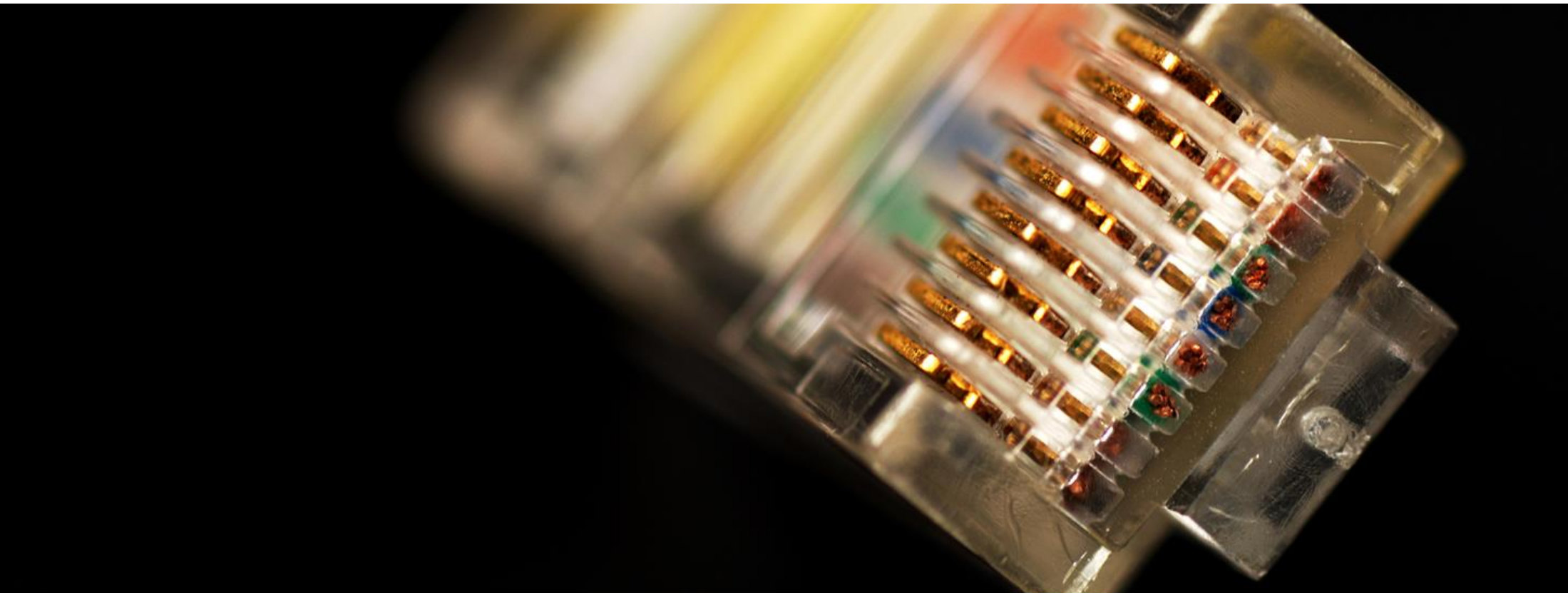
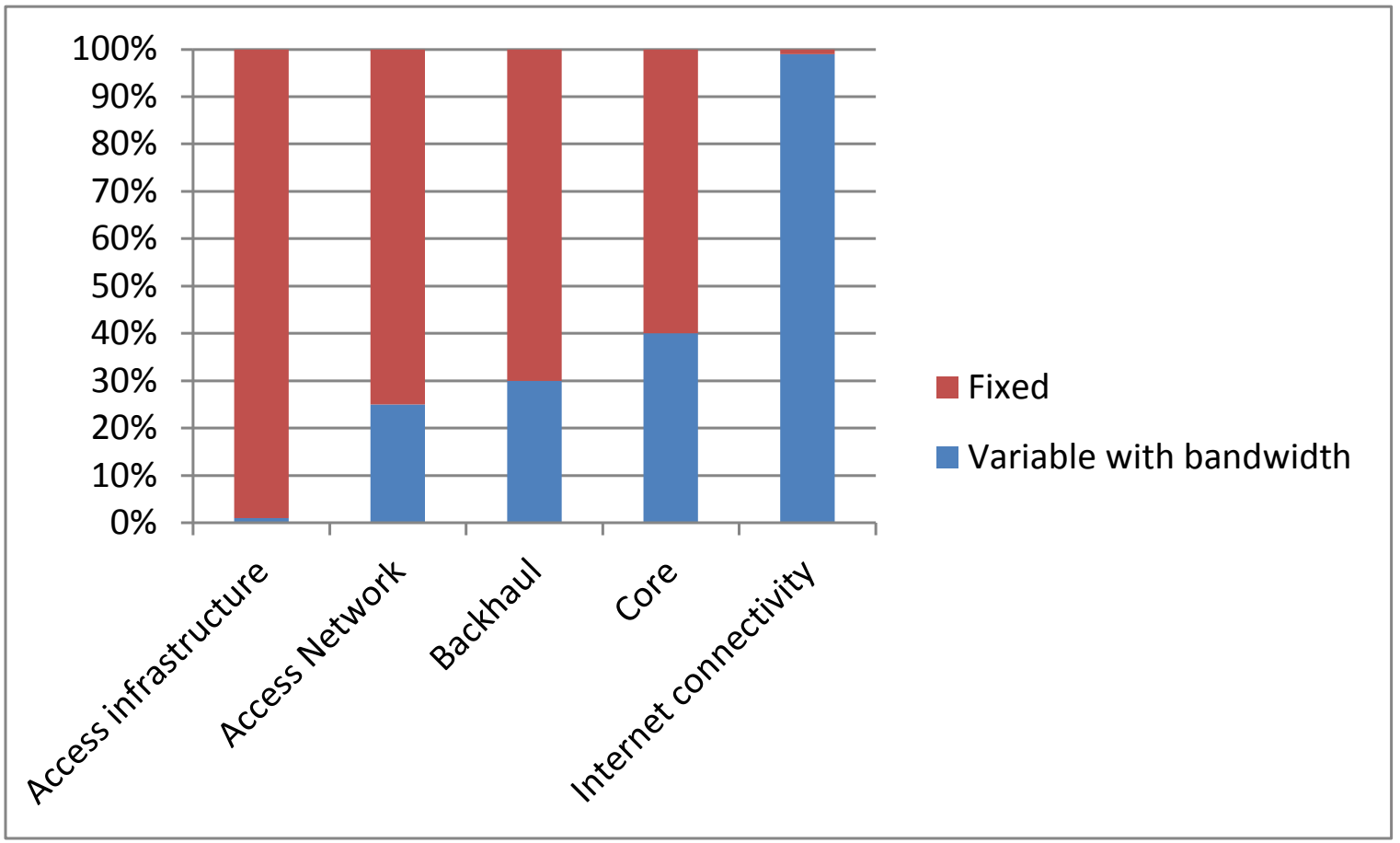
IP interconnection – Pricing and Costing

