Telecommunications Regulation Handbook

Module 3

Interconnection

edited by
Hank Intven
McCarthy Tétrault

infoDev

Telecommunications Regulation Handbook

Summary of Contents

Note: Detailed Tables of Contents appear at the beginning of each Module

Module 1	Overview of Telecommunications Regulation	1-1
Module 2	Licensing Telecommunications Services	2-1
Module 3	Interconnection	3-1
Module 4	Price Regulation	4-1
Module 5	Competition Policy	5-1
Module 6	Universal Service	6-1

Appendices

A	WTO Regulation Reference Paper	A-1
B	The Economics of Telecommunications Prices and Costs	B-1
C	Glossary	C-1
D	Selected Sources	D-1

1818 H Street, Washington, DC 20433, USA

First printing November 2000
ISBN 0-9697178-7-3

Table of Contents

Module 3 - Interconnection

3.1	Interconnection Principles		1
	3.1.1	The Importance of Interconnection	1
	3.1.2	Scope of Interconnection Issues	2
	3.1.3	Interconnection Issues	3
	3.1.4	Regional Interconnection Rules	3
	3.1.5	Multilateral Interconnection Rules	5
	3.1.6	Interconnection Principles	6
	3.1.7	Contents of Interconnection Agreements	10
3.2	Interconnection Procedures		17
	3.2.1	Establishing Interconnection Arrangements	17
	3.2.2	Negotiation of Interconnection Arrangements	17
	3.2.3	The Regulator's Role in Interconnection Negotiations	18
	3.2.4	Dispute Resolution	21
	3.2.5	Ex Ante Regulatory Guidance	22
3.3	Financial Terms of Interconnection		23
	3.3.1	Interconnection Charges	23
	3.3.2	Approaches to Setting Interconnection Charges	23
	3.3.3	Comments on Different Approaches	25
	3.3.4	Specific Interconnection Costs	27
	3.3.5	Structure of Interconnection Charges	29
	3.3.6	Internet Interconnection Charges	31
	3.3.7	Interconnection with Mobile Networks	33
3.4	Technical and Operational Conditions		35
	3.4.1	Provision of Information by Incumbents	35
	3.4.2	Treatment of Competitor Information	36
	3.4.3	Treatment of Customer Information	37
	3.4.4	Points of Interconnection	37
	3.4.5	Access to Unbundled Network Components	38
	3.4.6	Local Loop Unbundling	42
	3.4.7	Sharing of Infrastructure and Collocation	48
	3.4.8	Equal Access	49
	3.4.9	Quality of Service to Interconnecting Operators	52
	3.4.10	Quality of Interconnected Services	53

Boxes, Figures and Tables

Boxes

Box 3-1: Some Key Interconnection Issues 4
Box 3-2: Interconnection Rules of WTO Regulation Reference Paper 5
Box 3-3: Summary of Widely Accepted Interconnection Principles 9
Box 3-4: Principles for Efficient Interconnection Price Structures 29
Box 3-5: Examples of Technically Feasible Interconnection Points 38
Box 3-6: Compulsory National Roaming in the UK 39
Box 3-7: Some Possible Unbundled Network Components and Services 40

Figures

Figure 3-1: Full Unbundling – Local Loop 43
Figure 3-2: Full Unbundling – Two Local Loops 44
Figure 3-3: Shared Use of Copper Loop Using Splitter 45
Figure 3-4: Provision of High-Speed Bit Stream Access 46

Tables

Table 3-1: Contents of a Typical Interconnection Agreement 10
Table 3-2: Approaches to Resolving Interconnection Disputes 22
Table 3-3: Main Approaches to Interconnection Charges 23
Table 3-4: Advantages and Disadvantages of Unbundling 41
Table 3-5: Arguments For and Against Local Loop Unbundling 47
Table 3-6: Steps to Promote Infrastructure Sharing and Collocation 50
Table 3-7: Some Key Interconnection Quality of Service Measures 53

Telecommunications Regulation Handbook

Principal authors:

Hank Intven
Jeremy Oliver
Edgardo Sepúlveda

Funding for the preparation of this Handbook was provided by the *info*Dev Program of The World Bank

*info*Dev

Additional funding was provided by

McCarthy Tétrault
Telecommunications Lawyers and Consultants
www.mccarthy.ca

The authors gratefully acknowledge the support and assistance provided in the preparation of this Handbook by the International Telecommunication Union (ITU)

The modules of this Handbook are available electronically at www.infodev.org/projects/314regulationhandbook

MODULE 3

INTERCONNECTION

3.1 Interconnection Principles

3.1.1 The Importance of Interconnection

Interconnection of telecommunications networks has been important for a century, but never more so than today. Originally, operators, such as PTTs and the North American Bell companies, interconnected with neighbouring operators. However, these operators retained monopolies over all networks and equipment in their geographic serving areas. For decades, few other types of interconnection occurred.

Beginning in the 1970s, customers began to interconnect a growing range of terminal equipment and private network facilities to the incumbent operator's facilities. With the liberalization of telecommunications markets over the last few decades, effective interconnection arrangements have become key to the operations of an increasingly wide range of services. These services include local, long distance and international fixed, mobile and satellite services, providing everything from basic voice telephony to high speed Internet connectivity to Internet multimedia services.

Competition is the key to the growth and innovation of today's telecommunications markets. Interconnection is a critical factor for the viability of competition. For most of the history of telecommunications, operators and government administrations negotiated with each other to set the terms of interconnection without regulatory intervention. The emergence of competition has changed this. Incumbent operators have little incentive to make things easy for their new competitors, and most of the bargaining power in negotiations lies with the incumbents.

Strategic anti-competitive behaviour on interconnection matters by incumbents has retarded or prevented competition in many telecommunications markets around the world. Incumbents can engage in a wide range of behaviour to frustrate effective competition. For example, they can charge excessive rates for interconnection, refuse to build or make available adequate interconnection capacity, and refuse to unbundle network elements or services necessary for efficient interconnection. New entrants in telecommunications markets have little to offer in negotiations to remove these barriers to competition. Today, there is a consensus among telecommunications experts and policy makers that decisive and informed guidance by regulators is required to pave the way for effective interconnection arrangements.

Interconnection is an important consumer issue. Telecommunications users cannot communicate

with each other or connect with services they demand unless necessary interconnection arrangements are in place. Interconnection of a multitude of different types of networks has brought tremendous benefits to consumers and businesses around the world in the last decade. Without efficient interconnection arrangements, services such as direct international dialing, all Internet-delivered services, automated teller machines and e-commerce would not be possible.

Increasing network interconnection will continue to improve the convenience and utility of telecommunications service for users around the world in the next decade. Inadequate interconnection arrangements not only impose unnecessary costs and technical problems on operators - they also result in delays, inconvenience and additional costs for businesses, consumers and, ultimately, for national economies.

According to ITU' surveys, Interconnection-related issues are ranked by many countries as the single most important problem in the development of a competitive marketplace for telecommunications services, interconnection has been a highly contentious issue in Europe. Almost half of all countries in the Asia-Pacific region indicated that interconnection issues were a top regulatory priority. While fewer countries in the Arab states (20%) and the Americas (30%) pointed to interconnection as a regulatory priority, the general level of network competition was still low in those regions. That is changing. The importance of interconnection issues will increase in all regions as network competition develops.

This Module examines the arrangements that must be put in place between operators, and the steps that can be taken by regulators, to facilitate effective interconnection.

3.1.2 Scope of Interconnection Issues

Interconnection is defined in different ways in the different regulatory and policy regimes that deal with it. A good recent definition is included in the 12 July 2000 proposed European Commission Directive on access and interconnection:

> "interconnection" means the physical and logical linking of public electronic communications networks used by the same or a different undertaking in order to allow the users of one undertaking to communicate with the 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. (Article 2 – CEC(2000d))

This definition differs from others in that it includes interconnection of networks used by the same undertaking and not just networks of different operators. The proposed Directive also differs from some other regulatory interconnection regimes in that it includes a separate concept of "access", defined differently from interconnection:

> "access" means the making available of facilities and/or services, to another undertaking, under defined conditions, on either an exclusive or non-exclusive basis, for the purpose of providing electronic communications services. It covers inter alia:
>
> - access to network elements and associated facilities and services, which may involve the connection of equipment by wire or wireless means;
> - access to physical infrastructure including buildings, ducts and masts;
> - access to software systems, including operational support systems;
> - access to number translation or systems offering equivalent functionality;
> - access to mobile networks, in particular for roaming; and
> - access to conditional access systems for digital television services.
>
> Interconnection is a specific type of access implemented between public network operators. Access in this Directive does not refer to access by end-users.

The last sentence of the definition is important. It distinguishes the Commission's use of the term "access" from its normal meaning, which relates to end-user access, for example in the terms "access lines" or "network access service". Despite this potential confusion, the types of inter-operator "access" listed in the Commission's definition are very important in the context of interconnection.

The types of "inter-operator access" listed in the Commission's definition are treated as an integral part of "full" or "efficient" interconnection in other jurisdictions. They may also be considered as "supplemental" or "ancillary" forms of interconnection. These types of access arrangements are typically addressed in interconnection agreements entered into between experienced operators.

Whatever the regional or local definition of interconnection, the matters included in the Commission's proposed definition of "access" must be dealt with as part of a comprehensive approach to interconnection. In this Handbook, therefore, we will deal with this type of "inter-operator access" in detail, as an integral part of full interconnection.

3.1.3 Interconnection Issues

Commercial, technical and operational arrangements must be made to facilitate interconnection between network operators. A number of issues must be agreed upon by the operators, or determined by the regulator, in order to finalize these arrangements.

The major commercial issues of concern to new entrants are generally related to the cost of interconnection. In North America and Europe, for example, up to 50% or more of the total costs of some long-distance operators have been paid out in interconnection charges to local operators. Such interconnection charges are particularly significant for operators that rely heavily on resale or that must pay a subsidy or contribution component as part of interconnection charges. The practice of combining subsidies and cost-based charges is widely discouraged, for the reasons set out in Section. 3.3.5.4. Even without a subsidy component, the level of interconnection charges is often an important factor in determining the financial viability of a new telecommunications service provider.

Interconnection costs are certainly not the only major issue. Various technical and operational issues are also critical to both incumbent and new operators. Box 3-1 lists some of the most important interconnection issues encountered in many countries.

3.1.4 Regional Interconnection Rules

In recent years, the development of regional trading areas and the implementation of multilateral trade agreements has accelerated the liberalization of interconnection policies.

A leading example is the 1997 European *Interconnection Directive* (97/33/EC). It contains rules specifically aimed at liberalizing national interconnection regimes. The Directive requires interconnection arrangements to be public and non-discriminatory. It also requires interconnection charges to be cost-based. Related EU Directives supplement and amend the European interconnection regulatory framework. These Directives include obligations on special access (98/10/EC) and provision of leased transmission capacity (92/44/EC).

The provisions of the European Directives related to interconnection are fairly general in nature. This approach permits adaptation to the EU's different national legal regimes and regulatory frameworks. The European Commission has taken additional steps, beyond the Directives, to improve interconnection arrangements. One such step is the publication of "best current practice" interconnection rates. These interconnection rates are significantly lower than those of some member countries, suggesting that these countries should take action to meet international cost benchmarks. Another major step was the recent adoption of rules and a proposed regulation to require unbundling of the local loop. These rules are discussed later in this Module.

The European Commission has also reviewed its interconnection-related Directives. As previously indicated, on 12 July 2000, the Commission published a proposed new Directive on access to, and interconnection of, electronic communications networks and associated facilities (COM(2000) 384). The proposed new Directive seeks to respond to the

convergence phenomenon by covering a broader range of electronic communications networks and services. It also contains some new and different principles. However, under the proposed new Directive, the key provisions of the three previous (above-noted) Directives will continue to be legally binding on European Union Member States, pending further reviews.

Other multilateral organizations have also developed interconnection guidelines. For example, the Asia-Pacific Economic Co-ordination (APEC) Telecommunications Working Group has developed a *Framework for Interconnection*. Unlike the EU

Box 3-1: Some Key Interconnection Issues

Framework and Procedural Issues

- Adequacy of regulatory guidance for interconnection negotiations
- Availability of interconnection with incumbent operators for various types of services
- Access to standard interconnection terms with incumbent operator
- Independent and timely dispute resolution
- Non-discriminatory access to interconnection facilities and services
- Access to PSTN network specifications (including planned network changes)
- Treatment of Universal Service, Universal Access or Access Deficit Charges

Commercial Issues

- Level and structure of interconnection charges; basis for calculation (i.e. type of costs used to calculate charges, revenue sharing, bill and keep, etc.)
- Unbundling of interconnection charges for different network components and related services
- Resale of network facilities and services
- Payment for network modifications to facilitate interconnection
- Confidential treatment of competitive and customer information

Technical and Operational Issues

- Open network standards and technical compatibility
- Location of Points of Interconnection (POI)
- Access to signaling systems, advanced digital features, billing system, operations support systems (OSS), call-related databases and other software to provide advanced services
- Access to unbundled network components, including local loops
- Equal ease of customer access to competitive networks (e.g. customer dialing parity)
- Access to numbers and implementation of number portability
- Collocation and sharing of infrastructure (e.g. buildings, poles, conduits, ducts, towers)
- Quality of interconnection, including availability of sufficient interconnection capacity to avoid congestion, and to ensure the timely provisioning of interconnection services and facilities

approach, this framework is not binding on APEC members. The APEC framework is intended to provide principles, examples of interconnection approaches in APEC economies, and other useful information to assist in the development of national interconnection policies. Similarly non-binding approaches have been taken in interconnection principles published by other regional organizations, such as CITEL in Latin America.

3.1.5 Multilateral Interconnection Rules

The 1997 *WTO Agreement on Basic Telecommunications* (formally known as the *Fourth Protocol of the General Agreement on Trade in Services* or *GATS*) was the first widely accepted multilateral trade agreement to include binding interconnection rules. These rules were included in the so-called *Reference Paper*, an informal text containing regulatory principles negotiated among WTO Members. The *Reference Paper* became legally binding on WTO Members that attached it as part of their "additional commitments" in their GATS Schedule of Commitments on telecommunications market access. The *Reference Paper* was attached in whole or with minor modifications by 57 of the 69 signatories to the *Fourth Protocol*. Six additional signatories elected to list some of the principles in their Schedules, but not the entire document.

All WTO Members have the option of undertaking the obligations of the *Reference Paper* in their GATS Schedules on interconnection or other matters, whether or not they participated in the *Fourth Protocol*. As of late 1999, a total of 64 WTO Member governments had committed to the interconnection obligations of the *Reference Paper*. This increase from 57 was due to the submission of commitments by seven more countries since the *Fourth Protocol*. Of these, four WTO Members attached the *Reference Paper* to telecommunications commitments they made after the Protocol negotiations ended and three countries attached it to the GATS Schedules they filed upon accession to the WTO. Most of the nearly 30 additional countries seeking accession to WTO are expected to also commit to the *Reference Paper* and its interconnection obligations.

The most important interconnection-related rules set out in the *WTO Regulation Reference Paper* are summarized in Box 3-2. The full text of the *Reference Paper* provides more detail than the box.

The paper's central principles are non-discrimination, transparency, and the availability of reasonable interconnection terms, including cost-oriented rates and unbundled access, from "major suppliers". The concept of "major suppliers" in the *Reference Paper* can generally be assumed to refer to operators with a dominant position vis-à-vis essential infrastructure or market share. Thus, at present, the Paper's interconnection disciplines would most commonly apply to monopoly or former monopoly fixed-line operators.

The *Reference Paper* was designed as a set of general rules or principles to be observed, rather than as detailed prescriptive guidelines on how the principles are to be implemented. This approach makes the paper adaptable as telecommunications markets evolve, and provides flexibility for application to different legal systems and regulatory interconnection frameworks.

Box 3-2: Interconnection Rules of *WTO Regulation Reference Paper*

Interconnection With "Major Suppliers" must be assured:

- At any technically feasible point in the networks
- In a timely fashion
- On non-discriminatory and transparent terms (including quality and rates)
- Sufficiently unbundled to avoid charges for unnecessary components
- At non-traditional interconnection points if requestor pays charges

Procedures

- Procedures for interconnection to major suppliers must be made public

Transparency

- Agreements or model interconnection offer of major supplier must be made public

As a practical matter, therefore, more detailed guidance is essential to turn the general *Reference Paper* principles into workable interconnection arrangements, agreements, national regulations or regulatory directives. The experience of other countries can provide valuable precedents in this regard.

When the GATS *Agreement on Basic Telecommunications* came into effect on 15 February 1998, many signatory countries did not yet have detailed interconnection rules in place. Some still do not. Given the general nature of the *Reference Paper* principles, it will be a challenge for many countries to develop sufficiently detailed interconnection regimes to put "flesh on the bones" of their GATS obligations.

Before examining the details of interconnection arrangements, the following sections of this Module will review the basic principles underlying most interconnection rules.

3.1.6 Interconnection Principles

3.1.6.1 Providing Advance Regulatory Guidelines

There continues to be a regulatory debate about the relative advantages of providing *ex ante* or advance interconnection guidelines versus *ex post* regulation. Proponents of the *ex post* approach generally favour negotiation of interconnection agreements between operators, with recourse to regulatory dispute resolution or competition law remedies, if negotiations fail.

Several years ago, there were more advocates of the *ex post* approach, particularly outside of North America, than there are today. This approach was based on the belief that regulation should be minimized in competitive markets. Many regulators recognized that the financial, technical and operational details of interconnection arrangements could be complex. They considered that incumbent operators and new entrants would generally have a much better understanding of these arrangements than regulators. They were also concerned that inappropriate regulatory intervention in interconnection matters could impose high costs on the sector.

