Windsor Place Consulting

Regulating interconnection

From traditional networks to NGN and VoLTE

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Outline of WPC's presentation

1. What is interconnection?
2. Principles of interconnection regulation
3. Types of interconnection
4. Pricing interconnection
5. Access to NGNs
6. Emerging responses to NGN regulation
7. Conclusions

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What is interconnection?

Interconnection concept and definitions

Can be thought of as all of the required commercial and technical arrangements that operators use to connect their equipment, networks and services in order to provide other operators with access to their customers.

World Trade Organisation

"Linking with suppliers providing public telecommunications transport networks or services in order to allow the users of one supplier to communicate with users of another supplier and to access services provided by another supplier, where specific commitments are undertaken."

European Union

"The physical and logical linking of telecommunications networks used by the same or a different organization in order to allow the users of one organization to communicate with users of the same or another organization, or to access services provided by another organization. Services may be provided by the parties involved or other parties who have access to the network."

What is interconnection?

The concept of interconnection

Telecommunications operators are considered to have control over access to their own networks. In effect, they have **monopoly power over access to end-users** on their network.

An MNO could restrict access to its own customers by imposing unreasonable terms or high prices to terminate calls on its network, which would limit services for consumers.

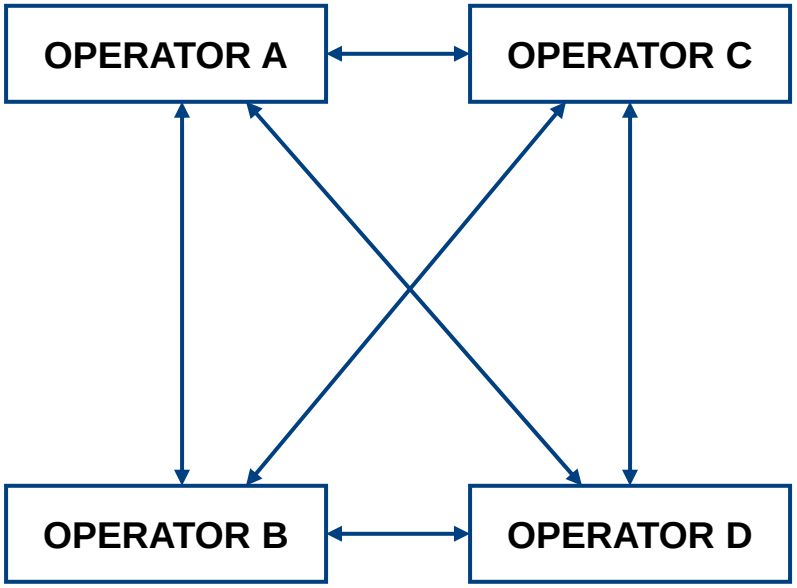
Through interconnection, an established operator can frustrate competition in a variety of ways including:

- Charging **excessive rates** for access
- **Unnecessarily delaying** the provision of equipment and facilities needed for interconnection
- **Misuse** of customer or competitive information
- **Imposing limits** on the number of points of interconnection
- Imposing **unnecessarily stringent** technical standards on interconnection
- Supplying a **lower grade** of interconnecting services to interconnecting parties.

What is interconnection?

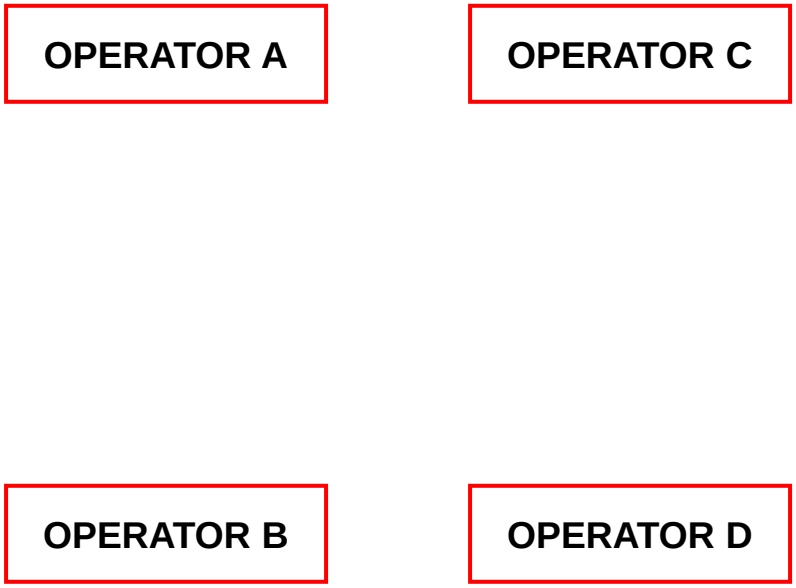
What happens without interconnection?