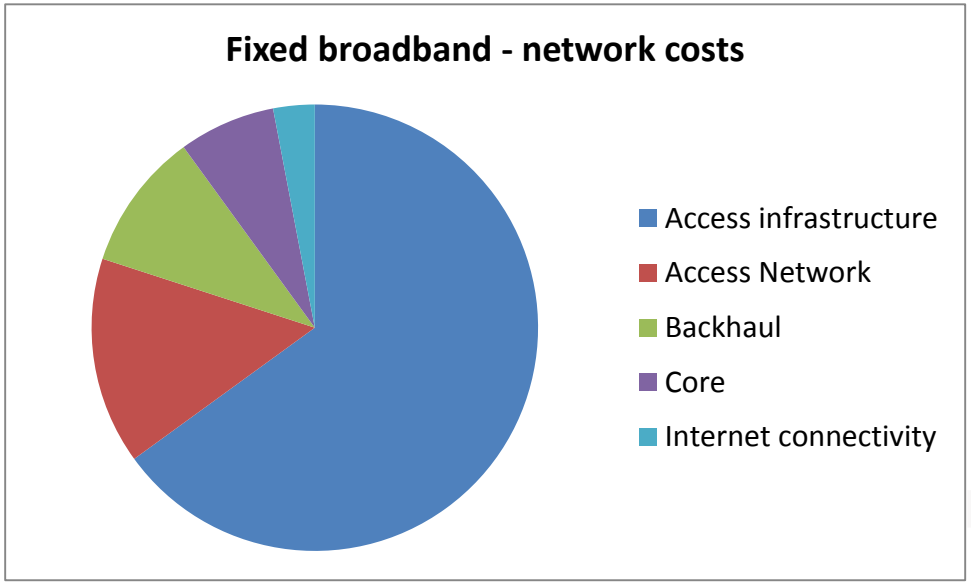


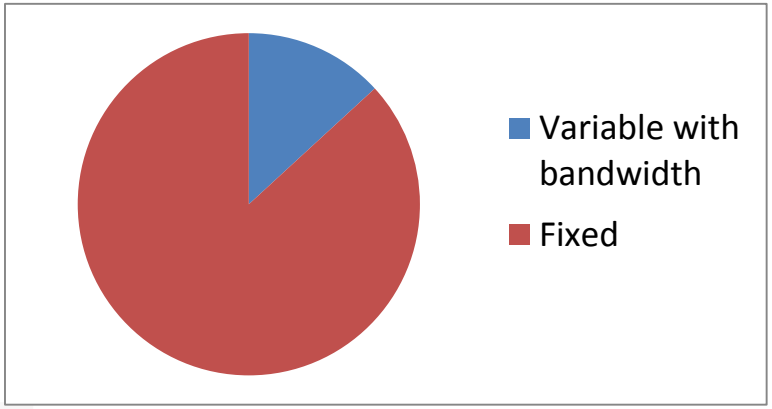
March 2014

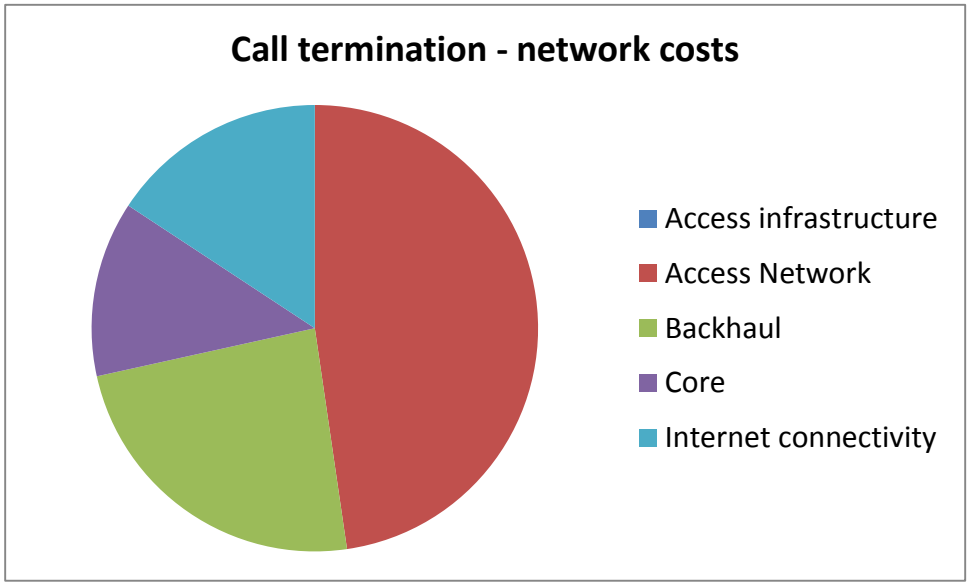
IP network costing – some elements fixed, others highly bandwidth dependent