For these reasons, a large number of regulators and telecommunications experts promoted industry negotiation as the main approach for developing interconnection arrangements. *Ex ante* regulatory intervention was discouraged. The focus of regulatory attention was on dispute resolution, in the event industry negotiations broke down.

In recent years, there have been increasing doubts about the effectiveness of the *ex post* approach. There appears to be a growing consensus that advance regulatory guidelines, or even specific interconnection rules, are necessary to facilitate successful negotiations. This view has been expressed recently by the European Commission, in its 12 July 2000 proposed Directive on access and interconnection. The Commission stated:

> "…there is a consensus that ex-ante sector specific rules will continue to be needed alongside competition rules to regulate access and interconnection, until such time as there is full and effective competition in all segments of the market." (CEC (2000c))

This view has long been held by regulators and policy-makers on the other side of the Atlantic. During the 1980s and 1990s, US and Canadian regulators issued a series of detailed guidelines and decisions on most aspects of interconnection with dominant operators, including interconnection rates and technical terms and conditions. The more interventionist approach of the North American regulators appears to have led to more unbundling of network services, more competition, and arguably more service innovation and growth.

The issues of negotiating interconnection arrangements and approaches to regulatory intervention are discussed in detail in Section 3.2.2 of this Module.

3.1.6.2 Focus Interconnection Obligations on the Incumbent Operator

One generally accepted means of minimizing regulatory intervention is to limit imposition of interconnection obligations to dominant incumbents. In practice, this is the most effective and efficient means of utilizing limited regulatory resources.

This approach is sometimes subject to criticism by incumbent operators. They argue that this approach amounts to regulatory "handicapping" and construction of "non-level playing fields". Others suggest that universal imposition of interconnection obligations would provide more interconnection opportunities for all operators.

However, this is a minority view. The consensus view is that universal imposition of interconnection obligations on all operators, large and small, generally amounts to over-regulation. In principle, only firms with a dominant market position have the ability to establish interconnection terms independently of competition. Non-dominant competitors would find it difficult to independently maintain excessive interconnection rates, or discriminatory conditions. Other service providers wishing to interconnect could avoid such unfavourable interconnection arrangements by interconnecting with a competitor, including the dominant supplier. Over time, as markets become increasingly competitive, it may be possible to deregulate more interconnection arrangements, including those of once-dominant operators. However, in the transition period to full competition, a degree of asymmetric regulation is required in order to level a playing field that is tilted in favour of incumbents.

For these reasons, the regulatory approach to interconnection in this Module focuses on interconnection arrangements with dominant incumbent operators.

This approach is consistent with the *Reference Paper* of the WTO *Agreement on Basic Telecommunications*, which only imposes interconnection obligations on dominant operators (i.e. "major suppliers"). It is also consistent with the European Commission's 12 July 2000 proposed Directive on access and interconnection. The proposed Directive aims to expand the scope of its interconnection framework to a wider range of electronic communications networks. However, only dominant operators will be subject to the *ex ante* regulatory obligations proposed by the Commission, such as mandatory interconnection, resale, collocation, etc.

3.1.6.3 Transparency

Transparency is a major policy objective of multilateral trade agreements as well as the national telecommunications policies of many countries. While there is a lot to be said for protecting the confidentiality of business agreements in a competitive marketplace, interconnection with dominant incumbents is generally considered an exception.

Confidential treatment of interconnection arrangements would provide incumbents with an opportunity to act strategically to thwart competitors. For example, such operators could enter into confidential interconnection agreements that provide unfavourable interconnection arrangements with competitors, and more favourable ones with affiliates. Dominant operators could also limit the functionality of the types of interconnection offered, levy excessively high charges, and otherwise act strategically to limit competition.

Transparency of interconnection arrangements is an effective means of discouraging anti-competitive strategic behaviour by dominant operators. It is easier for regulators to detect and remedy such behaviour if interconnection arrangements are made public. Publication of agreements also makes it easier for regulators and all industry participants to compare interconnection rates, terms and conditions. Transparency also assists in developing industry standards and benchmarks, as well as best practices on operational and administrative issues.

Many countries require publication of reference interconnection offers or model interconnection agreements. To further promote transparency, some regulators maintain public registries of interconnection agreements, or require publication of agreements by operators. In some cases, interconnection agreements are available over the Internet.

Where interconnection agreements are made public, various mechanisms can be used to protect confidential commercial information. For example, Indian legislation requires the regulator to maintain a registry of interconnection agreements. However, at the request of parties, the regulator may direct that parts of an agreement be placed in a confidential portion of the registry. In such cases, a summary of

the confidential parts must be made publicly available.

3.1.6.4 Non-Discrimination

Avoidance of discrimination is a central objective of most interconnection policies. Discrimination in interconnection arrangements can take several forms. One form involves discrimination by a dominant operator in interconnection arrangements entered into with several different new competitors. For example, new entrant B may obtain better arrangements than new entrant C. Such discrimination is relatively easy to detect if interconnection agreements are public.

It should be noted that interconnection arrangements may vary from one competitor to another without being "unduly" or "unjustly" discriminatory. The two competitors may have voluntarily agreed to different arrangements, for example, to suit their different operating conditions. The real test, therefore, should not be "discrimination" in the sense of "differences" in interconnection arrangements. The test should be "unjust", "undue" or "unfair" discrimination, in the sense that an interconnecting competitor is placed at a significant disadvantage as a result of less favourable interconnection arrangements.

The other major form of discrimination is often harder to identify. It involves the provision of more favourable interconnection arrangements by a dominant firm to its own operations or its affiliates than to competitors. Disputes or complaints about this form of discrimination are often difficult for regulators to resolve. For example, it is sometimes impossible to grant a competitor exactly the same type of interconnection arrangements as it is possible to provide to an internal operation.

Various approaches have been developed to identify and resolve cases of discrimination of the second type. Since interconnection arrangements need not be identical, the objective of preventing undue discrimination has been described as one of developing "comparably efficient" interconnection arrangements.

Some incumbents discriminate against competitors by treating them as "customers" rather than "peers" or "co-carriers". This approach often leads to higher prices and inferior interconnection arrangements. Regulators should generally insist that interconnecting carriers should be treated on an equal and reciprocal basis, as peers and not customers.

One type of discrimination can be fatal to the prospects of competition. It involves providing insufficient network capacity to interconnecting operators, as compared to an incumbent's own services. Network congestion can be a deadly anti-competitive barrier. Regulators must sometimes intervene to ensure non-discriminatory rationing of network access and transport facilities. They must often also ensure that established PSTN operators construct sufficient capacity to handle growing demand that can be expected in a competitive telecommunications market.

One regulatory approach to reduce, or at least assist in the identification of, discrimination between a dominant firm and its competitors involves the establishment of structural or accounting separations or divestiture. Under structural separation approaches, a dominant firm is required to move its competitive operations into a separate affiliated company, with separate management, accounting records, etc. Divestiture involves selling all or part of the separate affiliate to other persons. Accounting separations involve setting up separate accounting records only, and not actually requiring the establishment of a separate legal entity for the competitive business. These approaches are discussed in Section 5.3.3 of Module 5 – Competition Policy.

Another less interventionist approach that is commonly used by regulators and competition authorities to prevent undue price discrimination by a dominant firm is an "imputation approach". Such an approach is applied to vertically integrated suppliers. Such suppliers include operators that provide a retail service, like local telephone access service, on a competitive basis, and also provide a wholesale service, like international telephone service, on a monopoly basis to itself and other competitors.

Under an imputation test, a vertically integrated supplier would be required to include the same amount it charges to its competitors for international service in its own retail rates, and to add an amount

sufficient to cover its additional costs of providing local services. Imputation tests are discussed under the heading Vertical Price Squeezing in Section 5.3.4. of Module 5.

3.1.6.5 Cost Orientation

Interconnection principles, such as those set out in the *Reference Paper* for the WTO's *Agreement on Basic Telecommunications* and the European Union's *Interconnection Directive*, require interconnection charges to be "cost-oriented".

There are various reasons for specifying that interconnection charges should approximate costs. Without a cost-based standard for setting interconnection charges, an established monopolist or dominant operator would have an incentive to demand a high price for terminating calls that originate on a new competitor's network. Similarly, a dominant operator would have an incentive to pay little or nothing to the competitor to terminate calls originating on the dominant operator's network. In the absence of regulatory intervention, some new competitors might have little choice but to accept such a deal or remain unable to interconnect.

Serious problems can result from a dominant firm charging competitors interconnection prices that are significantly above cost. First, it deters market entry and the development of competition. Second, customers of the competitors will ultimately have to pay for these excessive charges. Third, the excessive prices can provide a pool of revenues that the dominant firm can use to subsidize losses, for example losses incurred as a result of predatory pricing action taken by the dominant firm to drive competitors out of a market.

The approaches used by telecommunications economists and regulators to calculate interconnection costs, and telecommunications costs generally, are discussed in Section 3.3 of this Module, in Module 4 and in Appendix B of the Handbook.

Box 3-3: Summary of Widely Accepted Interconnection Principles

- Terms of interconnection should not discriminate unduly between operators or between a dominant firm's own operations and those of interconnecting competitors
- Interconnection should be permitted at any technically feasible point, but the requesting operator should pay any additional costs of non-standard interconnection
- Interconnection charges should generally be cost-based (i.e. the evolving best practice specifies that the cost standard should be forward-looking long-run incremental costs; there is normally a mark-up to cover forward-looking joint and common costs)
- Cost inefficiencies of incumbent operators should not be passed on through charges to interconnecting operators
- Where reciprocal interconnection and costs can be expected to be reasonably balanced, bill and keep arrangements are an efficient alternative to cost-based interconnection
- Regulatory guidelines and procedures should be prescribed in advance, to facilitate interconnection negotiations between operators
- Standard terms and procedures should be published for interconnection to dominant operators
- Interconnection procedures and arrangements should be transparent
- Interconnection arrangements should encourage efficient and sustainable competition
- Network elements should be unbundled, and charged separately
- Charges related to universal service obligations should be identified separately, and not bundled with interconnection charges
- An independent regulator (or other third party) should resolve interconnection disputes quickly and fairly

3.1.6.6 Other Interconnection Principles

A number of other interconnection principles have been proposed and adopted by regulators, policy makers and trade organizations. In many cases, these are variations on the same themes. Box 3-3 summarizes widely accepted interconnection principles.

3.1.7 Contents of Interconnection Agreements

The contents of interconnection agreements vary considerably. Much depends on the regulatory framework. If the existing regulatory framework provides sufficient detail on the terms and conditions of interconnection, then interconnection agreements can be shorter. The same is true if an incumbent operator, or an industry group, has published detailed interconnection tariffs, technical standards, procedures, etc. which can be incorporated into an agreement. In other cases, interconnection agreements must be more comprehensive.

Bearing these variations in mind, Table 3-1 provides a list of the possible contents of a "typical" interconnection agreement.

Table 3-1: Contents of a Typical Interconnection Agreement

Contents	Detail and Comments
Interpretation	
Recitals	➢ "Whereas" clauses add historical and legal context to assist understanding by future readers of agreements
Definition of Key Terms	➢ Terminology varies significantly among different countries and operators ➢ It is important to ensure compatibility of terminology to the local environment when adapting interconnection agreements from other countries ➢ Definitions in other documents may be referenced, e.g. definitions in laws or regulations, regulatory guidelines, ITU definitions
Scope of Interconnection	
Description of Scope and Purpose of Interconnection	➢ Different types of interconnection agreements have different purposes (e.g. two local networks, local to long distance/international, fixed-to-mobile, mobile-to-mobile, local ISP to ISP backbone) ➢ The purpose of some interconnection agreements is to provide termination *services* or transit services; others involve provision of unbundled *facilities*, etc. ➢ Interconnection architecture (annotated diagrams)
Points of Interconnection and Interconnection Facilities	
Points of Interconnection (POI) and Related Facility Specifications	➢ POI locations (e.g. exchanges, meet points) usually listed in an appendix; may be modified from time to time. Typically includes exchange types and street addresses ➢ Specific POI facility locations (e.g. digital distribution frame; manhole splice box)

Table 3-1: Contents of a Typical Interconnection Agreement (cont'd)

	➢ Description of network facilities to be interconnected (e.g. OC-3 fibre optic terminals with interconnecting single-mode optical fibres) ➢ Specify capacity and/or traffic volume requirements ➢ Indicate which party is to provide which facilities (include diagram of POIs and interconnected facilities) ➢ Technical specifications, for example: ➢ Calling Line Identification (CLI) specs ➢ Other advanced digital feature specs, e.g. call forwarding, caller name ID, etc. ➢ Basic and ISDN call control interface specs ➢ Local Number Portability (LNP) query-response network specs
Signaling Interconnection	➢ Specify type of signaling networks/standards (e.g. CCS7) ➢ Signaling POIs locations to be specified (i.e. Signal Transfer Points or STPs) ➢ Point Codes to be specified ➢ Technical interface specifications (e.g. signaling links to be dedicated E-1 or DS-1 transmission facilities; operating at 56 kbps) ➢ Diagram of signaling interconnection architecture
Network and Facility Changes	
Planning and Forecasts	➢ Requirement for mutual notification of network changes and capacity forecasts, for example: ➢ traffic forecasts for each POI ➢ local number and portability requirements ➢ area code saturation and changes to increased digit phone numbers ➢ default and redundant routing arrangements ➢ Periodic network planning reports may be specified
Facility Ordering Procedures	➢ Specify rights and obligations of each party with respect to ordering and provisioning of interconnection facilities (including unbundled network elements – see below). ➢ Confidentiality requirements and procedures to ensure same ➢ Ensure no anti-competitive use of order information (e.g. no contacts with end users; competitive service divisions of operator receiving orders) ➢ Specify points of contact (e.g. Interconnection Service Groups; E-mail addresses, etc.) ➢ Specify order format and procedures (e.g. standard order forms may be utilized in paper or electronic (EDI) format)

Table 3-1: Contents of a Typical Interconnection Agreement (cont'd)

	➢ Procedures to expedite specific orders ➢ Co-ordination process for migration of customers between operators (e.g. coordination of cut-overs to prevent or minimize service interruptions to end users) ➢ Procedures for ordering operator to arrange for all equipment installations and changes at end-user premises ➢ Order confirmation and order rejection procedures, timely notification, notification of additional charges, etc. ➢ Order completion notification and reporting requirements
Traffic Measurement and Routing	
Traffic Measurement Responsibilities and Procedures	➢ Describe party responsible; measurement and reporting procedures (see billing procedures below): ➢ Rules for routing of different types of traffic, if any (e.g. Bill and Keep local traffic that is to be terminated reciprocally without charge may be carried on "Bill and Keep" trunks; traffic to which termination charges apply may be carried on other trunks, e.g. transit trunks, national traffic trunks, etc.)
Infrastructure Sharing and Collocation	
Sharing of Infrastructure, Procedures and Costs	➢ Availability of poles, conduits, towers, rights of way, etc. ➢ Procedures, if any, for determining available capacity; procedures for allocating capacity among requesting operators (e.g. first come/first served) ➢ Prices and/or costing method ➢ Provision and pricing of supplementary services (electrical power, security systems, maintenance and repairs, etc.) ➢ Sub-licences on property of third parties (e.g. right of way owners, municipal and other public and private property owners, where infrastructure is located), insurance and indemnification for damages
Collocation	➢ Availability of actual or virtual collocation (e.g. for transmission facilities on exchange premises); list of addresses where collocation is available; procedures for determining available space; reservation of expansion space ➢ Prices and/or costing method for collocated space ➢ Provision and pricing of supplementary services (e.g. electrical power and emergency backup power, lighting, heating and air conditioning, security and alarm systems, maintenance and janitorial services, etc.) ➢ Procedures for ensuring access to and security of collocated facilities (notification; supervised repair and provisioning work and/or separated premises, etc.)