Interconnection



- Any-to-any connectivity
- Six ICA's involved for four operators

No or limited interconnection

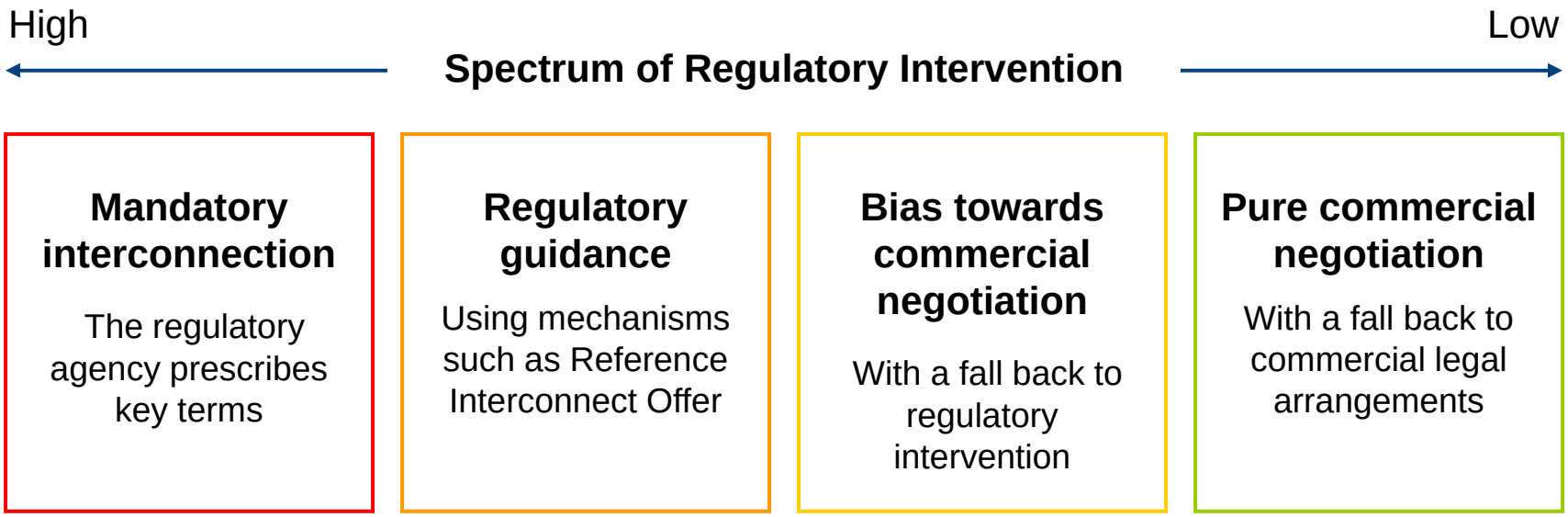


- Only 'on-net' calls
- Limits addressable market

What is interconnection?

Need for clear interconnection regulations

Effective and efficient interconnection arrangements need to be backed by the regulator. Rates and procedures for interconnection must be enforceable, available publicly and supported by dispute resolution mechanisms (there are **always** disputes).



What is interconnection?

Interconnection and competition

Interconnection plays **critical role** in promoting competition in telecommunications markets. Allows new entrants to provide telecommunications services using incumbent operator network and infrastructure.

- Also **contributes to universal service** by making basic telecommunication services **accessible to a larger number of users**.
- Effectiveness **depends on the regulatory framework** and how it is applied. Requires **high degree of cooperation** between competing companies. There may be an **imbalance in negotiating positions** that favours the incumbents over new entrants.
- Government and regulator must ensure **clear and transparent processes** to **determine costs** of interconnection and **resolve disputes** between operators.
- Dominant operators must transition to **cost accounting** to meet the requirements of regulation. Cost accounting allows operators and regulator to determine interconnection costs, which are the **main source of disputes** and principal obstruction to the **entry of new operators**.

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Principles of interconnection regulation

WTO Regulation Reference Paper

The Reference Paper is a blueprint for sector reform that largely reflects 'best practice' in telecommunications regulation.

Contained in the annex to the Fourth Protocol to the GATS Agreement, the *Agreement on Basic Telecommunications* negotiated under the auspices of the World Trade Organization in February 1997, which came into effect on 1 January 1998.

1. Interconnection to be ensured

Countries that commit to the Reference Paper must ensure that interconnection is **available on reasonable terms upon request** for any operator seeking access. Specifically, interconnection must be available at any technically feasible point in a network, and must be provided:

- *Under **non-discriminatory** terms, conditions, rates quality no less favourable than that provided for its own like services;*
- *In a **timely** fashion, on terms, conditions and **cost-oriented rates** that are transparent, reasonable and **sufficiently unbundled** that the supplier need not pay for network components or facilities that it does not require; and*
- ***Upon request**, at points in addition to those offered to the majority of users, subject to charges that **reflect the cost of construction** of necessary additional facilities*

Principles of interconnection regulation

2. Public availability of the procedures for interconnection negotiations

The procedures applicable for interconnection to a major supplier will be made publicly available.

3. Transparency of interconnection arrangements

It is ensured that a major supplier will make publicly available either its interconnection agreements or a reference interconnection offer.

4. Dispute settlement

A service supplier requesting interconnection with a major supplier will have recourse, either:

- At any time, or
- After a reasonable period of time which has been made publicly known.

to an **independent** domestic body, which may be a **regulatory body**, to resolve disputes regarding appropriate terms, conditions and rates for interconnection within a reasonable period of time, to the extent that these have not been established previously.