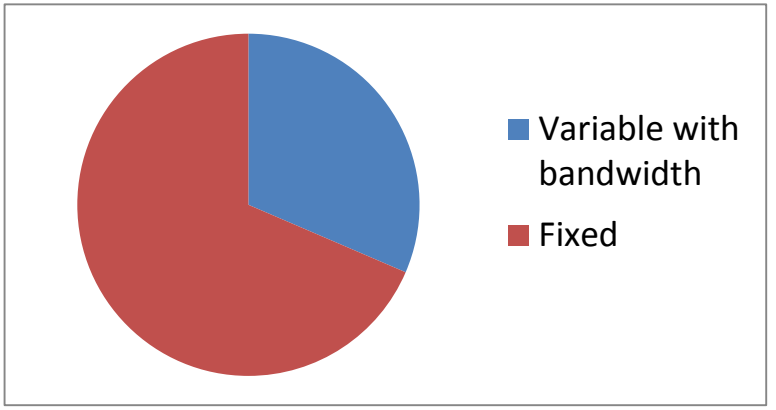


Different products will have different cost structures

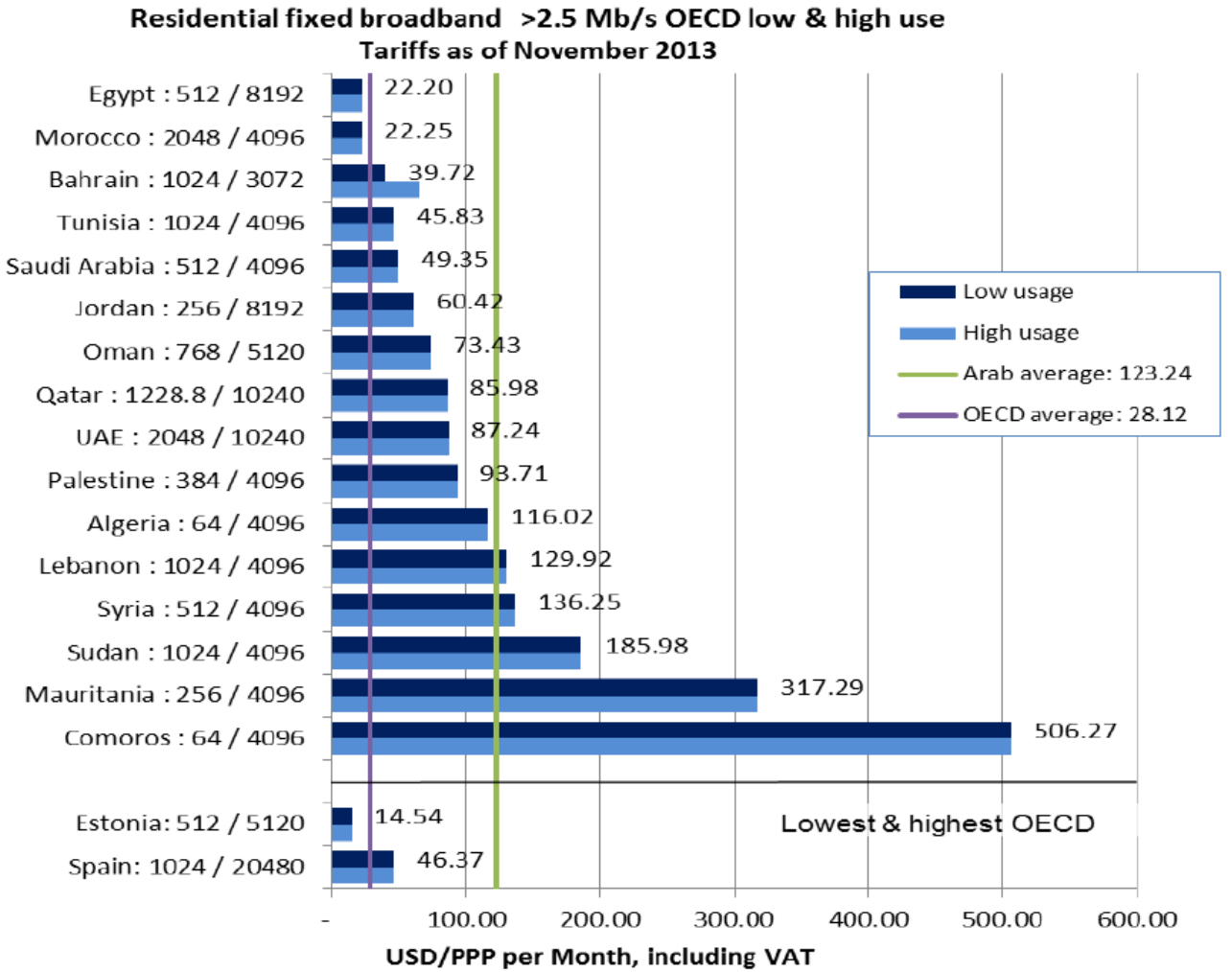








The premium for higher bandwidth is much higher in the Arab countries than it is in the OECD countries



Total monthly cost calculated based on two usage baskets:

Low usage: 6 GB and 15 hours per month, in 60 minute sessions.

High usage: 18 GB and 45 hours per month, in 60 minute sessions.