Table 3-1: Contents of a Typical Interconnection Agreement (cont'd)

	➢ Negotiation of other lease and/or licence arrangements, including issues of sub-licences on property of third parties (e.g. building owners, right of way owners, municipal and other public property owners), insurance and indemnification for damages
Billing	
Scope of Billing Arrangements and Responsibilities	➢ May include different arrangements, for example: ➢ Operators billing each other for interconnection services (e.g. termination) and facilities (e.g. unbundled loops and other network elements) ➢ Performance of billing functions by some operators for others (e.g. local operators billing end-users for long distance or international operators, ISPs, etc.)
Billing Procedures	➢ Interconnection billing media – discs, tapes, paper and/or electronic (EDI) transfers; format and software specifications ➢ Guidelines for production of interconnection billing outputs, including: ➢ Applicable industry standards (e.g. CABS, BOS, SECABS, used with or without modifications) ➢ Billing data format and data elements ➢ Standardized codes and phrases ➢ Billing schedule ➢ Customer Service Record (CSR) provision, including: ➢ details to be supplied by provisioning local operator (e.g. record of interconnection elements used, including circuit and other (e.g. DSLAM) equipment identification numbers) ➢ media (e.g. tape, paper, etc.) and schedule for delivery ➢ other requirements to facilitate efficient verification and billing of end-user by non-provisioning operator ➢ Retention periods for billing data
Payment Terms and Conditions	➢ Billing fees and related charges. ➢ Payment terms and conditions, including late payment penalties; service disruption credits, etc.
Billing Disputes and Reconciliation Procedures	➢ Contact details for reconciliation and billing queries ➢ Responsibilities to provide back-up records ➢ Notification of billing disputes ➢ Initial resolution procedures (e.g. escalation to more senior management) ➢ Final resolution (referral to arbitration, regulator or courts)

Table 3-1: Contents of a Typical Interconnection Agreement (cont'd)

Quality of Service/Performance and Trouble Reports	
Quality of Service	➢ Service performance standards may be specified in appendix, for example: ➢ Average time for provisioning interconnection circuits ➢ Percentage of interconnection cut-overs made on scheduled dates ➢ Comparative provisioning performance for competitors and self (or affiliates) ➢ Switching and transmission quality measures on interconnected circuits (e.g. probability of blockage at peak hours, transmission delay and loss – consider referencing ITU-T recommendations
Testing and Maintenance	➢ Right to make reasonable tests, and to schedule service interruptions; procedures to minimize disruption
Trouble Reports	➢ Procedure for trouble reports; notice periods; response time standards ➢ Duty to investigate own network before reporting faults to interconnecting operator ➢ Responsibility for costs incurred to second operator in investigating faults subsequently found to exist in first operator's network. Calculation of charges (labour, etc.) for investigating trouble reports
System Protection and Safety Measures	➢ Responsibilities of parties to take necessary precautions to prevent interference with, or interruptions of, other parties' networks or customers
Interchange and Treatment Information	
Data Interchange Format	➢ Method and format of data interchange between carriers, including data interfaces, software, forms, etc.
Data to be Exchanged	➢ Specify all data types and systems for which data is to be interchanged, for example: ➢ New facilities and service orders, network changes and forecasts, billing, etc. (see above) ➢ Number allocations and other data required for call routing and local number portability (where applicable, e.g. where LNP system is operated by incumbent operator rather than an independent party) ➢ Customer listings in directories and databases ➢ Access to network databases, for provision of advanced services

Table 3-1: Contents of a Typical Interconnection Agreement (cont'd)

Access to and use of Customer Information	➢ Confidentiality procedures for customer information, including: ➢ Establishment of separate interconnection services group with secure data (password protection for electronic files; locks for data rooms and filing cabinets, etc.) ➢ Confidentiality forms to be completed by all relevant employees (penalties and bonding optional) ➢ Procedures to ensure protection of customer privacy
Access to and use of Operator Information	➢ Confidentiality procedures (see customer information procedures – above) ➢ Intellectual property rights
Equal Access and Customer Transfer	
Equal Access Procedures	➢ Procedures depend on equal access approach, e.g. carrier pre-selection; casual selection. Detailed procedures normally incumbent for carrier pre-selection, including: ➢ Customer authorization requirements (signature on prescribed form, clear choice requirements) ➢ Authentication and measures to prevent unauthorized customer transfers (slamming) ➢ Penalties for unauthorized customer transfers ➢ Methods of reporting customer transfers (contact points and data to be provided) ➢ Order confirmation procedure (format, medium, etc.) ➢ Schedule to implement transfers ➢ Procedures to implement transfers ➢ Dispute resolution process (e.g. escalation through senior management, arbitrator and regulator); information to be provided in dispute resolution process ➢ Procedures for dealing with disputed customers (which operator may contact customer, information to be provided to and/or obtained from disputed customers)
Ancillary Services	
Operator Assistance	➢ Types of operator assistance services to be provided, including directory assistance, translation services, fault report routing, etc. ➢ Call handling and operations procedures ➢ Fees and billing procedures

Table 3-1: Contents of a Typical Interconnection Agreement (cont'd)

Other Ancillary Services	➢ Subscriber listings in telephone directories ➢ Information and billing inserts ➢ Repair and maintenance services ➢ Other services provided by one or other operators to increase mutual operating efficiencies
Termination	
Grounds for Termination and Restrictions	➢ Termination may only be permitted subject to certain restrictions (e.g. regulatory approval for termination of interconnection by incumbent operator) ➢ Grounds for termination by incumbent may include: ➢ Regulatory or court orders ➢ Bankruptcy, insolvency, receivership, etc. ➢ Cessation of business ➢ Fewer, if any, termination restrictions in competitive markets, and by non-dominant operators
Termination Procedures	➢ Advanced notice requirements ➢ Payment of non-recoverable interconnection costs incurred by disconnected operator ➢ Computation and payment schedule for disconnection costs ➢ Dealings with end-users, communications restrictions, etc. ➢ Disconnection cutover procedures.
Other Provisions	
Force Majeure	➢ List of conditions for which non-performance of interconnection agreement obligations will be excused
Assignment	➢ Rights of assignment and restrictions on same (e.g. consent or regulatory approval requirements)
Applicable Laws	➢ Agreement to be governed by, and interpreted in accordance with, the laws of relevant jurisdiction
Regulatory Approvals	➢ Specify regulatory approvals required for effectiveness and/or renewal, amendment, termination, etc. of agreement
Breach of Agreement	➢ Remedies and penalties ➢ Liabilities, indemnification and limitation of liabilities
Legal Interpretation	➢ Standard provisions for legal interpretation and enforcement of agreement (e.g. entire agreement clause, effect of unenforceable terms, cumulative rights and remedies, etc.)

Table 3-1: Contents of a Typical Interconnection Agreement (cont'd)

Dispute Resolution	➢ Procedures for resolution of disputes under agreement that are not specifically dealt with elsewhere. For example: ➢ Good faith negotiations, time schedule for same, escalation through management levels ➢ Referral to regulator, arbitrator or court (e.g. of different types of issues) ➢ Selection of, and procedures for, arbitration
Term	➢ Duration of term ➢ Renewal rights and procedures
Amendment	➢ Review and re-negotiation procedures ➢ Impact of regulatory changes

3.2 Interconnection Procedures

3.2.1 Establishing Interconnection Arrangements

A variety of different approaches have been used to establish interconnection arrangements. The main approaches are listed below. Combinations of these approaches have been used in different countries at different times.

- ➢ Regulatory prescription (*ex ante*) of interconnection arrangements.
- ➢ Negotiation between operators.
- ➢ Establishment of general regulatory guidelines for operators to negotiate.
- ➢ Regulatory mediation to facilitate operator-negotiated agreements.
- ➢ Regulatory prescription (*ex ante*) of default interconnection arrangements, for example, based on other jurisdictions, that will apply if negotiations fail.
- ➢ Regulatory decisions to resolve interconnection disputes.
- ➢ Independent arbitration or mediation of interconnection disputes.
- ➢ Regulatory review, variation and approval of negotiated arrangements.

Active industry participation is necessary to develop practical interconnection arrangements However, there has also been a growing consensus that it is necessary to have regulatory involvement to provide advance guidelines for operator negotiations and to resolve disputes. Different approaches to balancing industry participation and regulatory intervention are discussed in the following sections.

3.2.2 Negotiation of Interconnection Arrangements

In many countries, industry negotiation has been the main approach to establishing interconnection arrangements. As previously discussed, there are good reasons for this. Operators understand their networks and operational requirements better than regulators, and they have the technical information required to implement effective interconnection arrangements.

However, without regulatory intervention and direction, interconnection negotiations do not usually proceed successfully. Incumbent operators are

generally suspicious that interconnecting operators will seek subsidized access to their extensive existing networks. Indeed, interconnection at almost any price is less expensive for a new entrant than duplicating major parts of the PSTN. However, the purposes of interconnection include minimization of total network costs, and speedy introduction of competition and rollout of new services, such as broadband access services. Interconnection obligations must often be imposed on incumbents, whether or not they agree with them, in order to promote sector development.

Some incumbents may also act strategically during the course of negotiations to implement arrangements that can effectively prevent or hinder competitive entry. Consequently, regulators must find ways to overcome incumbents' reluctance to interconnect their network to new competitors' networks on efficient, cost-based terms and conditions.

Despite encouragement from governments and regulators, the reality is that dominant incumbents have little incentive to enter into agreements that expedite competitive entry by interconnecting operators. Incumbent operators hold all the bargaining power in negotiations. New entrants have little to offer in exchange for favourable interconnection terms. They can promise market expansion, which should benefit all operators. However, most incumbents see this benefit as being outweighed by the loss of existing markets to new entrants.

Delays and failure have characterized many interconnection negotiations. In some of these situations, regulators subsequently realized that delays and disputes could have been resolved by appropriate regulatory intervention. For example, regulators could have applied benchmarks or best practices from other countries. In other cases, while negotiations did produce interconnection agreements, these were sometimes one-sided, costly and inefficient. Sometimes, new entrants accepted one-sided agreements as the only means available to start up business and avoid bankruptcy.

As a result of this experience, many regulators and interconnection experts have concluded that it is generally impractical to direct dominant incumbents to negotiate interconnection agreements with new entrants, without adequate regulatory guidance. *Ex ante* regulatory direction and ongoing supervision or mediation are generally required for operators to negotiate reasonable interconnection agreements on a timely basis.

3.2.3 The Regulator's Role in Interconnection Negotiations

Once it is decided that regulators should play a role in promoting the successful conclusion of interconnection negotiations, the next question is: how can the regulator intervene most effectively? Regulators have a variety of tools available to expedite negotiations and to assist in the successful completion of interconnection agreements. Some proven regulatory approaches are described below. Variations and combinations of these approaches can be used in some cases:

- **Establishing guidelines in advance of negotiations** – As indicated in Section 3.1.6.1, there is a consensus that *ex ante* interconnection guidelines are a necessary and effective means to promoting good interconnection agreements. The task of developing such guidelines has been made easier for newer regulators due to the growing number of published interconnection principles and guidelines established by other regulators. The increasing availability of precedent interconnection agreements and the development of "best practices" and benchmark interconnection charges in other countries also make it easier for regulators to establish such guidelines. The remaining sections of this Handbook also discuss approaches that can be used in establishing *ex ante* guidelines.

- **Setting default interconnection arrangements in advance of negotiations** – Regulatory interconnection guidelines are usually fairly general. As a result, there are often disputes among operators about how best to apply guidelines. This can cause delays and impasses, and the need for further regulatory intervention. One approach to deal with this issue, is for the regulator to publish default interconnection arrangements together with guidelines. If the negotiations

fail, the default arrangements will apply. Such an approach was adopted for some interconnection issues by the US regulator in its landmark 1996 interconnection order.

In the case of a first interconnection agreement with an incumbent, it may be difficult for a regulator to establish appropriate default arrangements. The regulator may need to review the issues in depth, obtain information and submissions from the operators, etc. before it is in a position to establish default arrangements. However, default arrangements will usually be easier to establish for subsequent agreements.

As with guidelines, published interconnection agreements and the development of "best practices" and "benchmark" interconnection charges in other countries is making it easier for regulators to establish default arrangements. Benchmarking has been used extensively by the European Commission, and at the international level, such as in the US-Japan bilateral telecommunications negotiations.

Finally, if there is a concern about the appropriateness of the default arrangements, the regulator can provide a "sunset" clause for their applicability. In other words, the regulator can indicate that the default arrangements will cease to have effect after, for example, one year. That will provide time for a more detailed review between the time negotiations fail and the sunset of the default arrangements.

- ***Establish deadlines for various stages of the negotiations*** – Deadlines should be set at the outset of negotiations for completion of various steps or deliverables. For example, the incumbent might be asked to produce a proposed interconnection agreement in 30 days. Alternatively, deadlines can be proposed as soon as it appears delays will occur. Consequences of the failure to meet the deadlines can include regulatory intervention to impose an agreement and independent mediation or arbitration.

Another option that is sometimes proposed is final offer arbitration. In final offer arbitration, an independent arbitrator must select one of the final offers put forward by two disputing parties. In theory, this provides an incentive for the parties to make reasonable offers. In practice, this approach is generally inappropriate for interconnection negotiations, due to the number of issues involved, their complexity, and to the regulatory goal of developing efficient and non-discriminatory arrangements. The regulatory goal is not simply to establish an interconnection arrangement, but to establish a good one.

- **Establish Industry Technical Committees** – Bilateral or multilateral industry committees are often the best forum for establishing the details of interconnection arrangements. If negotiations are proceeding smoothly, incumbents and new entrants may take the initiative to delegate the details of technical interconnection arrangements to working groups or committees. However, in some cases, it may be necessary for the regulator to take the initiative to ensure appropriate technical committees are established. In either case, it is usually good practice to set deadlines for reports by such committees.

Depending on the degree of co-operation between operators, representatives of the regulator may also be able to play a useful role on the committees. They can often facilitate agreement on interconnection arrangements, suggest alternative approaches when there is an impasse, and otherwise mediate the discussions. In some cases, it will be necessary or useful for the regulator to retain expert consultants to assist in this role, and particularly in assessing the merits of conflicting positions of operators.

Sometimes industry technical committee work can drag on for months or years. In such cases, the committees actually slow down the process of reaching interconnection agreements. Delays can result from the establishment of committees with rigid work schedules, lack of familiarity with intercon-

nection technologies on the part of the regulatory participants, unnecessary process concerns, and other factors. The regulator should be flexible and willing to adopt alternative approaches to ensure that the industry technical committee process produces results on a timely basis. Alternatively, in some cases, the process should be abandoned, and other approaches adopted.

The industry technical committees established under regulatory supervision in Canada have generally been considered very successful. The Canadian Interconnection Steering Committee (CISC) and its sub-committees included participation from interested industry firms, as well as representatives of the regulator. CISC was established after a regulatory decision that provided *ex ante* guidance on the terms and conditions of interconnection. However much detail remained to be determined by CISC. It took about 2 years to reach agreement on major issues, and regulatory intervention was required from time to time. However, CISC managed to achieve consensus on many important interconnection issues. The CISC committees continue to deal with ongoing issues that arise, for example, in connection with new types of interconnection.

➢ **Incentives to complete interconnection arrangements** – A carrot can be more effective than a stick. Various incentives can often be provided to conclude interconnection agreements. Incumbents depend on regulators for approvals or actions that can sometimes be linked to the successful conclusion of interconnection arrangements.

An example of this approach can be found in Canada. In 1984, the incumbent operators (the "wireline operators") were licensed to provide new cellular telephone services. At the same time, licences were issued to a new entrant cellular operator. As an incentive, the incumbents were prohibited from starting up their cellular services until they had completed interconnection agreements with the new entrant. The arrangements that applied to the new entrant would also apply to the incumbents' own cellular operations. This "no head start" rule proved to be effective. Mutually acceptable agreements were quickly concluded. The incumbent operators did not want to delay the introduction of their own cellular services.

In developing positive incentives for incumbents to complete interconnection agreements, regulators must take care to ensure that they do not create incentives for new entrants to stall or frustrate the negotiations. In the Canadian example discussed above, for instance, if the new entrants had not been ready to start up service, they might have delayed start up by the incumbents by stalling completion of agreements. Regulators must provide incentives for both sides to complete negotiations.

Finally, the prospect of receiving compensatory interconnection charges can provide an incentive for incumbents to conclude interconnection agreements. Most incumbents focus on short-term loss of market share to competitors. However, those that take the longer view, and build appropriate network facilities, can earn significant interconnection revenues as a result of the new traffic stimulated by their competitors.

➢ **Appoint mediators or arbitrators** – Where negotiations fail, or where they are likely to fail, success can often be achieved by appointment of a mediator or arbitrator. The two are different in that arbitrators are empowered to make binding decisions where an agreement cannot be reached. Mediators can provide additional information, develop compromises, propose alternatives, and persuade. However, they cannot impose their own decision on the negotiations.

It is possible for regulators or regulatory staff to act as mediators and arbitrators. However, this in not always the best approach, particularly in the case of inexperienced regulators and staff. Interconnection is a

complex area, and the costs of delays and improper regulatory intervention can be high. There is a growing body of international interconnection "know-how". Experienced independent interconnection experts can often add valuable experience. They can recognize issues from other countries, suggest options for unresolved issues, and otherwise save time. In addition, the use of outside experts maintains the independence and credibility of the regulators. The regulators can act as a final decision-maker in the event the mediation process fails. They can also review the final decision of an arbitrator, if necessary.

One or more of the foregoing regulatory approaches is usually required to promote the successful conclusion of interconnection negotiations. Whatever the approach, it is important for regulators to be proactive in establishing interconnection procedures and guidelines that will promote the negotiation of effective interconnection agreements. Further, where negotiations fail, regulators must be prepared to take steps to bring them to a successful conclusion.

3.2.4 Dispute Resolution

In most countries, it is the regulator's role to resolve interconnection disputes. The *WTO Regulation Reference Paper* requires signatories to the *Agreement on Basic Telecommunications* to establish an independent dispute resolution mechanism. The Paper requires recourse to an independent domestic body to resolve interconnection disputes within a reasonable time. This may be the regulator or another independent body.

In practice, regulatory dispute resolution can be a difficult task. Most regulators will normally be less informed than the operators on the details of interconnection. The risk of making an unsatisfactory decision deters many regulators from wading into interconnection disputes.

However, regulators must resolve disputes in a decisive and timely manner, or competition and sector development will be retarded. If information on local costs is insufficient, international benchmarks can be applied. Other practices applied in foreign jurisdictions can provide useful precedents. Discussions with other regulators and assistance from expert advisors can facilitate the regulators' task.

If interconnection negotiations fail, an operator, usually the new entrant, may apply to the regulator to resolve the interconnection dispute. There is no single best approach to resolving a complex interconnection dispute, but some approaches are better than others. Table 3-2 suggests some approaches regulators may use in resolving interconnection disputes.

The *WTO Regulation Reference Paper* defines an independent regulator as follows:

> "Independent Regulator" - The regulatory body is separate from, and not accountable to, any supplier of basic telecommunications services. The decisions of and the procedures used by regulators shall be impartial with respect to all market participants.