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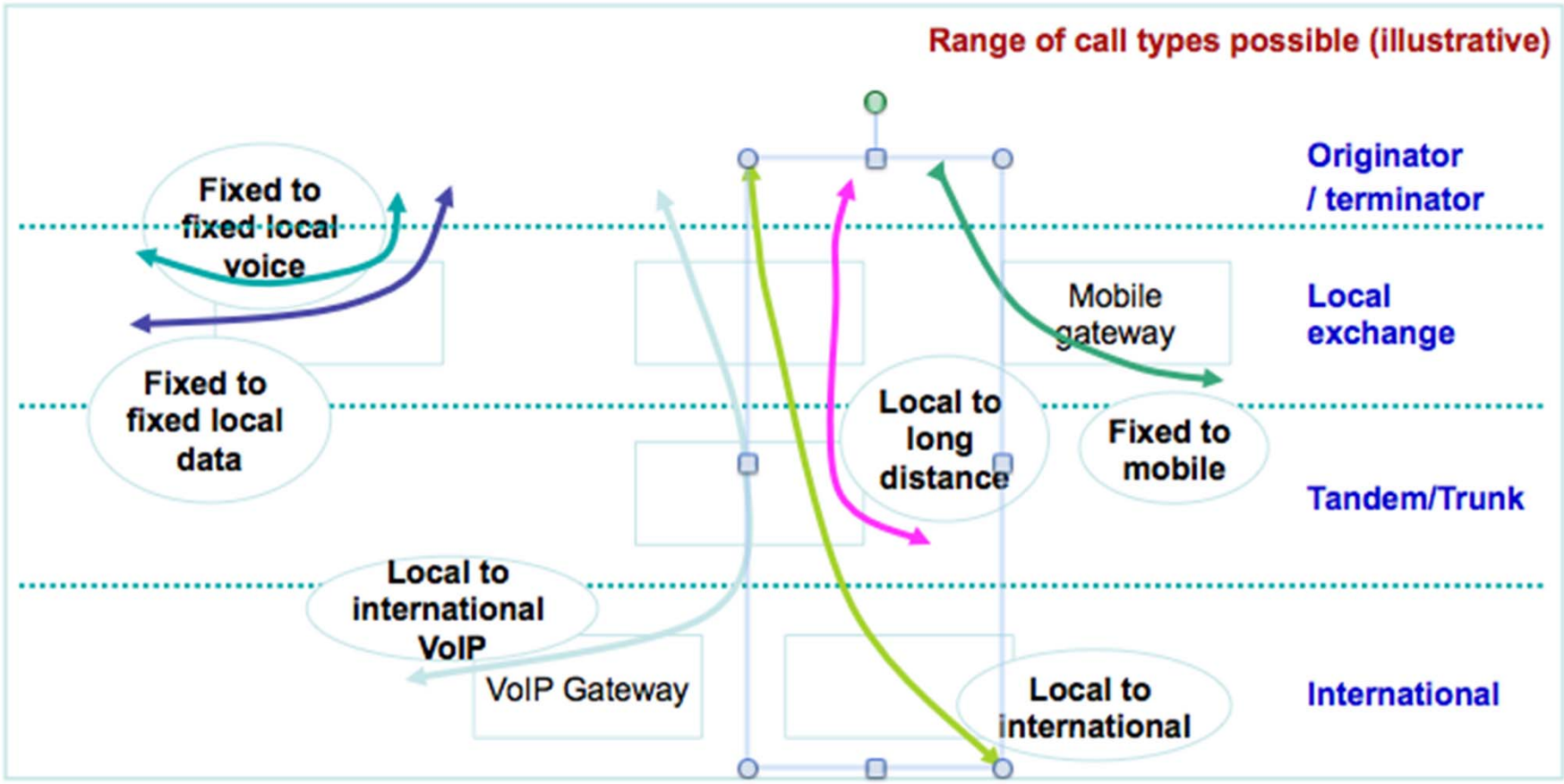
7. Conclusions

Types of interconnection



Types of interconnection

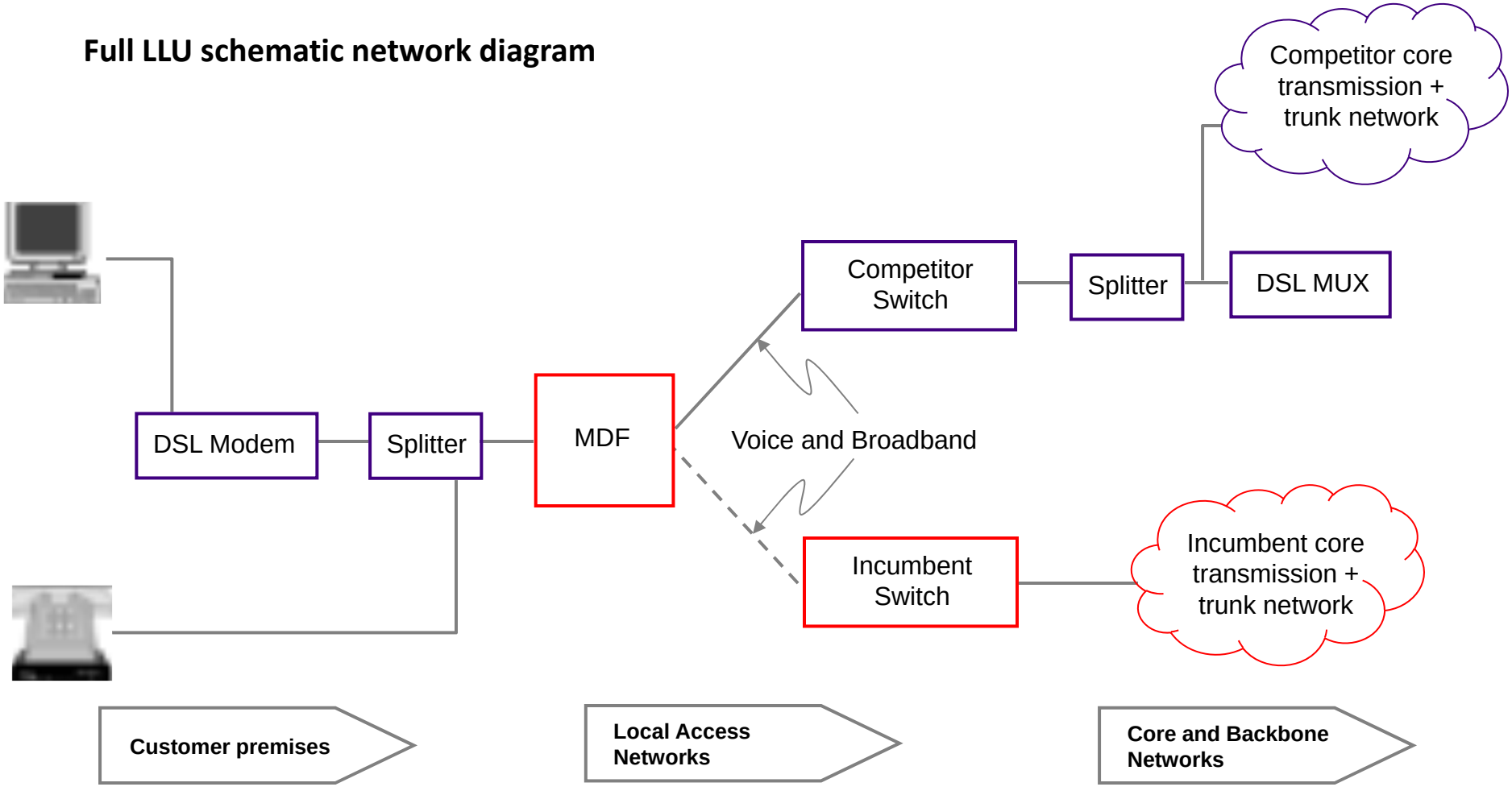
Local Loop Unbundling

Local Loop Unbundling (LLU) is defined in slightly different ways depending on the national market but the **common policy thread is the opening up of the local access network to additional competition.**

While various technical options are available for LLU and different approaches are possible, **there are typically four options which are utilised and/or have been determined by regulators** for incumbent operators to provide unbundled access to new entrants.

