnection carriers can obtain access to single unbundled components without an obligation to buy other components as part as an interconnection package: Unbundling allows new entrants to use parts of the incumbent's network in order to reach their customers without the need to duplicate the network.

- Unbundling can encompass a wide variety of network components including certain features, functions and services as well as physical facilities. The scope of unbundling differs from country to country.
- The FCC, in applying the unbundling requirement mandated by the 1996 United States Telecommunications Act, identified nearly every possible element of the local network and required incumbents to make these components available at Long Run Incremental Costs (LRIC), see Module 3. The components, dubbed "unbundled network elements (UNEs)" include the loop, sub loops, network interface devices, and switching and interoffice transmission facilities.
- The addition or subtraction of a particular item from the list can trigger immense controversy. For instance, line-sharing access to the high frequency portion of the local loop was mandated by the FCC as an item in the UNEs list in 1999, following a court challenge. The FCC is called to initiate a triennial review of its local loop unbundling policies to reflect changes in market conditions (see also [reference 66](#)).

Examples of Unbundled Network components:

- Network access lines (Local loops and related functions);
- Local /Tandem switching functions;
- Operator services and directory assistance functions Inter-exchange transmission (between local and tandem switches);
- Access to signaling links and signal transfer points;
- Access to call related databases (e.g. line information, toll-free calling and number portability databases);
- Operations support systems functions;
- Subscriber listings (in telephone directories and directory databases).

2.9.4. Collocation

- **Definition:** Collocation can be defined as a facility-sharing arrangement in which a competitive carrier leases space for its equipment at an incumbent carrier's premises.
- *Why collocation?*
  - The main rationale behind collocation is to allow operators to share facilities to speed competitive entry. New entrants need not necessarily construct supporting infrastructure for their network such as poles, ducts, conduits and towers.

- *Regulating collocation:*
  - Often incumbents are
  - reluctant to allow infrastructure sharing, requiring regulatory intervention and oversight of collocation.

2.10. Towards Next Generation Interconnection

I. CABLE MODEM ACCESS

II. INTERNET FOR A MOBILE GENERATION

- III. In the last few years Cable TV networks started providing high-speed access to Internet users. These services, called cable modem services, are provided primarily over coaxial cable wires with high bandwidth capacity that is usually used only for video program delivery.
- IV. High-speed Internet is a service that "enables consumers to communicate over the Internet at speeds that are many times faster than the speeds offered through dial-up telephone connections and that enables subscribers to send and view content with little or no transmission delay, utilize real time applications and take advantage of high-bandwidth services". (Definition by FCC in AOL Time Warner Merger Order, 16 FCC Red 6547, 6572, par 63 (2001)).
- V. In order to provide cable modem services, cable operators need to establish a connection to the Internet either by operating an ISP or interconnecting with Internet backbone providers (see Module 7). Because the market for cable modem is still in its infancy, the business model used by cable modem operators has not taken a specific shape. Operators are trying different models. Cable operators may choose to self-provide cable modem services, or provide the service in conjunction with Internet Service Providers (ISPs).
- VI. Cable modem interconnection raises many regulatory problems. For example in the United States, the first regulatory question to be addressed was how to classify the new service for purpose of regulation. The FCC decided that cable modem qualifies as an interstate information service and not as a telecommunication service. Accordingly, the FCC has adopted a competitive marketplace strategy preferring not to intervene in the regulation of cable modem. The FCC concluded that a deregulatory approach to cable modem deployment is needed to permit the flourishing of the new market.

3. Net Neutrality Law

Definition:

Net neutrality is the principle that governments should mandate Internet service providers to treat all data on the Internet the same, and not discriminate or charge differently by user, content, website, platform, application, type of attached equipment, or method of communication. For instance, under these principles, internet service providers are unable to intentionally block, slow down or charge money for specific websites and online content.

The Net Neutrality Law is actually is a rule in the United States, and has confused the countries in the world, where the limits of its enforceability, whether to overhaul the concept of Interconnection that has been set up by the International Telecommunication Union as a whole, or only partially altered. There are several alternatives to combine the principles of Interconnection and Net neutrality Law:

- 1) Implement the Net Neutrality Law completely and no longer comply with the principle of interconnection, in the sense that broadband providers do not apply charge money to websites, online content and also no charge money between broadband providers and over-the-top providers.
- 2) Implementing the charged money among broadband providers, and broadband providers also apply charge money to over-the-top providers.
- 3) Mutual applies charge money among broadband providers, but broadband providers do not apply charge money to over-the-top providers.

As of this writing, the three alternative implementations are still implemented in various countries around the world, whether secretly, or openly.

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