As discussed in Module 1, the degree of independence of regulators varies in different countries. In some countries, the regulator is a government ministry, or a government agency that also has responsibility for the operations of a state-owned incumbent. Many observers would not consider such a regulator independent for the purpose of resolving interconnection disputes. While such a regulator may technically be in a separate organization from the incumbent, it has similar interests. Both are part of the government telecommunications bureaucracy. Both may consider the financial and operating interests of the incumbent as their prime concern.

In such cases, other independent dispute resolution bodies should be considered, possibly using some of the approaches set out in Table 3-3. These might include an independent arbitrator or mediator acceptable to both parties. One option is to have an independent dispute resolution body established by a senior branch of government (the executive or legislature). This body need not be set up as a costly, permanent bureaucracy. It can be staffed on a temporary basis with independent domestic and international telecommunications experts. Another option is to request an international agency with re-

sponsibility in the telecommunications sector, such as the ITU or The World Bank, to appoint or recommend an independent dispute resolution expert or panel to assist in the domestic dispute resolution process.

3.2.5 Ex Ante Regulatory Guidance

In some countries, regulators have prescribed detailed interconnection conditions before interconnection arrangements are made. Examples are the 1996 US and the 1997 Canadian interconnection orders for competitive local operators. In these countries, lengthy regulatory interconnection proceedings were held before the rulings were made. Input was obtained from incumbents, new entrants and other interested members of the public. In the end, detailed decisions were issued, specifying many of the approaches and specific rates, terms and conditions on which interconnection should occur.

This experience produced a wealth of information, analyses and insights into interconnection issues. However, the work effort required to produce a detailed set of interconnection rules should not be

Table 3-2: Approaches to Resolving Interconnection Disputes

Improving the information base for decision-making	➢ Require parties to clearly define areas of agreement and dispute ➢ Send written information requests to operators to clarify disputed issues and provide information for interconnection decisions ➢ Require written argument (with supporting facts and research, if necessary) to assist in clarifying the issues in dispute ➢ To increase transparency, consider making the arguments (but not confidential business data) available for comment by other interested parties and the public ➢ Consider inviting other interested parties (e.g. other interconnecting operators, service providers, or user groups) to comment on the issues
Obtaining expert assistance	➢ Hire an experienced interconnection expert to assist in clarifying the issues, formulating information requests, and providing general advice to the decision-makers ➢ Consider appointing a mediator (or, if the parties agree, an arbitrator) ➢ Use outside parties for informal mediation, arbitration, information gathering or other participation in the negotiations. This approach is particularly useful in countries where direct regulatory involvement would "taint" the legality or politically prevent it from making an unbiased final decision.
Improving accuracy and credibility	➢ Consult with other regulators on their experience in similar cases ➢ Review decisions and interconnection agreements approved by other regulators ➢ Consider circulating a draft of the decision to resolve the dispute to the disputing operators and other interested parties. Their comments should be made public. Comments and corrections can improve the accuracy of the final decision.

underestimated. Moreover, these lengthy interconnection proceedings did not produce the "final word" on interconnection arrangements. In both Canada and the US, there have been lengthy follow-up proceedings before the regulators and in the courts. In Canada, much of the detail of interconnection arrangements was left to a number of industry technical committees led by regulatory staff. This CISC process (which is referred to above) produced very useful results, but it took about 2 years to resolve most of the issues.

It should be recognized that interconnection is a dynamic issue. The types of telecommunications infrastructure and services are constantly changing. As a result, interconnection requirements continue to change as well. Where regulators prescribe interconnection arrangements, they should be viewed as flexible rules that should evolve with telecommunications networks and markets.

3.3 Financial Terms of Interconnection

3.3.1 Interconnection Charges

Interconnection charges often account for a very significant part of the costs of new telecommunications operators. This is particularly the case with new entrants that do not own end-to-end networks. The level and structure of interconnection charges are, therefore, major determinants of the viability of operators in a competitive telecommunications market.

Over the years, a variety of approaches have been used to calculate interconnection charges and generally to determine the financial terms of interconnection. In this Section, we first consider the general approaches that have been used to determine interconnection charges. Later in the Section, we review specific types of interconnection-related costs that are often treated in specific ways. Examples are start-up costs, costs of interconnection links and collocation and infrastructure sharing costs.

3.3.2 Approaches to Setting Interconnection Charges

This Section reviews the general approaches that have been used to determine interconnection charges. While there is no single correct approach, there is a consensus among telecommunications and trade experts that the best approaches are cost-based. However, other approaches have their merits in some circumstances. Table 3-3 provides an overview of the main approaches used to determine interconnection charges. Readers interested in more detail on the costing concepts and economic theories underlying them should refer to Appendix B of the Handbook.

Table 3-3: Main Approaches to Interconnection Charges

Approach	Description and Examples	Comments
Forward Looking Incremental Costs	➢ Charges based on forward-looking costs of facilities and services provided to interconnecting operator (usually estimated over the long run, i.e. Long Run Incremental Costs or "LRIC") ➢ Examples: Australia, Canada, the Hong Kong SAR of China, Chile, and US local operators ➢ Variations of LRIC include LRAIC, TSLRIC and TELRIC. These approaches include different elements of fixed and common costs (e.g.	➢ Generally accepted as best practice ➢ Approach sends most efficient price signals; based on current technology rather than existing book assets ➢ Closest approximation of costs in a fully competitive market ➢ Requires study and some cost and demand estimates. ➢ Usually leads to lower interconnection rates; this stimulates competition but provides lower revenues to incumbent

Table 3-3: Main Approaches to Interconnection Charges (cont'd)

	overheads, and fixed-service costs).that are excluded from traditional LRIC analyses. These variations are growing in acceptance as "best practices". They are described in Appendix B of the Handbook	operator ➢ May be substantially out of line with actual book costs of inefficient incumbents Can be inappropriate if end-user prices are seriously unbalanced (e.g. set well below costs and below interconnection charges
Historical Accounting Costs	➢ Charges based on the accounting records of the operator supplying the interconnection facilities or services ➢ Generally includes an assignment of direct costs and an allocation of common costs booked in the accounting records ➢ Examples: UK, 1995 Japanese system, and Sweden	➢ Common practice; less favoured by regulators and experts today ➢ Less efficient since historical costs were often incurred less efficiently than those based on current technology and operational circumstances (e.g. privatization) ➢ Accounting records often misstate real value of assets: based on subjective accounting policies and political decisions regarding investments ➢ Usually requires study to assign/allocate booked cost to interconnection facilities and services
Sender Keep All (SKA) (Bill and Keep)	➢ No charges payable between interconnecting operators for termination of each other's traffic ➢ Typically, each operator pays for its own facilities up to the point of interconnection, plus charges for any unusual costs incurred by the other operators to accommodate its traffic ➢ Examples: Indian, US and Canadian local operators, and Indonesian regional operators	➢ Works best where the two operators are similarly situated and exchange approximately the same amount of traffic (e.g. for interconnecting local operators) ➢ Charges can apply to compensate for traffic imbalances ➢ Without such charges, SKA can retard financing and development of rural or other services, where there is an imbalance of traffic (i.e. more incoming) ➢ Was the main model for interconnection of ISPs in many markets. However, this is changing as larger ISPs, with substantial backbone facilities and reach, increasingly treat smaller ISPs as customers rather than peers
Revenue Sharing	➢ Typically, new entrants pay the incumbent operator a share of their revenues from interconnected services (or all services) ➢ In some revenue-sharing arrangements, no additional charges are	➢ This approach is simple – no need for cost studies to determine interconnection charges ➢ Generally considered non-transparent ➢ Potentially inefficient and anti-

Table 3-3: Main Approaches to Interconnection Charges (cont'd)

	payable between interconnecting operators for termination of each other's traffic; in others, additional charges do apply for direct interconnection costs (e.g. transmission links, interconnection interfaces) ➢ Examples: Thailand, Indonesia, and China	competitive (i.e. when excessive revenue shares are paid) ➢ Sometimes prescribed by governments or PTTs as the only basis on which interconnection will be permitted in an otherwise closed market; sometimes treated as a "tax" for doing business in a country. May be a transitional step to a more efficient approach
Interconnect Charges based on Retail Prices	➢ Interconnection charges based on prices to end users ➢ A discount is sometimes applied for inter-operator charges. This can be estimated based on the avoided costs of the supplying operator (e.g. retail billing and marketing costs). ➢ Examples: US local resale prices, pre-1995 Japanese approach	➢ Difficult to estimate appropriate discount – may lead to inefficiency (i.e. high discount discourages construction of competitive facilities; low discount undermines financial viability of competition) ➢ Specifically rejected in some jurisdictions (e.g. Hong Kong, China which differentiate "carrier-to-carrier" charges from retail rates)
Other Negotiated Interconnect Charges	➢ Interconnection charges have been negotiated between operators based on a wide range of other approaches; some principled, many arbitrary ➢ Example: International accounting rates, and some reseller agreements	➢ Efficiency of charges depends on how closely they approximate efficient costs; many negotiated charges include implicit subsidies between operators and customers ➢ Level of negotiated charges often depends on the bargaining power of the operators

3.3.3 Comments on Different Approaches

Internationally accepted interconnection principles generally require interconnection charges to be cost-based or "cost-oriented". This is the case with the interconnection principles of the WTO's *Agreement on Basic Telecommunications* and the European Union's *Interconnection Directive*. Cost-based pricing of interconnection services is consistent with best practices adopted by regulators in most countries. This issue is discussed further in Section 3.1.6.5.

Forward-Looking Costing Approaches

There remains a fair amount of debate in regulatory circles about the best approaches to use to calculate interconnection costs in different circumstances. However, today most regulators and experts generally agree that the ideal approach for calculating the level of interconnection charges would be one based on forward-looking costs of supplying the relevant facilities and services. This ideal is usually implemented by means of some variant on the long-run incremental cost (LRIC) approach. This approach has been entrenched in the regulations of some countries (e.g. India) and the laws of others (e.g. the US).

The major variations of the LRIC approach that have been most widely accepted by regulators and experts are:

Long Run Average Incremental Costs (LRAIC) - A long-run costing approach that defines the increment as the total service. It differs from traditional marginal and incremental cost measures by including allowance for the fixed costs specific to the service concerned: "service-specific fixed costs". The European Commission has adopted this approach.

Total Service Long Run Incremental Costs (TSLRIC) - This approach, developed by the Federal Communications Commission (FCC) in the USA, measures the difference in cost between producing a service and not producing it. TSLRIC is LRIC in which the increment is the total service.

Total Element Long Run Incremental Costs (TELRIC) -This approach, also developed by the FCC, includes the incremental cost resulting from adding or subtracting a specific network element in the long run, plus an allocated portion of joint and common costs.

Other variations - There are other variations on the LRIC approach. In Canada, for example, the regulator uses an incremental cost approach (Phase II Costing) and adds a mark-up to approximate forward-looking fixed and common costs. Other regulators have developed different approaches.

A well-designed LRIC-type approach provides an estimate of the costs of an operator to provide interconnection in a fully competitive market. An LRIC-type calculation generally starts by estimating the direct costs incurred by an operator in providing the interconnection services in question. These costs are calculated over the "long run", usually at least ten years, in order to average out the inherently "lumpy" nature of the investment costs of interconnection facilities in the year they are introduced.

In addition to the directly attributable costs, LRIC-type calculations generally include a capital cost component. This component is intended to reimburse the operators for the costs of financing the interconnection facilities, since these costs are necessarily incurred by the operator providing the facilities.

As can be seen from the preceding descriptions, the most widely accepted LRIC-type approaches generally include a reasonable allocation of joint and common costs. Such costs can also be calculated on a forward-looking basis, to approximate the costs of an efficient operator. Joint and common costs are, by definition, not directly caused by the interconnection services, but are nevertheless incurred by an operator in connection with its interconnection facilities and services. Common examples of such costs are the salaries of the president, managing director or legal counsel of the operator. By including capital, joint and common costs, a LRIC approach can approximate costs in a competitive market, while providing reasonably full compensation to the operator supplying the interconnection – assuming it operates efficiently.

Further descriptions of the methods used to calculate long-run incremental costs, including LRAIC, TELRIC and TSLRIC are included in Appendix B and in Module 4.

While variations on the LRIC approach are considered the best practices by most experts, there are practical limitations on their applicability. Some of these are listed in Table 3-3. Some of these limitations are particularly significant in countries with less developed telecommunications sectors. For example, if local retail telecommunications rates are set well below costs, setting interconnection prices at LRIC may not permit a new, local services entrant to run a viable business. The new entrant's interconnection costs may exceed its retail prices. While rate rebalancing is the long-term solution to this problem, in the short term interconnection rates may need to be discounted in order to permit competition to emerge. There are other practical problems with the application of LRIC-type approaches in some environments.

Other Approaches

The applicability of the non-LRIC-type approaches listed in Table 3-3 depends on the circumstances of different countries. The comments in the Table describe strengths, weaknesses and other considerations. Several other comments follow.

Modifications are often made to the various approaches to attempt to compensate each operator

more closely for costs resulting from its interconnection. An example is the Sender Keep All (Bill and Keep) approach. As indicated in Table 3-3, this approach is appropriate where the two operators are similarly situated and exchange approximately the same amount of traffic. Thus, it is often used for interconnection of local operators in the same city or neighbouring regional operators.

The Sender Keep All approach may be modified to add charges to compensate for traffic imbalances. For example, operator no. 1 may receive and terminate more traffic from operator no. 2 than it sends to that operator. Operator no. 1 will then usually incur higher costs as a result of the interconnection than operator no. 2. To compensate for this imbalance, operator no. 2 may pay a cost-based interconnection charge to operator no. 1 for every minute of traffic it sends that exceeds the traffic it receives.

A word or two about revenue sharing approaches. An element of revenue sharing may be appropriate in some cases to distribute surplus revenues after payment of cost-based interconnection charges. However, in some cases, revenue shares paid to incumbents have included a wide range of components, ranging from interconnection costs to a "licence fee" for operating in a jurisdiction or "compensation" to an incumbent for loss of business to new entrants, or fulfilment of universal service obligations.

The latter three components are typically not cost based. They are usually not transparent and are not recommended in any jurisdiction where the regulator wishes to improve efficiency in the telecommunications sector. These approaches can be subject to abuse. For example, excessively high revenue-sharing arrangements have been imposed in some jurisdictions in a short-sighted attempt to earn additional operator or government revenues. The effect is to prevent efficient competition.

If revenue-sharing schemes must be used, then regulators should consider identifying each component of the revenue share separately. This includes, for example, shares to pay for cost-based interconnection charges, for concession or licence fees, etc. This approach adds transparency and allows for the gradual elimination of revenue-sharing components that are not cost-based. Universal service charges should be dealt with by means of a separate charge, not a revenue-sharing formula. Issues related to universal service and universal access charges are discussed in detail in Module 6.

Table 3-3 does not provide an exhaustive list of the approaches to calculating interconnection charges. Other approaches exist. One example is the Efficient Component Pricing Rule (ECPR), which bases interconnection charges on the net incremental costs of interconnection, plus the "opportunity costs" or margin lost by the incumbent as a result of traffic "taken" by the new entrant. This approach has been discussed among academics and consultants, but has generally not been accepted by regulators as a reasonable option.

Finally, interconnection charges are sometimes indexed or "price capped" to determine future increases (e.g. for a five or ten year period). Such approaches provide certainty to interconnecting parties regarding their level of future costs or revenues.

3.3.4 Specific Interconnection Costs

3.3.4.1 Start-up Costs

The network infrastructure of most incumbent operators was designed to function on a monopoly basis. In the transition to a competitive telecommunications market, some modifications are usually required to the operator's switching and transmission facilities and related software to permit efficient interconnection among multiple operators. For example, switches must be programmed to recognize and route traffic to telephone numbers on the network of interconnection operators. Additional numbers must often be allocated and equipment modified to deal with them. These modifications are often referred to as "start-up costs", since they are required at the outset to permit interconnection.

Regulators in different countries have treated start-up costs in different ways. Some take the view that new operators are the beneficiaries of interconnection, so they should pay all start-up costs. In the extreme, this approach is applied not only to interconnecting transmission circuits, but to all modifications and upgrades to an incumbent's network required to facilitate interconnection. Some

new operators accept this approach as the only one that will provide them with interconnection, particularly in countries with state-owned PTTs. However, this approach has disadvantages. It can impose a heavy financial burden on a new entrant, shift costs of network upgrades from incumbents to competitors, and ultimately lessen the chances of viable competitive entry.

A different approach that is more pro-competitive in nature has been adopted by a number of countries such as Canada. The approach is based on the assumption that competition is introduced to benefit all telecommunications users and the economy in general. Interconnection start-up costs are seen as a direct result of the policy decision to open a market to competition. It is also recognized that the costs incurred by all operators will, market conditions permitting, generally be borne by telecommunications users.

Therefore, some basis is developed to apportion costs among established and new operators on the assumption that they will generally pass these on through user rates. A specific surcharge may be considered, but may not be adopted for political reasons. One method of apportioning costs is on the basis of the projected use of telecommunications services (including interconnected services) in the future. A formula can be established to adjust compensation between operators in case actual use differs from projected use of telecommunications or interconnected services.

Under this approach, the incumbent will generally bear a large share of start-up costs. Some regulators regard this approach as necessary or appropriate to facilitate competition. Understandably, this approach is generally opposed by incumbents.