Types of interconnection

Full LLU schematic network diagram



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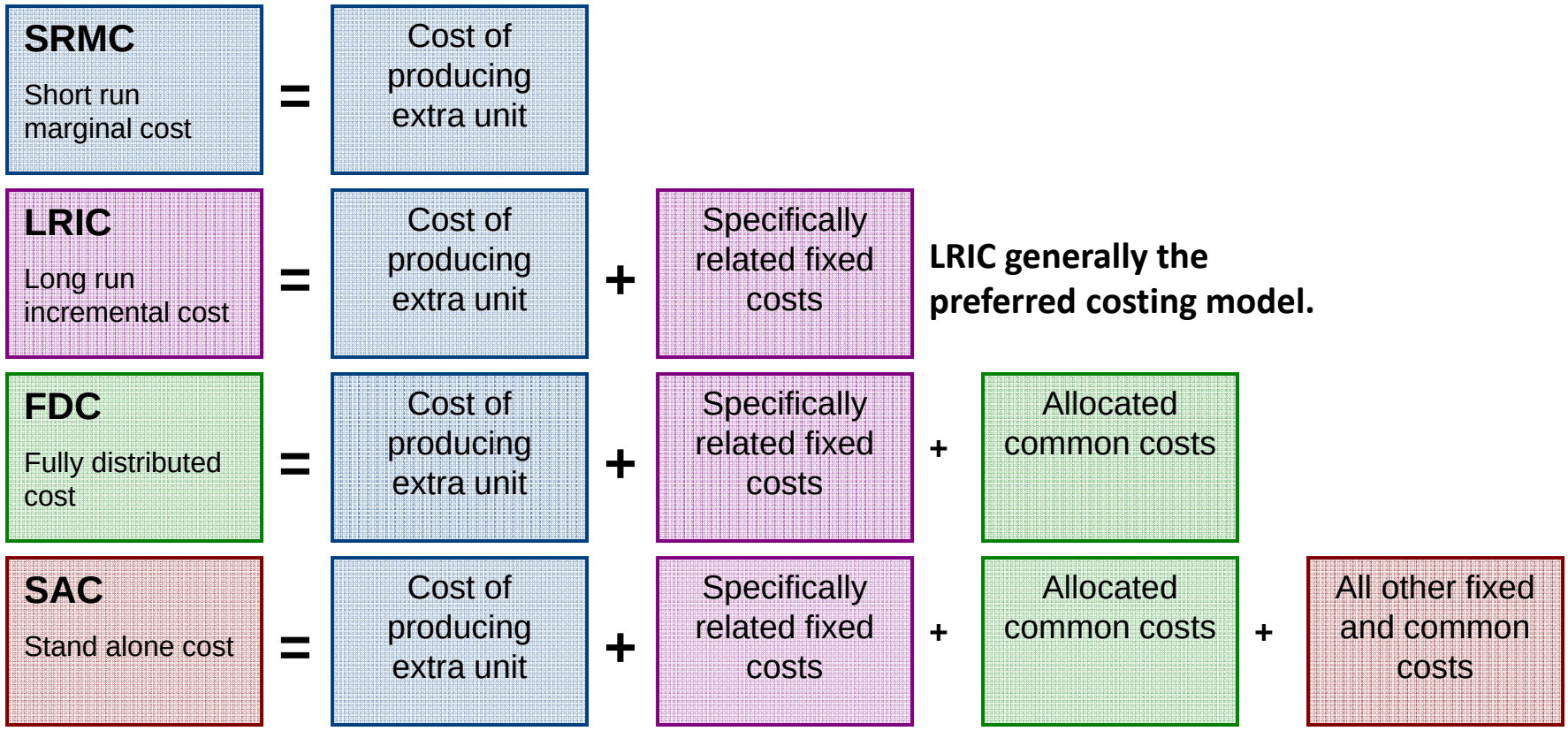
Pricing interconnection

Interconnection costing models



Pricing interconnection

Long Run Incremental Cost (LRIC)

An understanding of the basics of Long Run Incremental Cost, should include the following:

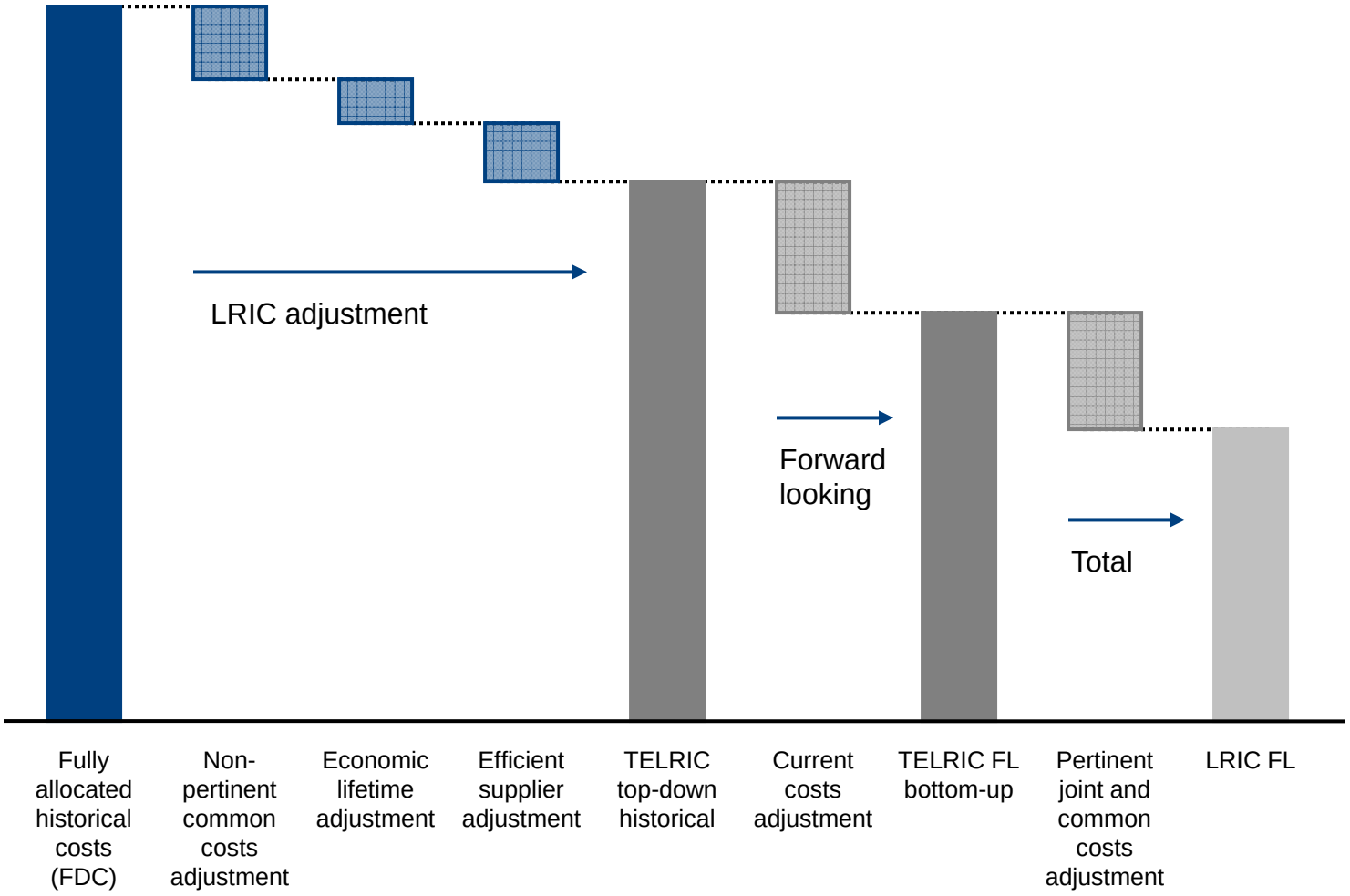
- LRIC is a **forward looking** cost methodology.
- It measures the direct additional cost of providing interconnection allowing for the **replacement of assets** and the cost of capital.
- Marginal cost of providing an **additional unit of service** (e.g. next minute of traffic, next subscriber).
- May not provide sufficient returns to incumbents over the long run.

In a developed market context, LRIC **provides commercial incentives** for operators to ***maintain*** the network at maximum technical efficiency.

However, in a less developed market (with low levels of penetration), inappropriate intervention of regulators in access price setting may provide an incentive to the access provider – in a competitive environment – to **forgo any expansion and technical upgrading** of the access network.

Pricing interconnection

From historical accounting costs to economic costs (LRIC)



Pricing interconnection (case study)

Access to the HSBB network

In Malaysia, as part of the agreement with the Government, TM agreed to make available HSBB Access, HSBB Connection Services and HSBB Transmission Services to access seekers on a commercially negotiated basis. The 2008 HSBB Agreement states that TM shall set a **fair and equitable price** based on commercially negotiated pricing.

In order to promote uptake, the Government **deferred the implementation** of certain network services listed in the *Ministerial Direction on High-Speed Broadband and Access List, Direction No. 1 of 2008* until 15 September 2015. These services include:

- ***Full access service***: Essentially the unbundling of the communications wire which forms part of customer access network (i.e. local loop) between customer's premises and the point of interconnection ('POI') at the local exchange.
- ***Line sharing service***: The unbundling of non-voiceband spectrum of the local loop between customer's premises and the POI at the local exchange.
- ***Sub-loop service***: The unbundling of the local loop between customer's premises and POI at an intermediate point such as a roadside cabinet.

Pricing interconnection (case study cont'd)

Setting access prices

In October 2012 the MCMC conducted a **public inquiry** to determine which services and facilities on the Access List should be subject to ***ex-ante* price regulation** and, if so, how the price should be calculated based on the cost of providing access.

The MCMC determined that the appropriate circumstances in which it should intervene in the market through *ex-ante* regulation are:

1. The presence of **non-transitory high barriers to entry**.
2. The **continuing absence** of a trend towards effective competition.
3. *Ex-post* regulatory controls are **unlikely to be sufficient** to address concerns regarding access to fair and reasonable access prices.

In setting access prices, the two principles identified by the MCMC that must be taken into account are:

1. **Appropriate cost recovery**; and
2. **Promotion of economic efficiency**.

Pricing interconnection (case study cont'd)

TSLRIC pricing methodology

The MCMC determined that the TSLRIC method of cost pricing would used to price access services. TSLRIC stands for **Total Service Long Run Incremental Cost**, which is a forward looking cost-based pricing methodology.

TSLRIC involves the following concepts:

- **Total service**: the total quantity or amount of the service provided by the firm (as opposed to the marginal cost of the final unit).
- **Long run**: The period of time over which all inputs to provide the service are variable (including sunk costs).
- **Incremental cost**: additional costs the firm incurs or will incur in providing the service. Identifying these costs involves a comparison of the costs the firm would incur if it **did** provide the service with the costs the firm would incur if it **did not** provide the service.

TSLRIC is an established practice and is commonly used by other regulators including the ACCC in Australia. However, there are **range of methodologies** that are **used by different regulators**.

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Access to NGNs

NGN interconnection

Interconnection between public fixed and mobile telecommunications networks has been **highly regulated** in most countries while **IP inter-working has not**.

NGN typically **changes locations and functions** of points of interconnection and **requires interworking with legacy networks**.

In transition to NGN environment, **new frameworks** will be required to account for range of models applicable to both telecommunications and internet industries, including:

- **Cost based interconnection charges** (which are often regulated to address market power) that characterise access to PSTN and wireless infrastructure.
- **Peering arrangements in an IP context** where operators exchange traffic for only their respective customers, often for no explicit charges and where the sharing of facilities costs may be unequal.