3.3.4.2 Interconnection Links

Different approaches have been adopted to apportion the costs of the physical links between interconnecting operators. Such links include transmission lines or radio links that carry the interconnecting circuits. They also include the ducts, towers, manholes and other support infrastructure, as well as the modifications that are required to the transmission-related facilities (e.g. cross-connects and distribution frames) in order to accommodate the interconnected circuits.

One approach is to require the new operator to pay the entire cost of the transmission links and related facilities. This approach is based on the theory that transmission facilities are being added and the modifications made solely for the benefit of the new operator and its customers. If this approach is adopted, incumbents should not be able to recover any more than the actual costs of the transmission links and related facilities. Sophisticated costing approaches are not required. Normally, these costs are easily tracked through expense invoices, related labour costs and overhead. As a general principle, the costs should not exceed fair market costs for installing the links. Incumbents may have an incentive to inflate charges for such links, and regulatory oversight may be required to ensure charges are based on market costs.

One method of ensuring charges for interconnection links are not inflated is to give the new operator the option of installing the links itself, including work on the premises of the incumbent. Specifications for such work can be subject to discussion at a joint technical committee with a dispute resolution mechanism. Work on its premises can be monitored by the incumbent to avoid arguments about improper work or sabotage.

As with start-up costs (see discussion in previous Section), interconnection links are a necessary prerequisite for the development of a competitive market. Taking this view, regulators may consider it appropriate to apportion the costs of such links between incumbents and new entrants, based on the assumption that end users of all operators will ultimately benefit.

The simplest, and probably most common method of apportioning costs of interconnection links is to have each operator pay the costs of its interconnection links up to the Point of Interconnection (POI). Since POIs are often located in or near the exchange of the incumbent, this method can impose significant costs on a new operator. However, under this approach, the new operator can decide how to configure its network to limit its costs.

3.3.5 Structure of Interconnection Charges

The structure of charges for interconnection often varies from country to country. These variations reflect a number of factors, including differences in the telecommunications infrastructure, policy differences and varying levels of effort on developing cost and price structures. Price structures need not be complex to be efficient and fair. In many cases, simplicity is best. However, with some effort, a price structure can be developed that levels the playing field for all operators and facilitates more efficient interconnection.

Box 3-4 sets out some basic principles for an efficient interconnection price structure.

Operators, regulators and telecommunications experts have long discussed how best to refine telecommunications pricing structures to improve efficiency. Many of the principles applicable to other telecommunications prices also apply to the structure of interconnection charges. Several examples are given below.

3.3.5.1 Fixed and Variable Charges

As a general principle, interconnection charges should reflect the difference between fixed and variable costs of interconnection. For example, the fixed costs of providing a dedicated network access line (loop) are best recovered through a fixed charge. On the other hand, where the costs of network components, such as telecommunications switches, are traffic sensitive, they are best recovered through usage charges. Usage charges are usually based on time (minutes). In the case of interconnection of Internet backbone operators and Internet Service Providers, charges are often based on capacity (bits of traffic).

While it is not always practical to implement this principle, doing so is consistent with efficient pricing theory. Distinguishing between fixed and variable costs in the charges for interconnection components

Box 3-4: Principles for Efficient Interconnection Price Structures

- Interconnection charges should be cost-based (ideally based on long-run average incremental costs, including cost of capital, plus a reasonable markup to cover forward-looking joint and common costs)
- Where information is available, costs should be based on the current replacement costs of assets (discounted to their remaining service life); in the absence of such costs, depreciated book value of assets is sometimes used
- Interconnection charges should be sufficiently unbundled so that an operator seeking interconnection need only pay for the components or services it actually requests
- Where the costs of a particular component vary significantly in different locations, the interconnection charges should be disaggregated (e.g. costs of access lines may be higher in rural areas (where they are typically longer) than in cities)
- Charges should not include hidden cross-subsidies, particularly of an anti-competitive nature (e.g. charges for monopoly-supplied network components should not be inflated to a level well above costs in order to fund below-cost provision of competitive components). This principle is adopted in the *WTO Regulation Reference Paper*.
- The structure of interconnection charges should reflect underlying costs. Thus, fixed costs should be covered by fixed charges, variable costs by variable charges. Peak and off-peak charges should be set where there is a significant difference in costs.

will send the right price signals. For example, there will be less incentive to overuse usage-sensitive network components if they are priced based on usage, rather than on a flat monthly charge. Establishing a price structure that reflects underlying fixed and variable costs should lead to a more efficient use of those components.

3.3.5.2 Peak and Off-Peak Charges

Peak and off-peak pricing differentials have been used for retail pricing of telecommunications services for many decades. Charging higher rates for usage in peak hours provides users with an incentive to call in off-peak hours. Advantages of a peak/off peak pricing structure include:

- reduced peak-hour congestion;
- reduced demand to build new infrastructure to meet peak traffic loads;
- increased overall network utilization; and
- improved quality of service.

The same principles of peak and off-peak pricing are often incorporated in interconnection charges. If they are not, then interconnecting operators will have no incentive to charge higher rates to their end-users during peak hours. The result can be a migration of peak-hour traffic to new entrants, who will then impose higher costs on incumbent's that must build the infrastructure to support the higher peak-hour loads.

Good regulatory policies, such as those adopted in Hong Kong, China specifically provide that the structure of interconnection charges must reflect the behaviour of underlying costs. Thus, the "carrier-to-carrier" charging principles in Hong Kong encourage interconnection charges to reflect both fixed/variable and peak/off peak cost differences.

3.3.5.3 Unbundled Charges

In an increasing number of countries, telecommunications policies require incumbent operators to provide competitors with access to unbundled network components. This approach is supported by the *WTO Regulation Reference Paper*, which states that major suppliers must provide interconnection on a basis that is sufficiently unbundled so that a supplier need not pay for network components or facilities that it does not require for the service to be provided.

In keeping with their WTO commitments, or generally because it is good policy, many regulators have issued directives requiring unbundled charges. For example, in India, a regulation was issued in 1999 by the Telecommunications Regulatory Authority of India (TRAI) that states that "No service provider shall be charged for any interconnection facility it does not seek or require". (TRAI (1998a))

3.3.5.4 Universal Service and ADC Charges

In many countries, incumbent operators incur deficits in carrying out uneconomic universal service obligations (USO) or universal access obligations. Beneficiaries of these social obligations generally include high-cost service areas, such as remote villages or low-income customers. In some countries, however, deficits are not incurred by the incumbents to perform specific universality. Rather, the deficits are incurred as part of a policy of maintaining low access charges for all customers. These are usually referred to as Access Deficit Contributions (ADCs) to distinguish them from Universal Services Obligation (USO) payments that generate revenues for more targeted social purposes.

In a monopoly environment, ADCs are often paid from services priced above costs (e.g. international rates or business services) to access costs that are priced below cost. In the case of the incumbent, ADCs may be explicit, or implicit in unbalanced rates. Traditional telecommunications policies often prevent "rebalancing" of the prices to more closely reflect their costs. New interconnecting operators often do not have similar universal service obligations or access deficits. Accordingly, they are often asked to contribute to USO payments or ADCs of the incumbent.

There are a number of ways of dealing with this issue. These are discussed in detail in Module 6. As indicated in that Module, the best practice for regulators is to levy any USO or ADC charges separately from interconnection charges. As demonstrated in

this Module, the underlying concepts and calculations for interconnection charges are very different from those underlying USO and ADC charges.

If USO or ADC charges are established, it is clearly a good practice to identify them as separate from interconnection charges. Blending the two charges removes transparency from the interconnection process. Separate charges permit regulators to comply with the requirement of the *WTO Regulation Reference Paper* that USO charges be administered in a transparent, non-discriminatory and competitively neutral manner. Please see Module 6 for a more comprehensive discussion of USO and ADC issues.

3.3.6 Internet Interconnection Charges

Over the past decade, the Internet has changed from a co-operative to a commercial communications medium. It has also changed from a relatively small education and research-based data network to a network that accounts for more traffic than voice telephony in several countries today. This transformation of the Internet has changed the basis for interconnection charges among ISPs and between ISPs and the operators of the large capacity backbone telecommunications networks that carry Internet traffic.

Originally, many ISPs regarded themselves as equals or "peers". They generally entered into Bill and Keep interconnection arrangements. Under these 'peering' arrangements Internet networks exchanged traffic without levying charges or paying fees to each other. The underlying premise for peering arrangements was that Internet networks of substantially similar size and traffic volumes benefited more-or-less equally from interconnection, and incurred generally similar costs.

Over time, some Internet Protocol (IP) networks expanded their coverage to national and global levels. Some network operators developed into specialized IP backbone operators, carrying large volumes of Internet traffic for long distances between ISPs and Internet hosting services. These backbone network operators generally provide 'transit' services. Transit services involve the transmission of Internet traffic between two or more ISPs and Internet hosts. Providers of Internet transit services may or may not provide any Internet content or access services themselves. Some ISPs with larger networks also provide transit services, in addition to standard Internet interconnection arrangements.

ISPs generally interconnect with each other and with Internet backbone providers at Internet Exchange Points (IXPs). These are sometimes referred to as Network Access Points (NAPs), although that term is becoming less common. IXPs have switching equipment and routers that permit interconnection of the various Internet networks using the IXP. As with the Internet generally, IXPs are evolving into increasingly multifunctional, and commercial operations, that charge fees for an increasingly wide range of services, rather than just facilitating 'free' interconnection of ISPs. Many IXPs now provide collocation services, providing space as well as equipment for Internet routing, transmission, web-hosting and other services. Separate, market-based charges are usually levied for such services. As with most Internet-related services, these charges are generally unregulated, except where they are provided by a dominant incumbent operator.

The transition of the Internet to a more commercial medium, with large disparities between the sizes and functions of Internet networks, has changed the structure of Internet interconnection charges. In some cases, interconnecting ISPs still exchange traffic with each other as 'peers' on a Bill and Keep basis. Under this arrangement, each ISP typically pays its own costs of transmission, routing and other equipment, or shares the costs on a negotiated basis.

However, such peering arrangements are becoming less common, particularly where different types or sizes of Internet operators interconnect. There, asymmetrical charges have become the norm. The backbone network operator, or the larger ISP, usually charges the smaller ISP or local access provider for interconnection and transit services. The basis for such interconnection charges is often similar to those found in other parts of the telecommunications industry. Charges are typically based on one or more of the following variables:

- traffic flow or usage, based on the increasing capacity of Internet routers and other equipment to measure traffic;
- imbalance of traffic flows between ISPs;
- distance or geographical coverage;
- number of points of interconnection; and
- other cost-based interconnection charges.

All of these charging variables are related to costs incurred by the ISP providing the service, or at least proxies for such costs. This trend toward cost-based interconnection charges is consistent with developments in other telecommunications services.

One anomaly in the trend toward cost-based Internet charges has been related to the traditionally heavy reliance on US-based ISPs and Internet backbone providers by ISPs in other countries. Due to the early lead of the US-based Internet industry, and the heavy concentration of attractive Internet web sites in the US, many ISPs in other countries have paid US ISPs for transportation to and from the US to their home country. There have often been no reciprocal charges paid by US ISPs for traffic to the interconnecting ISPs in other countries. This imbalance has become a hot policy issue within the ITU and other international organizations. Within APEC, for example, Australia and various Asian countries have complained that current costs of interconnecting with North America are too high and that it is inequitable that Asian networks are not compensated for their costs in carrying traffic generated by North Americans.

In April 2000, ITU Study Group 3 adopted Recommendation D.iii on International Internet Interconnections:

> "Noting the rapid growth of Internet and Internet protocol-based international services: It is recommended that administrations involved in the provision of international Internet connection negotiate and agree bilateral commercial arrangements applying to direct international Internet connections where each administration will be compensated for the cost that it incurs in carrying traffic that is generated by the other administration."

The US and Canada have opposed this recommendation. They argue that the North American bias of Internet routing will decrease over time, as competition and market developments reduce costs and increase Internet facilities in other regions. The US, in particular, has long argued that the Internet should remain unregulated in most respects. The proposed resolution was considered at the ITU's World Telecommunications Standardization Assembly in Montreal in October 2000. After much discussion, the Assembly adopted a recommendation that calls for arrangements to be negotiated and agreed upon on a commercial basis when direct Internet links are established internationally. The new recommendation does not prescribe any particular costing approach; thus operators are free to determine the approach to be used in implementing it. This recommendation has been referred to as a framework for future discussions. The US and Greece stated that they would not apply this recommendation in their international charging arrangements.

Local interconnection charges are also important to the viability of ISPs. Local Internet access providers will be principal beneficiaries of the move to unbundling of local loops, which is discussed in Section 3.4.6 of this Module. Unbundled local loops can be used by ISPs to provide DSL-based high speed Internet services on more favourable terms than those currently available in most markets.

In a number of countries, cable television networks provide an efficient and highly successful form of high-speed local Internet access. These 'cable modem' services have generally been provided only by the serving cable TV operator. This has given the cable operator a strong position in ISP markets compared to other ISPs without high-speed capabilities. Several countries have considered whether to require cable operators to interconnect with other ISPs to provide them access to high-speed cable networks.

In Canada, the CRTC has ordered major cable operators to grant other ISPs access to their high speed networks at a discount from retail ISP rates. In the US, the FCC has not, to date, taken similar

action. Some US cable operators have entered into agreements with ISPs to access their high-speed networks on an exclusive basis, thus making access unavailable to competitors. This appropriateness of such exclusive arrangements is under consideration by the FCC.

3.3.7 Interconnection with Mobile Networks

As indicated in various places in this Module, mobile operators must obtain interconnection with incumbent operators of the PSTN in order to ensure the viability of their services. In general the interconnection principles and practices described in this Module apply to interconnection by mobile operators to the PSTN. However, certain differences apply to interconnection with mobile operators.

Historically, regulators devoted much less attention to mobile services than fixed services. Mobile service was priced at a substantial premium to wireline service. As a result, mobile service was viewed as a discretionary or even a luxury service where consumers did not need much in the way of regulatory protection. As well, mobile service was offered competitively in many countries, with the expectation that market forces rather than regulators would be the prime force in setting prices. Mobile operators were not perceived as possessing market power in the same way as fixed operators.

However, the role of mobile services has changed in recent years, leading to increased regulatory interest and attention:

- The consumer rates for mobile service have declined in both developed and developing countries. The combination of rate decreases, the fact that consumers like the flexibility of mobile service, and improvements in mobile technology (such as longer battery life) have contributed to an enormous increase in the number of mobile users. Indeed, in some countries, the number of mobile users now exceeds the number of fixed users. Thus, for many, mobile service is no longer a luxury – it is the prime way in which they access the PSTN.

- Some less developed countries have begun to devote much more attention to fostering the growth of mobile service, as they realize that implementing mobile infrastructure can be quicker and less capital intensive than building the type of ubiquitous wireline networks that are found in most developed countries.

- All countries have come to appreciate the revenues that can be realized by auctioning mobile wireless spectrum. Bidders will take the design of the regulatory environment into account as they assess how much to bid.

When mobile service was first introduced, most countries adopted Calling Party Pays (CPP) arrangements. Under CPP, the person that originates a call is the one that pays for it, whether it originates on a mobile or fixed-line telephone. A person who makes a mobile-to-fixed call pays the mobile operator at the retail rate. The mobile operator, in turn, pays the fixed operator an interconnection charge that is relatively small when compared to the retail rate. Usually, the interconnection charge is invisible to the mobile caller. However, the situation is quite different for a fixed-to-mobile call. Because the interconnection charge paid by the fixed operator to the mobile operator is relatively large, the fixed operator will want to recover it from the caller who makes the call. Accordingly, the fixed operator will charge a substantial surcharge for fixed-to-mobile calls, with the surcharge (less an administrative charge) being passed on to the mobile operator. The mobile operator does not charge its customers for calls received from the PSTN.

CPP has not been adopted in countries such as the US and Canada, where most local calls on the PSTN are not metered, but charged at a flat monthly rate. These are referred to as Receiving Party Pays (RPP) or Mobile Party Pays (MPP) environments. In a RPP country, the mobile customer pays both for mobile-to-fixed calls and for fixed-to-mobile calls. However, the customer on the fixed network pays the same amount to call someone whether on the fixed network or on a mobile network. Interconnection between the fixed and mobile operators is generally on a reciprocal basis, either bill-and-keep (also referred to as sender-keep-all) or mutual compensation at the same interconnection rates that are found in fixed-fixed interconnection arrangements.

A number of countries that do not have CPP are considering a switch to it, or have done so. For example, Mexico introduced CPP in April 1999. This move is partly motivated by evidence of higher mobile subscriber growth rates in CPP countries. Sri Lanka has announced its intention to change to CPP. The transition to CPP affects subscribers of all networks in a market, including PSTN subscribers. Their bills will be increased since they will be charged for calls to mobile subscribers. Accordingly, the transition normally involves regulatory supervision to ensure, among other things, that PSTN subscribers are adequately notified of increased charges that will appear on their bills.

Because fixed-to-mobile calls are so much more expensive than fixed-to-fixed calls in a CPP country, many countries have distinct dialling prefixes for fixed-to-mobile calls. In that way, consumers understand that they will be charged a premium for fixed-to-mobile calls, and it is obvious when such charging takes place.

In recent years, some observers have expressed concern about the level of CPP charges for fixed-to-mobile calls. The ITU's Trends 2000 Report, which focuses on interconnection, points out that in Europe, where CPP arrangements prevail, the average fixed-to-mobile interconnection rate was USD 0.21 per minute for a three minute call. This contrasts with mobile-to-fixed interconnection rates of USD 0.01 per minute for local interconnection, 0.014 for single transit interconnection and 0.02 for double transit interconnection. The ratios of fixed-to-mobile and local mobile-to-fixed rates range from a low of 8.7 in Norway to a high of 34 in France. The report suggests that asymmetrical regulation of fixed-line and mobile operators may have resulted in inflated mobile termination charges under CPP.