Access to NGNs

Characteristics governing conflicting interconnection arrangements

Factor	PSTN-cellular networks	IP-based networks
Revenue stream	Caller triggers call using facilities provided or paid for by caller's carrier.	Traffic types varied and unclear which party triggers exchange.
Revenue stream	Call costs (and margin) paid for by call initiating subscriber.	Generated by subscriber access flat rates and advertising.
Traffic measurement	Symmetrical traffic with calls and minutes can be monitored and measured.	Asymmetric traffic. Measurement possible but not necessarily clear who should pay.
Parties	Only two carriers at each end of circuit established for duration of call.	Many carriers may be involved in handing off packets on best efforts basis.
Model	Framework developed by ITU on multilateral basis between countries with Calling Party Network Pays (CPNP) is preferred regime.	Model evolved from zero cost peering to commercial hierarchy of peers and clients with Sender Keeps All (SKA) emerging as preferred regime.
Technical interconnection	Carriers interconnect at agreed POIs.	Unregulated connection through peering or transit.
Routing	Calls routed on dialed number, circuit switched with end-to-end signaling.	Packets routed on IP header on best efforts basis through connectionless protocol.
Network characteristics	Intelligent network elements contained at the core.	Intelligent network elements contained at edge.

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Emerging responses to NGN regulation

NGN regulation overview

Global precedents for NGN regulation are limited. **No definitive position yet** on key aspects of forward looking framework. Most preliminary work on NGN regulation undertaken by industry stakeholders from developed economies.

Development of NGN core and access infrastructure **not occurring in parallel**. Only a few OECD markets currently undertaking end-to-end NGN rollouts. Regulators likely to face **different challenges** in addressing NGN core and access issues.

Currently two streams of activity beginning to shape NGN regulatory environment:

- **Multilateral co-operative efforts** with respect to defining standards and interoperability, including ITU-T, ATIS, ETSI and IETF
- **National level NGN inquiries and policy working groups** to develop country-specific policy responses in areas such as access and interconnection, universal services and consumer protection

Emerging responses to NGN regulation

Developed versus developing markets

Commonalities between NGNs in developed and developing ICT markets, also many differences; regulatory, financial and operational, especially **access** and **affordability**.

Developed countries able to **leverage existing fixed networks** for core while developing countries likely to **leverage existing 2G and 3G mobile networks**.

Developing countries won't have to build out fixed networks to achieve full migration - important driver is to **reduce the cost of building and operating** separate networks.

Critical question is whether to **regulate IP network development** or to allow **evolutionary approach** for IP networks.

When to intervene?

Default position to **encourage continuity** of existing legal and regulatory framework E.g. ERG in reviewing the EU Framework recommended **continuation of reference legislation** until new laws will be enacted. 3 main emerging challenges are:

Fitness of current service and market definitions to deal with developments;

- **Understanding how technological change affects Capex and Opex** in terms of structure of network interconnection and pricing arrangements; and

- **Adopting measures to encourage service neutrality** and reduce risk of 'walled gardens' at the IP Multimedia Subsystem level.

Emerging responses to NGN regulation

NGN requires some existing arrangements as well as new measures

Broad Scope of Potential NGN Regulation

Legal Requirements	Operational Requirements	Competition Requirements	Consumer Requirements	National Security
Digital Rights Management (DRM) Cybercrime mitigation measures Fraud detection and management Judicial + evidentiary requirements Penalties + sanctions	Inter-carrier compensation PoI arrangements Roaming and service provider co-ordination Default service and routing options Transaction billing + accounting Numbering + electronic addressing	Market and service definitions Market dominance remedies Number portability and pre-selection Directory access Service bundling and inter-operability	Emergency calls (including call location) Consumer protection + privacy (eg Do Not Call registry + SPAM) Disability assistance Authenticated caller + sender identification	Network attack + Denial of Service Public safety + homeland security Disaster response Priority service provision + restoration Reporting of network outages

Emerging areas of focus

There is the potential for **expanded scope of regulatory intervention and compliance** in an NGN environment

Carry forward provisions

Will remain the **primary regulatory concern** in the near term, particularly for interconnect + access

Emerging responses to NGN regulation

Regulatory approaches in key markets

Several national regulatory agencies have taken account of shift to NGN. Many have finished consultation processes regarding regulatory implications, challenges and potential measures to cope with NGN environment.

- Markets like **UK, Japan, Malaysia, Netherlands, Germany and US** taking leadership positions on NGN. Regulator responding to commercial initiatives associated with migration of incumbent legacy networks to NGN.

- Other countries like **Singapore, Taiwan and Australia** have adopted "first follower" strategy and will be looking to replicate key NGN regulatory components from markets mentioned above.

- Key findings on global stock take is that all markets under review were **motivated by significantly different market and policy parameters**. All have strong reliance on consultative approaches with industry stakeholders which has led to long lead times for implementation.

VoLTE interconnection

Explaining IP interconnection
Generally takes place over the public Internet, or via **IP Exchange (IPX). IPX more common** on a large carrier commercial scale.

IPX is a **set of common principles** developed by GSMA starting in 2004. It allows for traffic exchange by providers by **connecting them via an IPX peering point.**

IPX offers **bilateral and multilateral** interconnection options - clearly multilateral optimal for large operators who may need bilateral agreements with hundreds of partners.

As of 2014, **more than half of major operators** have moved to IPX to deal with increasing demand for 4G/LTE. Korean and Chinese operators have done testing of **international IP-based interconnection** with some success based on the IPX framework.

IPX is an **all-IP architecture**, but covers only **Network-Network-Interfacing**, with User-Network-Interfacing **beyond the scope of IPX**.

IPX has a **key potential flaw**: it **does not naturally force** Session Initiation Protocol (SIP) data to pass through **same IPX path** as related voice data. Operator of the IPX through which voice data passes **cannot use time-based charging for the voice data**.

VoLTE interconnection

80 operators are investing in VoLTE in 42 countries

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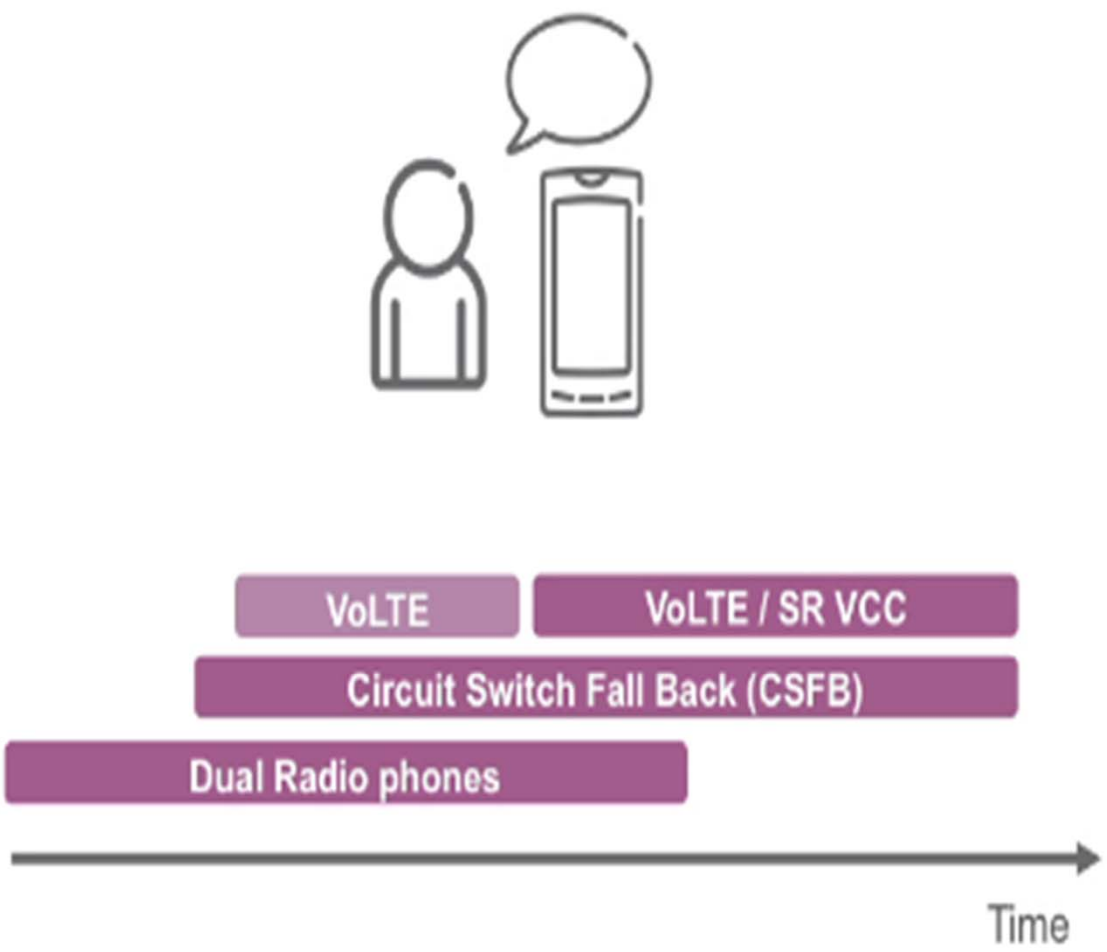
Country	Operator	VoLTE status
Denmark	**TDC**	**Launched**
Hong Kong	**CSL**	**Launched**
Hong Kong	**3 HK**	**Launched**
Japan	**KDDI**	**Launched**
Japan	**NTT DoCoMo**	**Launched**
Romania	**Vodafone**	**Launched**
Singapore	**SingTel**	**Launched**
Singapore	**StarHub**	**Launched**
South Korea	**KT**	**Launched**
South Korea	**LG U+**	**Launched**
South Korea	**SK Telecom**	**Launched**
USA	**AT&T Mobility**	**Launched**
USA	**T-Mobile US**	**Launched**
USA	**Verizon Wireless**	**Launched**
Algeria	Algérie Telecom	In deployment
Australia	Optus	Trialling
Australia	Telstra	Planned
Australia	Vodafone	In deployment
Austria	T Mobile	Trialling
Bulgaria	Max	Planned
Canada	Rogers Wireless	Planned
Canada	Sasktel	In deployment
Canada	Telus	In deployment
China	China Mobile	In deployment
Czech Republic	T-Mobile	Trial planned
Denmark	Telenor	In deployment
Ecuador	CNT	In deployment
France	Bouygues Telecom	In deployment
France	Orange	Planned
France	SFR	In deployment
Germany	DT	In deployment
Germany	O2	In deployment
Germany	Vodafone	Trialled
Hong Kong	China Mobile HK	In deployment
India	Bharti Airtel	Trialling
India	RIL	Trialling
India	Videocon	Planned
Italy	Vodafone	Trialling
Japan	Softbank	In deployment
Kazakhstan	Altel	In deployment
Kuwait	Viva	Trialling
Kuwait	Zain	Trialled
Lebanon	Alfa	In deployment
Netherlands	KPN	Trialling
Netherlands	Tele2	In deployment
Netherlands	Vodafone	In deployment
New Zealand	Vodafone	Trial planned
Nigeria	Smile	In deployment
Norway	Ice.net	Trials planned
Poland	Polkomtel	Trialled
Russia	MTS	Trialled
Russia	Megafon	In deployment
Russia	Vimpelcom	In deployment
Saudi Arabia	Mobily	In deployment
Singapore	M1	In deployment
Slovakia	Slovak Telecom	Planned
Slovenia	Telekom Slovenije	In deployment
South Africa	Vodacom	Trialling
Spain	Telefonica	Trialling
Spain	Vodafone	In deployment
Sweden	Tele2	In deployment
Sweden	TeliaSonera	In deployment
Switzerland	Sunrise	In deployment
Switzerland	Swisscom	In deployment
Taiwan	Asia Pacific Telecom	In deployment
Taiwan	FarEasTone	In deployment
Taiwan	Taiwan Mobile	In deployment
Tanzania	Smile	Trialled
Turkey	Avea	Trialling
UAE	Du	In deployment
UAE	Etisalat	In deployment
Uganda	Smile Communications	Trialled
UK	EE	In deployment
UK	Vodafone	Trialled
USA	C Spire	Planned
USA	KPU	In deployment
USA	US Cellular	In deployment
USA	Sprint	In deployment
USA	VTel	In deployment
Venezuela	Digitel	Testing