Some observers believe that the high level of CPP charges for fixed-to-mobile calls is due to a combination of two factors, market failure and regulatory inattention:

- The market failure arises because there is little competition in fixed-to-mobile rates. Mobile operators often compete vigourously on subscription and mobile-to-fixed rates, service levels and coverage, but they rarely compete on fixed-to-mobile rates. Such competition does sometimes arise, for example in Finland, where mobile operators have reduced fixed-to-mobile rates in line with mobile-to-fixed rates. In countries where there is a monopoly fixed operator, the fixed operator has little incentive to reduce fixed-to-mobile rates. Even in countries with competing fixed operators, there seems to be little evidence of competition to reduce fixed-to-mobile rates.

- The regulatory inattention arises because, as explained earlier, mobile service was historically viewed as a discretionary or even a luxury service that appealed to a narrow segment of users. In many countries, mobile service was offered competitively, and rates were set by market forces. Unlike the fixed networks, regulators did not have good cost data for mobile networks. Without cost data, the regulators were not in a position to determine if fixed-to-mobile rates might be higher than necessary.

The result of these two factors is that fixed-to-mobile rates in some countries have remained at high levels even as mobile-to-fixed rates have declined substantially due to reduced costs and vigourous competition.

An examination of the fixed-to-mobile rates that are charged to the customers of a fixed operator leads to an examination of the interconnection charges levied by the mobile operator to the fixed operator for the termination of a call on the mobile network. Few countries have examined the costs of mobile termination and applied these costs in setting interconnection charges. One country that has recently made such an attempt is the United Kingdom. In a 1998 report, the Competition Commission determined that fixed-to-mobile termination rates were substantially above cost. In 1999, OFTEL ordered that rates be substantially reduced to a ceiling of 11.7 pence per minute, and that the ceiling be further reduced by 9% per year (after inflation) for two years thereafter. OFTEL will be considering if further pricing action is needed following this period.

High mobile interconnection rates may be reduced by competition over time. However, as mobile services catch up with and overtake fixed networks, there is likely to be more regulatory scrutiny of high mobile termination rates, particularly where they are

thought to be set at levels that are significantly above cost.

3.4 Technical and Operational Conditions

While financial arrangements are important to the development of interconnection arrangements, the technical and operational conditions determine how efficient and "seamless" interconnection is from the users' perspective. These conditions can also determine whether competition in a particular market will succeed or fail.

The most important technical and operational conditions are neither complex nor difficult to understand. At a minimum, regulators should develop an overview of the key technical and operational conditions in order to resolve disputes that may arise in interconnection negotiations.

3.4.1 Provision of Information by Incumbents

3.4.1.1 Availability of Agreements or Offers

The advantages of transparent interconnection arrangements are discussed in Section 3.1.5.4. The simplest way to encourage transparency is to require publication of interconnection agreements or offers of incumbents. In this regard, the *WTO Regulation Reference Paper* requires signatories to ensure that a major supplier will make publicly available either its interconnection agreements or a reference interconnection offer.

The advantages of publication of interconnection agreements or standard offers include:

- Publication facilitates interconnection by existing and potential new entrants. It allows them to obtain basic interconnection terms and conditions without lengthy negotiations or regulatory orders;
- It discourages undue discrimination by a dominant operator (or by both parties to an agreement) that may not be readily detectable by regulators if filed in confidence;
- It facilitates comparisons of interconnection rates, terms and conditions among major operators; and
- It assists in developing industry standards, benchmarks and best practices.

The disadvantage of mandatory publication of interconnection agreements is that it breaches the normal confidentiality of commercial agreements. However, this disadvantage can be mitigated in several ways. One is to permit deletion of commercially sensitive information from filed agreements. This can include proprietary network or service information and related costs. In such cases, a confidential filing with the regulator is normally required. Another approach is to require only the filing of standard agreements or offers ("reference offers"), rather than all executed agreements.

For the reasons discussed in Section 3.1.5.2, the filing of interconnection agreements between non-dominant operators is not generally required. The *WTO Regulation Reference Paper* requires publication of agreements with major suppliers, or a reference interconnection offer with them. A number of countries with well-developed regulatory regimes, for example Denmark and the UK, only require the publication of interconnection agreements of incumbents.

There is often no telecommunications regulatory requirement for publication of interconnection agreements between smaller operators. However, these are increasingly being made public to comply with the securities laws of some countries. In these countries, securities regulators require companies that issue shares to the public to disclose their material contracts. Examples of such agreements can be found on the EDGAR Web Site in the US. Agreements between new entrants can provide insight into interconnection arrangements in less regulated markets.

3.4.1.2 Network Specifications

Interconnected networks must be technically compatible. A new entrant must, therefore, have access to technical specifications of the network of the incumbent with which it will interconnect. Similarly, the incumbent requires information on the

technical characteristics of an interconnecting operator's network. For example, it will be important for both operators to know the types of switching, routing and transmission equipment used by the other, signalling protocols, number of circuits and the projected volume of traffic to be exchanged.

Sufficient information is required to permit the interconnecting operators to design their own networks to provide efficient connectivity between each other's customers. Regulators should ensure that incumbents and new entrants do not withhold information necessary to ensure efficient interconnection arrangements for both sides.

Operators should not be permitted, for example, to withhold necessary information on the grounds that their standards and specifications are proprietary. If necessary, some technical information could be exchanged under non-disclosure agreements. In practice, however, this is impractical and can frustrate interconnection of future networks. The telecommunications sector is evolving towards more open standards, and this is a trend that regulators should encourage. Open standards are often developed through industry committees with regulatory observers or mediators. In keeping with this practice, regulators should encourage interconnection operators to establish technical committees to develop specifications, protocols, and procedures for the interconnection of their networks.

In many cases, incumbent operator networks have not been designed to anticipate interconnection with other operators. Accordingly, some network modifications are often required to permit interconnection. Treatment of such network modifications or "start-up costs" is discussed in Section 3.3.4.1.

3.4.1.3 Network Changes

Telecommunications networks are dynamic. In most countries, networks are constantly changing as new switching and transmission facilities are added, new software and features are installed, and new protocols adopted. The most obvious example is the current transition from circuit-switched to packet-switched networks, such as Internet Protocol networks, to carry both data and voice traffic. However, the network plans of operators change regularly in response to technological development, market and budget considerations.

Over time, as the networks are modified, it is good practice for regulators to require that networks of dominant incumbents evolve into more open networks.

3.4.2 Treatment of Competitor Information

Monopoly or dominant providers of local telephone services, and certain other monopoly services, are in a position to collect competitively valuable information on their interconnecting competitors. A typical situation might involve a local monopoly operator that receives orders from a long distance competitor to install leased local lines to interconnect with the competitor's POP. The monopolist would know that the competitor had located a relatively heavy long distance user (probably a business or government user) that had sufficient traffic to require a leased local line. In the absence of competitive restrictions, the monopoly could send a salesperson from its own long distance division to offer a discount or other incentive to the customer to persuade it not to use its competitor's services.

Abuse of such competitive information is subject to regulatory restrictions in many countries. The Reference Paper on Regulation that forms part of the *WTO's Agreement on Basic Telecommunications* attempts to prohibit such activities. The Reference Paper requires signatories to maintain "appropriate measures" for the purpose of preventing major suppliers from engaging in anti-competitive practices. One of the practices identified is using information obtained from competitors with anti-competitive results.

A national example of a prohibition against competitive misuse of information can be found in the General Licence issued by the Irish regulator. Condition 20 of that licence deals with misuse of data in the following terms:

> "The Licensee shall not make use of network or traffic data, traffic profiles or any other data of any nature, and which are not otherwise publicly available and which become available to the Licensee directly or indirectly either as a result of entering into interconnection arrangements or

> otherwise as a result of carrying telecommunications messages, in such a way which, in the reasonable opinion of the Director, would unduly prefer the interests of any business carried on by the Licensee or an Affiliate or place persons competing with that business at an unfair disadvantage." (OTDR (1998))

A good approach to preventing abuse of competitive information is the establishment of an Interconnection Services Group (ISG). This is sometimes called a Carrier Services Group. The idea is to establish a separate organization within the incumbent operator, whose role it is to handle interconnection-related dealings between that operator and interconnecting operators. For example, all orders by interconnecting carriers for interconnection links, additional capacity and customer access lines would be submitted to the ISG. The ISG will process the orders.

Safeguards will be put in place to ensure that information obtained by the ISG is not used for improper purposes. For example, where a new entrant orders an access line from the incumbent operator to serve a new customer, the ISG should not pass that information on to the marketing department of the operator to try to "snare" or "win-back" the customer before the access line is installed. Confidentiality safeguards should include codes of conduct with mandatory suspension or termination of employees who "leak information". Separate office space, locked filing cabinets, audits and other measures can help ensure confidentiality of ISG information.

3.4.3 Treatment of Customer Information

Monopoly providers of local telephone services are in a position to collect information on their customers. Such information may include names, addresses and telephone numbers, as well as information on monthly billing levels, calling patterns, percentage of calls unanswered, etc. Customer information of this type can be very valuable in marketing new services. For example, customers with very long calls may be heavy Internet users to whom Internet services can be successfully marketed. Users with many missed calls make good customers for voice-messaging services. Customers with high international calling would be good targets to tie up in long-term contracts if a competitive international service operator is about to be licensed.

In some countries, including the US and Canada, regulatory restrictions are imposed on the use of customer information. Some of these rules are aimed at protecting the privacy of customers. For example, customers typically do not want the world to know what phone numbers they call.

Another example of a regulatory restriction is found in the European Union data protection directives and in related laws of EU Member States. These laws impose specific obligations on telecommunications service providers regarding the use that can be made of billing and other customer data, including a prohibition against using such information to market telecommunications services to customers unless the customer has consented to that use of its data. Other countries have implemented, or are considering similar consumer protection rules.

Other restrictions are aimed at preventing anti-competitive use of customer information gathered by monopoly operators that have competitive operations or affiliates. Such rules may require a monopoly local operator, for example, to share any customer information that it provides to its competitive operations or affiliates with interconnecting operators or other direct competitors in the same business line. For example, if a local monopoly operator's long distance services division collects information to identify heavy Internet users to help its Internet division sell services, it would be required to provide the same information to competitive Internet Service Providers.

These restrictions are based on the assumption that the local monopoly service provider is in a position to collect the information solely due to its monopoly position. Distribution of this type of information can be handled through an Interconnection Service Group (see Section 3.4.2).

3.4.4 Points of Interconnection

The interconnection policies of many countries require incumbent operators to permit interconnection with their networks at any technically feasible point. This policy is reinforced by the *WTO Regulation Reference Paper*, which requires

signatory countries to ensure interconnection at any technically feasible point with their major suppliers.

Interconnection agreements and regulatory orders have established different interconnection points in different countries. Box 3-5 provides examples of technically feasible interconnection points that have been prescribed by regulators or established in interconnection agreements.

The definition of technically feasible interconnection points is not static. Telecommunications networks continue to evolve. As new technologies, such as those based on the Internet Protocol and digital subscriber loops, are rolled out, it is becoming technically feasible to interconnect networks at different points. Therefore, interconnection agreements and regulatory directives should not prescribe limitations on the points of interconnection that will be permitted. It should be open to interconnecting operators to propose interconnection at different points as networks evolve.

The costs of interconnection incurred by both operators will vary depending on the points of interconnection. Incumbents will sometimes propose standard points of interconnection of their networks with other operators. These standard points of interconnection may be set out in the "reference interconnection offers" major suppliers are required to make available pursuant to the *WTO Regulation Reference Paper*.

In some cases, new entrants may wish to interconnect at points other than the standard points. In such cases, the Reference Paper provides that such interconnection should be made available upon request. However, the requesting party may be required to pay charges that reflect the cost of construction of necessary additional facilities.

A variation on the theme of interconnection at non-standard points can be found in a recent regulatory decision in the United Kingdom on Third Generation cellular services. The UK regulators have recently ruled that new Third Generation cellular networks should have access to earlier generation cellular networks at points around the country, by means of a compulsory roaming arrangement. This example is set out at Box 3-6.

3.4.5 Access to Unbundled Network Components

In an increasing number of countries, telecommunications policies require incumbent operators to provide competitors with access to unbundled

Box 3-5: Examples of Technically Feasible Interconnection Points

- The trunk interconnection points of local and national tandem exchanges (most common point of interconnection or POI)
- The national or international circuit interconnection points of international gateway exchanges
- The trunk side of local exchanges
- The line side of local exchanges (e.g. at the main distribution frame (MDF) or Digital Distribution Frame (DDF)
- Cross-connect points of any exchange
- "Meet points" at which operators agree to interconnect
- Signaling transfer points (STF) and other points outside of the communications channel or band, where interconnection is required for CCS7 or other signaling to exchange traffic efficiently and to access call-related databases (e.g. a Local Number Portability (LNP) database).
- Access points for unbundled network components
- Cable landing stations

network components. Unbundling generally refers to the provision of network components on a stand-alone basis. Unbundling permits interconnecting operators to access a single unbundled component without an obligation to buy other components as part of an "interconnection service".

There are many possible types of unbundled network components. The policies of some countries require provision of certain features, functions and services on an unbundled basis – as well as certain physical facilities. These features, functions and services may be associated with transmission or switching facilities. They may also be associated with software facilities, such as databases that support the efficient provision of telecommunications services. Examples include access to directory information databases, operator services and subscriber listings in telephone directories.

In this Module, we will use the term "network components" to refer to both physical network facilities and these "non-physical" features, functions and services. Box 3-7 lists examples of unbundled network components.

Unbundling of the local loop is a special case of unbundling that is currently being addressed by regulators in many countries. It is dealt with in more detail in the next Section.

Box 3-6: Compulsory National Roaming in the UK

Background:

As part of the process leading to the licensing of "Third Generation" cellular wireless networks in the UK, Oftel and the Department of Trade and Industry ("DTI") dealt with the issue of compulsory roaming. The regulators determined that any existing wireless network operator which participated in the auction to obtain spectrum for Third Generation network services would be required to accept a licence modification obligating the operator to negotiate an interconnection agreement to provide national roaming access to new entrants. The aim was to prevent incumbent operators from using their existing wireless networks to an unfair competitive advantage while new entrants built up their networks and territorial coverage. In effect, DTI and Oftel determined that access to earlier generation networks was an essential facility to be made available to new entrant competitors. (The concept of essential facilities is discussed in the next Section.)

The Nature of Roaming:

Roaming is typically an arrangement between wireless network operators or services providers to allow access by one service provider's customers to the network or services of another service provider located outside the service area of the first service provider. Roaming arrangements require the implementation of subscriber authorization and billing systems. They also require appropriate technical and spectrum capacity arrangements to be at all points of access by customers of roaming operators.

The Requirements of National Roaming:

DTI and Oftel intend to make what was previously a system of negotiated interconnection among non-competing wireless operators a compulsory arrangement between incumbents and a new entrant. National roaming is to be made available on a non-discriminatory basis. Oftel will deem the incumbent to have costs of roaming services equal to the rates for roaming services charged to competitors. Oftel will then include such deemed costs in determining whether the service charges of incumbents are sufficient to cover costs and make an adequate return. National roaming services will not be available to a competitor before the competitor has achieved network roll-out covering at least 20% of the UK population, and may expire any time after 31 December 2009. Roaming charges are to be determined on a "retail minus" rather than "cost plus" basis (meaning that roaming charges will be derived from end user charges, less a discount reflecting elements of cost not incurred in providing the roaming service rather than an end user service).

Decisions as to what components to unbundle and how to unbundle them are sometimes left to negotiations between operators. According to the Japanese interconnection policy, for example, unbundling should be promoted as much as possible through a process which takes into consideration the opinions of carriers other than the incumbent. However, the Japanese policy also indicates that the regulator should be involved if negotiations fail. In practice, for the reasons discussed below, negotiated unbundling arrangements are generally unsatisfactory in the long run. The incumbent has little incentive to unbundle its network sufficiently to permit competitors to operate very effectively.

Rationale for Unbundling

The purpose of unbundling policies is to lower economic and technical barriers to competitive entry. The large capital costs of building duplicate networks raise a significant barrier to entry. Competitors may not be willing or able to finance the construction of complete networks. However, they may be willing to build parts of such networks. For example, they may build certain switches, inter-exchange transmission facilities, and access lines in a limited number of locations. If the regulatory framework permits, competitors can then obtain other network components, such as switching capability and access lines in other locations, from the incumbent. This permits new entrants to mix their self-built network components with those of the incumbent in an efficient manner.

The ability to mix self-built network components and those of the incumbent will increase the viability of the business case for competitive entry in many countries. Thus, competition will emerge where it otherwise would not. The use of the incumbent operator's network components by competitors will often be transitional. Over time, the competitor will build more of its own facilities and become a full-fledged facilities-based operator.

Many incumbents are unwilling to provide competitors with access to unbundled network components unless they are required to do so by regulation. While the issue is still controversial in some countries, and among some experts, mandatory network unbundling is becoming more common.

Unbundling Policies

The trend to unbundling was given a strong impetus in the *WTO Regulation Reference Paper*. The

Box 3-7: Some Possible Unbundled Network Components and Services

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

Reference Paper states that major suppliers must provide interconnection on a basis that is sufficiently unbundled so that a supplier need not pay for network components or facilities that it does not require for the service to be provided. While this statement is supportive of unbundling policies, it is quite general. It provides little guidance for the development of national unbundling policies. Unbundling policies are still in the early stages of development in many countries.