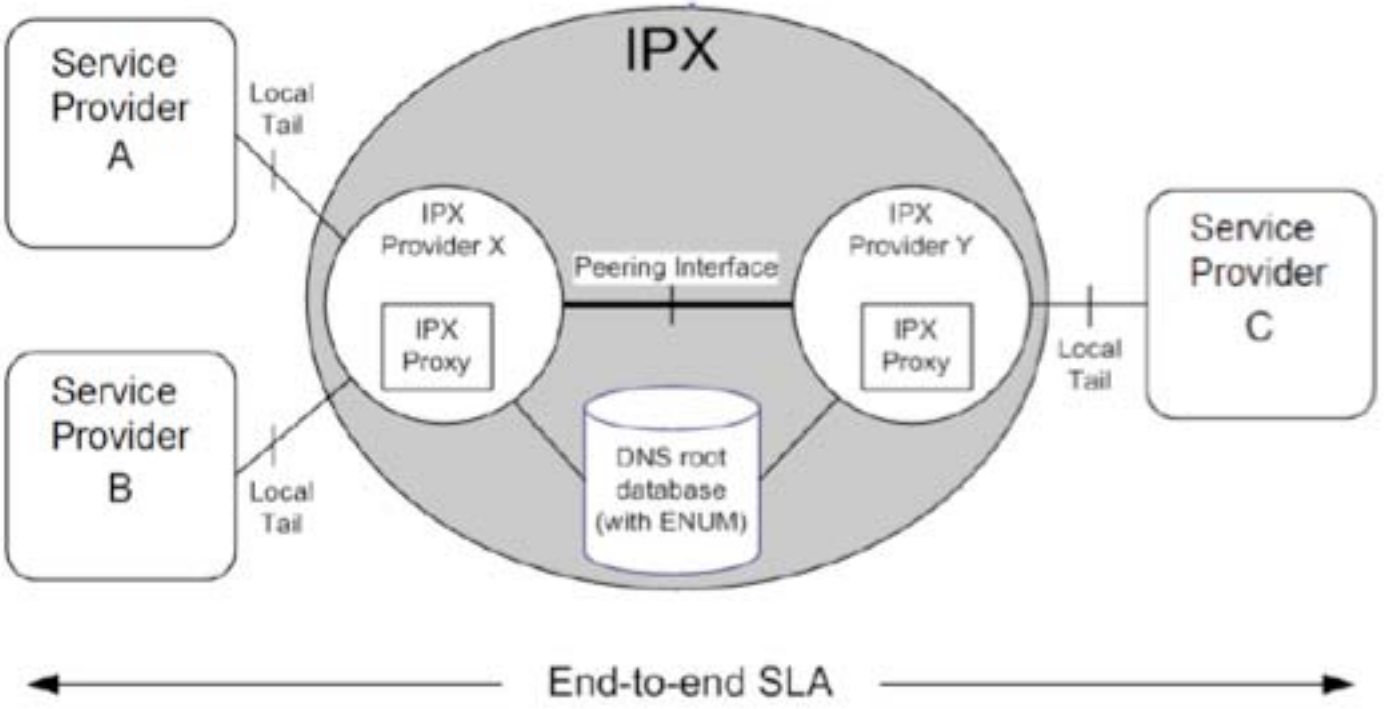
VoLTE interconnection



Source: *Informa Telecoms & Media* and *Ericsson*, *LTE Early Launch Strategies: Who and Why? Webinar*, 21 June 2011

VoLTE interconnection

IP interconnection diagram



VoLTE interconnection

Expected impact of VoLTE on interconnection regulation

Moving to VoLTE will have a **number of implications** for access regulation and pricing. VoLTE and IP based interconnection from circuit switched interconnection is the **most profound change in mobile interconnection in 20+ years**.

There are **few precedents** or exemplar models at this time, key global regulators are either working on **revising their rules** (Australia, Germany, UK), **jetissoning old costing models** (e.g. ACCC in Australia, Ofcom in the UK) or puttng in **transition schemes** (e.g. ARCEP in France). However, it appears:

- ***Profound change to access regulation is required:*** VoLTE and IP based interconnection will result in fundamental rewriting of rules and pricing models.
- ***More work is needed:*** Regulators and operators need to undertake extensive review of technical, financial, roaming and regulatory aspects to explore implications. In Australia, mobile operators are **seeking to have current access and pricing extended** for 2-3 years ahead of any transition to VoLTE.

Given global unevenness of both LTE and VoLTE deployments, there is risk of **'talking up' need** to address VoLTE and IP interconnection issues, that **regulation may push ahead of technical and commercial realities** - this is likely to have **adverse financial implications** for operators in terms of additional capex (to ensure IP interconnection) and opex (lower MTRs/roaming prices).

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Conclusions

- Interconnection is how a **customer of Network A** connects with a **customer of Network B**
- Operators have a **monopoly over terminating access to their customers** (and incentive to exploit this) - interconnection is usually the subject of regulation due to its **importance to competition**
- WTO reference paper **specifies that interconnection be available** and principles for how
- **LRIC is the preferred pricing methodology**, but **many options available** (e.g. TSLRIC in Malaysia) and change is coming
- Transition to NGNs has **significant implications for interconnection** - **new frameworks are needed**
- As of yet there is no **definitive/best-practise position** on NGN interconnection regulation - default position is to **encourage continuity** of existing measures, question is whether to **regulate preemptively** or follow an **evolutionary approach**
- IPX is the **most common** means of interconnection for major operators, but has **crucial flaw re: time-based billing mechanisms**

Bottom line:

- **Move to IP interconnection in fixed and mobile is the most profound change in interconnection/access and hence regulation in 20 years!**

Thank you

I am happy to answer any questions