Unbundling policies have developed in the US, Canada, Australia, Singapore, Hong Kong and other countries, including, more recently, the EU. The new regulatory framework for electronic communications services proposed by the European Commission on 12 July 2000 provides a strong new impetus for implementation of national unbundling policies. Particularly significant in this regard, is the EU's new regulation on local loop unbundling, which will come into force on 31 December 2000.

Unbundling has also been required in other EU regulatory documents. Article 7(4) of the EU Interconnection Directive provides that interconnection charges must be sufficiently unbundled so that an applicant for interconnection is not required to pay for anything that is not strictly related to the service requested. Similarly, Article 7(4) of the *Revised Voice Telephony Directive* (Directive 98/10/EC) states that:

> "Tariffs for facilities additional to the provision of connection to the fixed public telephone network and fixed public telephone services shall, in accordance with Community law, be sufficiently unbundled so that the user is not required to pay for facilities which are not necessary for the service requested."

Advantages and Disadvantages of Unbundling

There are some disadvantages to a full-scale mandatory unbundling policy. In particular, it can act as a disincentive to the construction of competitive network components, and the development of true facilities-based competition. However, the disadvantages appear to be outweighed by the advantages. Moreover, the potential disadvantages can generally be avoided if the pricing and other terms of the unbundling guidelines are properly set. The main advantages and disadvantages of a mandatory unbundling policy are summarized in Table 3-4.

Table 3-4: Advantages and Disadvantages of Unbundling

Advantages	Disadvantages
➢ Reduces economic barriers to entry, by allowing new entrants to construct some components of their networks and obtain other components from the incumbent operator ➢ Encourages innovation, since new entrants can combine new technologies (e.g. ADSL and IP data/voice switches) with components of existing networks (e.g. access lines) ➢ Avoids unnecessary duplication of components (e.g. access lines in remote areas, transmission tower space) ➢ Facilitates access to rights of way, towers, etc. by new entrants (in many countries it can be very time consuming and expensive to obtain such rights)	➢ Reduces incentive for construction of competitive network facilities (depending on the availability and price of unbundled components) ➢ Can enrich the new entrant at the expense of the incumbent operator (if unbundled component prices are set below costs) ➢ Requires detailed regulatory intervention and technical co-ordination

Regulatory Approaches to Unbundling

Given the potential disadvantages of a mandatory unbundling policy, some regulators have adopted modified approaches to such a policy. These approaches are intended to achieve some advantages and avoid some disadvantages of policies that require unbundling of all network components. Some of these approaches may be summarized as follows.

- **Transitional Unbundling Requirements** - Access to certain types of unbundled components may be required for a limited period of time. This approach can apply, for example, to access lines (loops) in urban areas. Unbundling of access lines might be required for the first five years after a market opening. Thus, competitors can use the incumbent's access lines to "jumpstart" competition. However, they will have to construct their own access lines by year five, in order to maintain network connections with their customers. In theory, this approach will encourage the development of competition in the short term. At the same time it should promote development of complete facilities-based competition over the mid to longer term. Local loop unbundling is described further in the following Section of this Module.

- **Selective Unbundling Requirements** - Some unbundling policies distinguish between network components. They require unbundling of some and not others. Unbundled access may be required only for certain types of components. For example, unbundled access may be required for network components in cases where construction of duplicate components would cause environmental damage or public inconvenience. Thus, incumbents might be required to provide access to towers, poles, conduits, ducts, aerial access lines and inside wiring, where a proliferation of such facilities would degrade the environment, disrupt public roads, and/or otherwise inconvenience the public. The same may be true of access lines or switching facilities in architecturally or culturally important areas. Such access might be required over the long term as well as the short term.

Many countries are still developing policies on network unbundling. Unbundling policies vary from country to country, depending on the conditions of local telecommunications markets. It is arguable that mandatory unbundling is less desirable in countries with very limited telecommunications network infrastructure and large pent-up demand. In such less developed countries, mandatory unbundling may reduce the incentive to build much-needed new infrastructure. On the other hand, in some less developed countries, the business case for new entry may not be viable without mandatory unbundling. Each telecommunications market should be carefully assessed to determine the role unbundling policies should play in sector development.

3.4.6 Local Loop Unbundling

Mandatory unbundling of local loops is increasingly being used as a regulatory tool to accelerate competition in local access markets. Around the world, telecommunications network competition has developed most rapidly in the long-distance and international markets. Local access markets are generally less competitive. Wireless services currently provide an alternative means of local narrowband access in many markets, and broadband competition is starting. However, wireline services still provide the main means of local access around the world. There, high entry costs and low margins have discouraged competition.

Competition in local access is increasingly seen as an important policy objective. One reason is the perceived need to provide more competition in high-speed access markets in order to accelerate the roll out of Internet, e-commerce and video services. Many regulators and policy makers see such competition as necessary to maintain or increase the competitiveness of their national economies.

Regulators have now mandated unbundled access to local loops in a range of different economies. At one end of the income spectrum, these countries include the US, Australia, Canada, Singapore and the EU members. Unbundled loop access has also been mandated in a number of middle income countries, such as Mexico and the Slovak Republic, as well as in lower income countries, such as Albania, Guatemala, Kyrgistan and Pakistan.

Types of Local Loop Unbundling

Local loop unbundling regimes typically require incumbent operators to provide access to their local loops to competitors. Other third parties, such as customers, may sometimes also obtain unbundled access. Access to local loops is provided at a point of interconnection somewhere between the network termination point on the customer premises and the line-side of the access network operator's local switch. From this point of interconnection, the competitor will obtain dedicated or shared access to the local loop. The competitor will thus be able to use the loop as a direct transmission medium between its network and the customer's premises.

Various technical options are available for local loop unbundling. In its proceedings on unbundled access to the local loop in early 2000, the European Commission's DGIS focussed on three main options for access to local loops:

- Full unbundling of the local loop (unbundled access to the copper pair for competitive provision of advanced services by third parties);
- Shared use of the copper line (unbundled access to the high frequency spectrum of the local loop for the competitive provision of Digital Subscriber Loop (DSL) systems and services by third parties); and
- High speed bit stream access (provision of xDSL services by the incumbent).

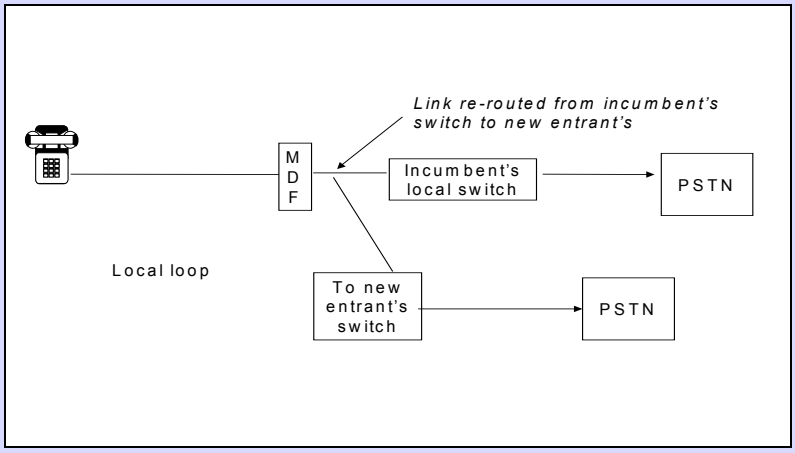
Although different approaches are possible, these three are the main ones in use today. Each of them is described in greater detail below.

Full Unbundling (Copper Loop Rental)

Full unbundling can provide new entrants with access to raw copper local loops (copper terminating at the local switch) and sub-loops (copper terminating at the remote concentrator or equivalent facility). In the case of unbundling at the local switch, the link between the main distribution frame (MDF) and the local switching equipment on the incumbent's premises is re-routed and connected to the new entrant's switch. The new entrant takes over the operation of the local loop.

Figure 3-1 illustrates this type of full unbundling of a local loop. The illustrated case assumes that the

Figure 3-1: Full Unbundling – Local Loop



Source: Adapted from CEC (2000b)

customer has decided to change telecommunications service suppliers. The local loop that previously connected the customer to the incumbent's switch has been re-routed to connect it to the new entrant's switch. The new entrant will then use the unbundled local loop to provide an alternative local access service to that previously provided by the incumbent.

Figure 3-2 illustrates full unbundling in a case where there are two local loops to a customer's premises. One loop is unbundled by the incumbent and re-configured to connect the customer to the new entrant's network. The other loop continues to connect the customer to the incumbent's network. A similar approach would apply where there are three or more loops to a customer's premises. In each case, the customer could decide how many loops it wanted connected to different operators. The approach illustrated in Figure 3-2 would be used where a customer wants to retain its basic telephone service with the incumbent. It can do so and, for example, at the same time have a dedicated connection to a new entrant's xDSL services to access high-speed data services (e.g. Internet or video services).

Full unbundling of the type illustrated in Figure 3-1 and Figure 3-2 essentially involves rental of a dedicated copper loop by the incumbent to a new entrant. Such copper loop rental provides the new entrant with direct access to and use of the copper loop. This allows new entrants to operate their own end-to-end transmission systems. Such operational control can be important to ensure the integrity and quality of high-speed services.

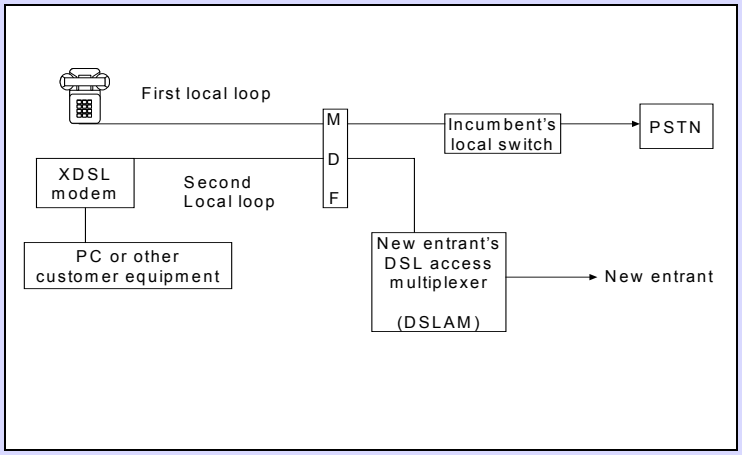
Although Figure 3-1 and Figure 3-2 indicate that the point of interconnection is at the distribution frame where the copper loop terminates, it is also possible to locate the point of interconnection at a remote concentrator unit (remote line unit).

Shared Use of the Copper Loop

An alternative means of providing access to the local loop involves shared access rather than exclusive access by a new entrant. In this form of unbundling, the incumbent and the new entrant provide services over the same loop.

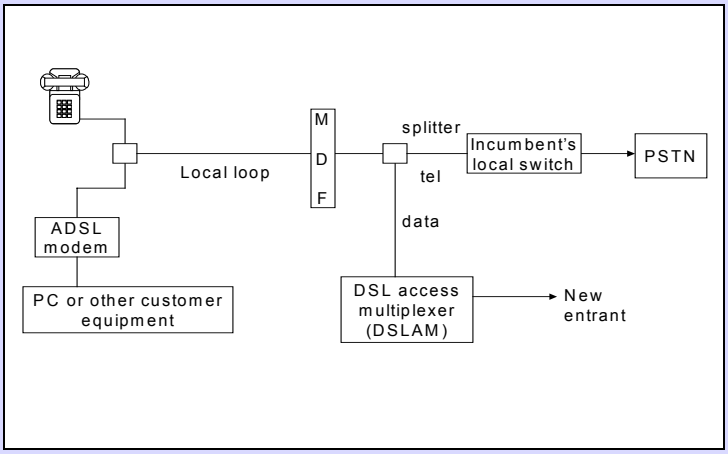
Figure 3-3 illustrates one form of sharing the local loop. In this case, the customer will continue to

Figure 3-2: Full Unbundling – Two Local Loops



Source: Adapted from CEC (2000b)

Figure 3-3: Shared Use of Copper Loop Using Splitter



Source: Adapted from CEC (2000b)

receive basic PSTN services from the incumbent, and at the same time, receive DSL access services from a new entrant. As illustrated, a splitter is located between the MDF and the incumbent's local switch. The splitter is connected to both the incumbent's switch and to a DSL access multiplexer (DSLAM) connected to the new entrant's high-speed network.

As indicated, the splitter separates telephone and data traffic. Thus, the voice frequencies of the loop continue to be used by the incumbent. The non-voice frequencies are made available to the new entrant to provide high-speed services. In effect, this arrangement provides unbundled access to the high frequency spectrum of the local loop for the competitive provision of Digital Subscriber Loop (DSL) services by new entrants.

Shared use of copper line can provide a cost-effective solution for some customers. For example, it permits a customer to retain the incumbent as its telephone service provider, and at the same time, select a new entrant to provide high-speed Internet service over the same loop.

High-speed Bit Stream Access

A third approach to providing access to the local loop involves provision by an incumbent of a high-speed bit stream to new entrants. To do this, the incumbent would install a high-speed access link to the customers' premises and then make it available to other operators to enable them to provide high-speed services. Provision of bit stream access services requires provision of both the transmission medium (e.g. copper cables, coaxial cables and optical fibre cables) and the transmission system (e.g. synchronous digital hierarchy transmission on optical fibres and xDSL transmission on copper cables).

In the case of high-speed bit stream access, the point of interconnection will usually be at the incumbent's local switch, but circuits could be back-hauled to points of interconnection further up the switching hierarchy. Technically, bit stream access can be provided to any transmission system, since it only requires reservation of a specified bandwidth, rather than dedicated use of a physical loop. This access arrangement does not entail any unbundling of a copper pair. Rather it uses the higher frequencies of the copper local loop, as in the case of shared use of the copper line.

Providing high-speed bit stream service can be attractive for incumbent operators as it does not involve physical access to copper pairs. As a result, for example, it would not hinder the progressive

modernization of the local access network by replacing copper with fibre.

Figure 3-4 illustrates the provision of high-speed bit stream access by an incumbent. In this example, two customers obtain high-speed data services from two different service providers, the incumbent and a new entrant. At the same time, the incumbent continues to provide basic PSTN services to both customers.

The three means of access to the local loop referred to above are not necessarily mutually exclusive. Where regulators mandate local loop access, they may require or permit incumbent operators to provide one or more alternative forms of access.

Advantages and Disadvantages of Unbundling the Local Loop

The main reason regulators have required incumbents to unbundle their local loops is to promote competition and innovation in access and advanced high-speed services. However, there continues to be an active debate on the merits of mandatory loop unbundling. There remain arguments against it, as well as for it. Table 3-5 summarizes the pros and cons of mandatory loop unbundling.

Implementation of Local Loop Unbundling

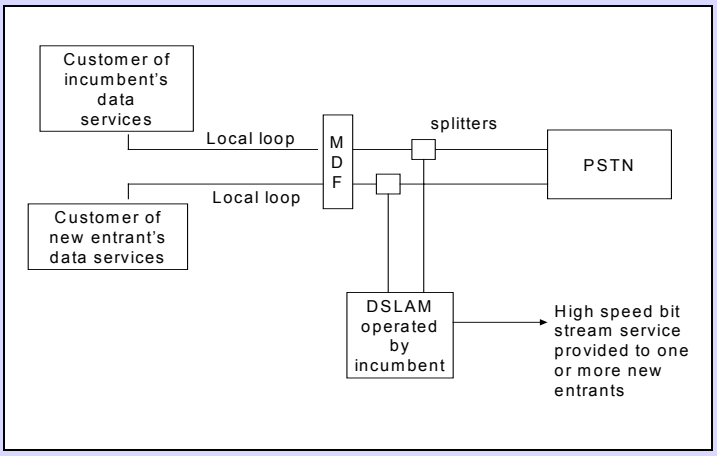
Different approaches may be used in mandating and regulating local loop unbundling. The appropriate approach will often depend on the state of competition in the relevant market for local access. Possible approaches include:

- Mandatory loop access without specification of the type of access arrangement. In this case, it is likely many incumbents will choose to offer bit stream access, which enables them to retain greater management control and possibly obtain higher access charges from competitors. The disadvantage of this approach is that competition may be delayed. Incumbent operators will have little incentive to accelerate implementation of bit stream access arrangements, at least until they are positioned to provide competitive services.

- Requiring bit stream access only (see previous point – same considerations apply).

- Requiring all three forms of access described above, except where the incumbent can

Figure 3-4: Provision of High-Speed Bit Stream Access



Source: Adapted from CEC (2000b)

demonstrate significant problems with dedicated loop rentals.

- Requiring all three forms of access in some or all national markets.

Various other regulatory approaches to unbundling may be developed.

Local loop unbundling may be a transitional phenomenon in some areas. Unbundling of loops may be required, for example, to facilitate competition in the short term. This will enable new entrants to roll out service rapidly, while they are constructing alternative access networks in the areas where there is sufficient demand.

Implementation of local loop unbundling continues to be a novel issue for regulators in many countries. A major source of experience to date is the United States. In the US, the 1996 *Telecommunications Act* requires incumbents to offer access to unbundled network elements and to making retail services available at wholesale prices. The US regulator has stated that "[p]reventing access to unbundled local loops would either discourage a potential competitor from entering the market in that area, thereby denying those consumers the benefits of competition, or cause the competitor to construct unnecessarily duplicative facilities, thereby misallocating societal resources" (FCC, *First Report and Order in the Matter of the Implementation of the Local Competition Provisions in the Telecommunications Act of 1996*). The FCC and US state regulators have subsequently taken further steps to facilitate loop unbundling.

As of June 1999, approximately 685,000 loops had been provided to competitors in the US as unbundled network elements. This represented an

Table 3-5: Arguments For and Against Local Loop Unbundling

Pros	Cons
➢ Accelerates introduction of local access competition, including xDSL access	➢ Reduces incentive to build alternative access networks and more sustainable facilities-based competition
➢ Accelerates competition, service innovation and roll out for high speed services, including: ➢ Internet services ➢ Video services (including interactive ones) ➢ E-commerce ➢ other data services	➢ May undermine investment in alternative access networks (wireline and wireless) ➢ May complicate modernization of incumbent operators' networks (e.g. if some access loops are dedicated to competitors use) ➢ Requires prolonged and detailed regulatory intervention compared to facilities-based access competition
➢ Avoids duplication of access networks, and increases network operating efficiencies	➢ Requires more technical co-ordination between operators compared to facilities-based access competition
➢ Provides new revenue streams to incumbent (which may or may not exceed existing revenues from loops, depending on tariffs)	
➢ Reduces disruption of streets and environment due to construction of new access networks	

increase of 180 percent over the previous year. In addition, competitors had collocation arrangements in exchanges covering 60 percent of all lines in the US (compared with 32 percent of all lines the previous year). By the end of 1999, competitors had provided 117,000 xDSL lines, up from 1,500 lines in 1997, while incumbents provided 386,000 DSL lines, up from 32,000 at the end of 1998. Competitors had installed over 1,400 data switches, a fivefold increase over 1997. Recent estimates suggest that about 60% of the US population had access to DSL at the beginning of 2000, with 25% located in cities with four or more DSL providers.

In July 2000, the European Union adopted a *Regulation on Unbundled Access to the Local Loop*. The regulation will be binding on dominant operators in EU Member States, as of 31 December 2000. Issuance of the regulation is based on the assumption that providing access to the local loop to all new entrants will increase the level of competition and technological innovation in the local access network, and in turn stimulate the competitive provision of a full range of telecommunications services from simple voice telephony to broadband services. The regulation is aimed, in part, at ensuring that the EU does not fall further behind the US in the deployment of high speed access and the advanced services it enables.

The European regulation requires dominant operators to provide physical access to third parties at any technically feasible point of the copper local loop or sub-loop. The third party can locate and connect its own network equipment and facilities at such points (i.e. at the local switch, concentrator or equivalent facility) in order to deliver services to its customers. Dominant operators are required to make unbundled loop access available to third parties under transparent, fair and non-discriminatory conditions. In addition, the regulation provides that the dominant operators must provide competitors with the same facilities as they provide to themselves or their associated companies, and with the same conditions and times. Regulators are given authority to intervene in pricing issues and resolve disputes in connection with the regulation.

Experience in other jurisdictions suggests that regulatory guidance is required in determining the pricing (and costing) of unbundled local loops. Operator negotiations, or unilateral price setting by incumbents can result in anti-competitive pricing. Where advance regulatory guidelines are not established, *ex post* regulatory intervention will often be required. A recent Australian case illustrates the point. In early August 2000, the Australian regulator, the ACCC, found that prices imposed by the dominant operator (Telstra) on competitors for local loop access were too high.

3.4.7 Sharing of Infrastructure and Collocation

Extensive infrastructure is required to build telecommunications networks. Key supporting infrastructure includes poles, ducts, conduits, trenches, manholes, street pedestals, and towers. Sharing of such infrastructure can significantly increase the efficiency of telecommunications supply in an economy. The same is true in the case of sharing building space in exchanges to permit two or more operators to "co-locate" their cable and radio transmission facilities and related equipment. Collocation permits direct (or near-direct) access to exchange switches and local access lines.

Availability of infrastructure sharing and collocation can significantly decrease barriers to competitive entry. The acquisition of rights of way and other permits required to build pole lines or towers, dig trenches or install ducts and conduits can be very time consuming and expensive. In some countries, only government entities, such as the incumbent operator, have clear legal authority to obtain rights of way, occupy public property or expropriate private property. Sharing of infrastructure and collocation can reduce costs for the new entrant, and at the same, time provide additional revenues to incumbents.

An added benefit is reduced environmental impact and public inconvenience. Competitive entry into telecommunications markets has led to a proliferation of cellular and microwave towers, aerial pole lines and road trenches in many countries. This result has become an increasing concern for many municipalities and other local administrations.

Some regulators require incumbents to permit infrastructure sharing and collocation of a new operator's transmission facilities in their exchanges. Other

operators, including new entrants, are frequently required to cooperate as well, at least in the sharing of infrastructure that is seen to be environmentally degrading, such as towers. In some countries, third parties that own support infrastructure, such as electrical power utilities, are also encouraged to participate in sharing arrangements.

In some jurisdictions, sharing of infrastructure occurs without regulatory intervention. Both sharing parties can benefit from the arrangements. In these jurisdictions, sharing of infrastructure is often seen as a matter to be freely negotiated between operators. However, as with other interconnection issues, there is often an asymmetrical market situation. In some cases, incumbents resist sharing their infrastructure. In these markets, regulatory intervention will be required to implement efficient sharing and collocation arrangements.

Table 3-6 lists steps regulators can take to promote sharing of infrastructure and collocation.

Once there is clear regulatory direction that infrastructure sharing and collocation must be permitted, operators are sometimes able to negotiate mutually acceptable sharing arrangements. In many other cases, however, regulatory direction or dispute resolution has been required to finalize sharing arrangements. Regulators seeking to expedite sharing arrangements may want to provide advance guidelines on such arrangements, after taking into account the views of incumbents and new entrants.

Some of the main issues that have arisen in relation to infrastructure sharing and collocation are:

- Rationing of space between incumbents' future requirements and current and future requirements of various new entrants; reservation of future expansion space for each operator.
- Pricing of facilities, and costing basis for the same.
- Access and security arrangements for various operators' equipment. Collocation premises of different operators are usually separated physically (e.g. by wire mesh) and locked.
- Appointment and supervision process for mutual cut-overs and work affecting more than one operator's facilities. Payment and rates for the same.
- Provision and pricing of ancillary services such as electrical power and back-up power, lighting, heating and air conditioning, security and alarm systems, maintenance and janitorial services, etc.
- Negotiation of other lease and/or licence arrangements, including issues of sub-licences on property of third parties (e.g. building owners, right of way owners, municipal and other public property owners), insurance and indemnification for damages.

3.4.8 Equal Access

On a level competitive playing field, telecommunications users should be able to access the services of new entrants as easily as those of incumbent operators. Without equal ease of access, new entrants will find it difficult to attract customers. While access need not be exactly equal, accessing a competitor should not be significantly more difficult.

In the early days of long-distance competition in Canada and the US, for example, customers were often required to dial up to 20 or more extra digits to route calls to new entrants' networks. This significant difference in access was due to the historical design of the PSTN. The operators' switches had been programmed for a monopoly environment. The additional digits were required to permit the operators' switching software to identify the new entrant to which the call should be routed as well as to provide billing details for the customer. It is not surprising that the new entrants initially found it difficult to encourage customers to switch services from the incumbents.

Over time, many incumbents and telecommunications equipment manufacturers redesigned their switches and related software. These facilities are now far more adaptable to the requirements of a multi-operator environment. Dialling parity is easy to achieve with the right software package. This has made it much easier to implement equal access.

However, changes in incumbent procedures and the regulatory environment are also required to facilitate equal access in a previously monopoly environment.

Table 3-6: Steps to Promote Infrastructure Sharing and Collocation

Develop Regulatory Policy	➢ Publish a regulatory policy encouraging infrastructure sharing and collocation ➢ Encourage local authorities, such as municipal governments to support and facilitate infrastructure sharing ➢ Encourage reciprocity of infrastructure sharing (i.e. new entrants should be required to size and build their facilities to permit sharing with incumbents and other operators) ➢ Require incumbent operator to publish a standard offer and price list for access to key infrastructure components: poles, ducts, conduits, tower space, etc. ➢ Incumbents should be required to provide information on the location of infrastructure, and capacity available for sharing (e.g. excess capacity in ducts, towers, etc.) ➢ A joint committee of operators should be established to plan infrastructure capacity, co-ordinate permits from local authorities and improve the mutual efficiency of the infrastructure provisioning process ➢ Operators should be able to reserve capacity in advance on reasonable terms
Price of Shared and Infrastructure Collocation	Regulators should encourage development of clear pricing guidelines (the following guidelines are illustrative only) ➢ Normally, incumbents and other operators should be able to recover at least their direct incremental costs of sharing, plus reasonable overheads ➢ Additional price components may be subject to negotiation and regulatory dispute resolution ➢ Prices for collocation and infrastructure sharing should generally be unbundled so that the operator requesting access is only required to pay for the services it uses ➢ Cost of new infrastructure should be shared among 2 or more operators in proportion to their use of the infrastructure (e.g. number of antennae located on a microwave tower) ➢ Costs of increased capacity and re-location of infrastructure should be shared among those that benefit from such works. Where an incumbent operator receives no benefit from works required to accommodate a new entrant, it should normally not pay, unless and until it benefits from such works. An alternative approach is to allocate the costs among sharing operators based on use, with a surcharge for the operator that requests the work. ➢ Future sharers of infrastructure should reimburse early entrants for expenditures that benefit them
Regulatory Safeguards	➢ Shared infrastructures should be made available to all operators on a non-discriminatory basis. This includes the owner of the infrastructure. Capacity should normally be provided on a first come, first served basis. The regulator should approve rationing schemes for scarce capacity.

Table 3-6: Steps to Promote Infrastructure Sharing and Collocation (cont'd)

	➢ New entrants (or other operators) that do not use ordered infrastructure capacity within a set time period should be required to return it. A penalty for excessive orders may also be appropriate ➢ Operators that provide shared infrastructure should record and have available for regulatory review: provisioning times for their own operations and competitors ➢ Physical separation of infrastructure (e.g. by walls or fences) may be warranted where necessary to prevent sabotage, but operators should be encouraged to share in the most efficient manner

There are basically two approaches to providing equal access:

➢ **Call-by-call customer selection** – Customers select the operator of their choice for each call. They usually do this by dialing a short code or prefix for their selected operator. For example, in Colombia, customers dial 09 to route national calls through TELCOM's network, 05 to route them through Orbitel's network, and 07 for ETB's network. The main requirements to provide this type of equal access on an efficient basis are:

  ➢ Trunk-side interconnection by new entrants to incumbent switches.

  ➢ A numbering plan that allocates equivalent numbers to the incumbent operators and new entrants (For example similar access codes for long distance and international competitors; and equivalent blocks of access numbers for local and mobile operators).

  ➢ Provision of basic signalling services by incumbents to new entrants including Calling Line Identification (CLI); answer and disconnect supervision.

  ➢ Appropriate billing and audit arrangements to permit direct billing by each operator or billing by one and remission to the others. For example, the local operator might do all billing and remit long distance charges to the other operators.

➢ **Operator pre-selection** – Under this approach, customers select a operator for some or all of their calling. For example, an operator other than the incumbent might be selected for all long distance and international calling. After the selection is made, all calls from these customers will be routed to the operator of choice until their selection is changed. The main requirements for this type of equal access are:

  ➢ Trunk-side interconnection by new entrants to incumbent switches.

  ➢ Switch software features to identify customer selections and to route and bill calls appropriately to the selected operator.

  ➢ Appropriate billing and audit arrangements to permit direct billing by each operator or billing by one and remission to the others. As with the call-by-call approach, the local operator might do all billing and remit long distance charges to the other operators.

The implementation of equal access has been uneven around the world to date. It is available, for example in Argentina, Australia, Canada, Chile, Hong Kong, and the US, but unavailable to date in many other countries. Equal access is more common for international and local services but less so for long distance services. In some countries, equal access is unavailable due to limitations in installed switching and software facilities. In others, it is due to delays in implementing a numbering plan that allocates equivalent numbers to competitors. In

some, regulators have simply not seen equal access as a priority.

Market experience in more open markets has demonstrated that there is considerable inertia among telecommunications customers. Regulators that wish to expedite the development of fully competitive markets will, therefore, want to consider equal access as a useful approach.

3.4.9 Quality of Service to Interconnecting Operators

It is good regulatory policy to require incumbent operators to provide a reasonable quality of interconnection services and facilities. Without such a policy, it would be possible for an incumbent to frustrate a competitor's ability to provide competitively attractive services. For example, if an incumbent connected its own new customers' circuits within days, but delayed connection of a competitor's customers' circuits for months, customers in a hurry would likely choose the incumbent's services.

The *WTO Regulation Reference Paper* deals with quality of interconnection with major suppliers in signatory countries. It requires interconnection to be ensured under terms and conditions that are no less favourable than those provided for their own similar services. Interconnection must also be no less favourable than that provided to a major supplier's subsidiaries, its other affiliates or to non-affiliated service suppliers.

Similar types of policies in many countries require "non-discriminatory" interconnection by an incumbent. In practice, it is very difficult to ensure the implementation of such policies. Many interconnection complaints of new entrants deal with unequal quality of interconnection as between the incumbent's services and their own.

The practical tools available to a regulator to promote high quality interconnection are:

- Establishing interconnection quality of service monitoring requirements;
- Monitoring complaints seriously, and establishing significant penalties for clearly unequal service quality; and
- Establishing an independent Interconnection Services Group within the incumbent's organization.

Quality of interconnection services can be monitored by an Interconnection Services Group (ISG) (see Section 3.4.2). The ISG should measure quality of service to interconnecting operators, and compare it to the incumbent's self-provisioning. For example, it should ensure that new circuits ordered by interconnecting operators are provisioned, on average, within the same number of days as internal orders.

Table 3-7 provides examples of interconnection quality of service measures. Where interconnection service problems are serious enough to warrant regulatory supervision, regulators can monitor these measures. Regulators may also establish a monitoring regime in advance, to prevent problems. A monitoring regime may require reports from incumbents on two types of quality of service performance:

1. Absolute performance based on established standards or international benchmarks, and
2. Relative performance by the incumbent in providing interconnection facilities to itself and to interconnecting operators.

Interconnection policy in some countries may require an incumbent to provide superior interconnection services to interconnecting operators under some circumstances. For example, it may be useful to require an incumbent to provide interconnecting operators with higher quality service than it normally provides for its own services – if the interconnecting operator is willing to pay for the difference. Such an approach has applications in industrialized countries seeking to promote the provision of advanced telecommunications services.

Table 3-7: Some Key Interconnection Quality of Service Measures

Provisioning Measures	➢ Average time for provisioning interconnection circuits and other interconnection facilities and services (including unbundled components) ➢ Percentage of installation appointments met for competitors' service installations ➢ Average time for processing changes in customers from incumbent operator to competitor (in an equal access regime) ➢ Percentage of repair appointments met for competitors ➢ Comparative provisioning performance for (1) competitors, (2) affiliates, and (3) self-provisioning (including measures such as those set out in the previous points)
Switching and Transmission Quality Measures	➢ Probability of blockage in peak hour on interconnecting circuits ➢ Transmission delay (ref: ITU-T recommendation G114) ➢ Transmission loss (loudness – ref: ITU-T recommendation P76) ➢ Noise and distortion (ref: ITU-T recommendations, including Q551-554, G123, G232, G712, P11) ➢ Other transmission quality standards (e.g. for digital services ref: ITU-T recommendations G821 re: bit errors and timing, and G113 re voice coding problems, and for both analogue and digital services ref: ITU-T recommendations G122 re: echo and loss of stability; and P16 et. al re crosstalk).

This type of policy can also be useful in less developed countries. In many less developed countries, the quality of service provided by an incumbent is below international standards. This low quality of service is often due to financial constraints on the incumbent. In such cases, regulators should be willing to promote improvement of the quality of service provided to a new entrant, provided the new entrants pays for it. For example, a new entrant may be willing to pay for new trunk circuits between the point of interconnection at a congested customer service exchange and a tandem exchange.

Such payments can be a win-win situation for the incumbent and new entrants. Arrangements of this type are best negotiated between incumbents and interconnecting operators. However, some regulatory supervision may be required to ensure new entrants do not have to pay excessive charges. Similarly, the regulator may need to ensure that the incumbent does not require payments from new entrants to construct facilities to improve the incumbent's competitive advantage, as a condition of providing an adequate quality of service.

3.4.10 Quality of Interconnected Services

The previous Section discussed the provision of services by incumbents to interconnecting operators. Regulators in most countries are also concerned with the broader issue of the quality of service to the public. Many regulators established quality of service reporting systems during the time services were provided in their countries on a monopoly basis.

To deal with the emergence of competition, some countries have apportioned responsibility for providing a prescribed quality of service among interconnecting operators. For example, in the UK,

the regulator prescribed maximum delays for interconnecting operators. The purpose of these maximum delay standards was to ensure calls between operators met national transmission speed standards. Customer PBX equipment at each end of a call was allocated 5 milliseconds (ms); originating and terminating local network operators 3 ms each; and the long distance network operator 7 ms, for a total maximum delay of 23 ms.

Other countries have taken a more deregulatory approach. They have not imposed quality of service reporting requirements on new entrants. This approach is based on the assumption that new entrants will not be able to attract and retain customers if their quality of service does not match or exceed that of the incumbent operator. Based on the same approach, it should be possible to remove regulatory quality of service requirements from incumbents once competition is well established and they lose their market power.

As competition develops, it should be possible for more and more regulators to take the latter approach. Regulation of service quality can then be left to the market, rather than to regulators.