Average lines are based on the low usage results.

Teligen report for TRA, Report from the AREGNET Price Benchmarking Study, April 2014, 2013 Telecommunications Retail Price Benchmarking Report for Arab Countries

Options for costing/pricing IP interconnection

COSTING

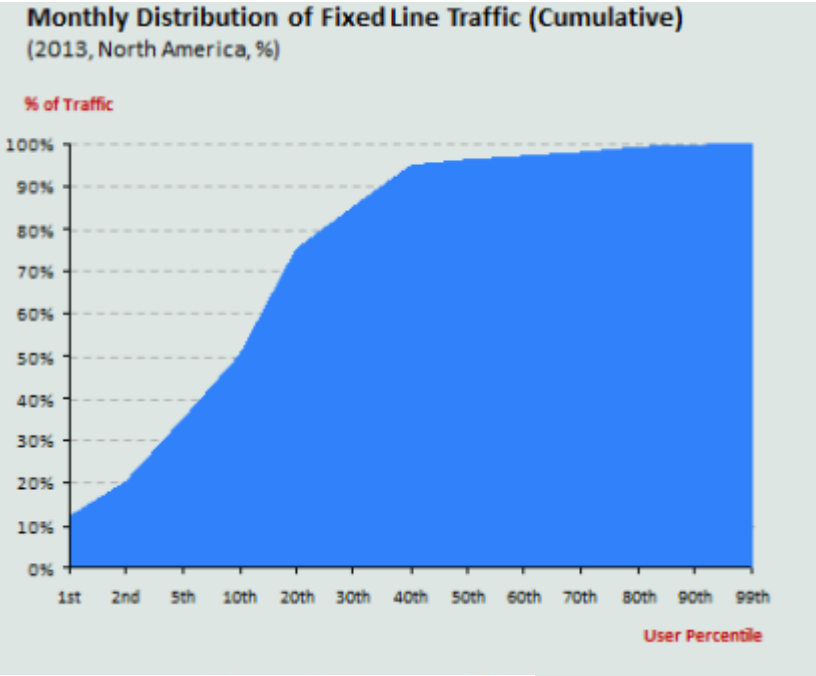
- Usage
- Capacity based costing
- Geographic costing
- Ramsey based allocations
- Time of day based costing

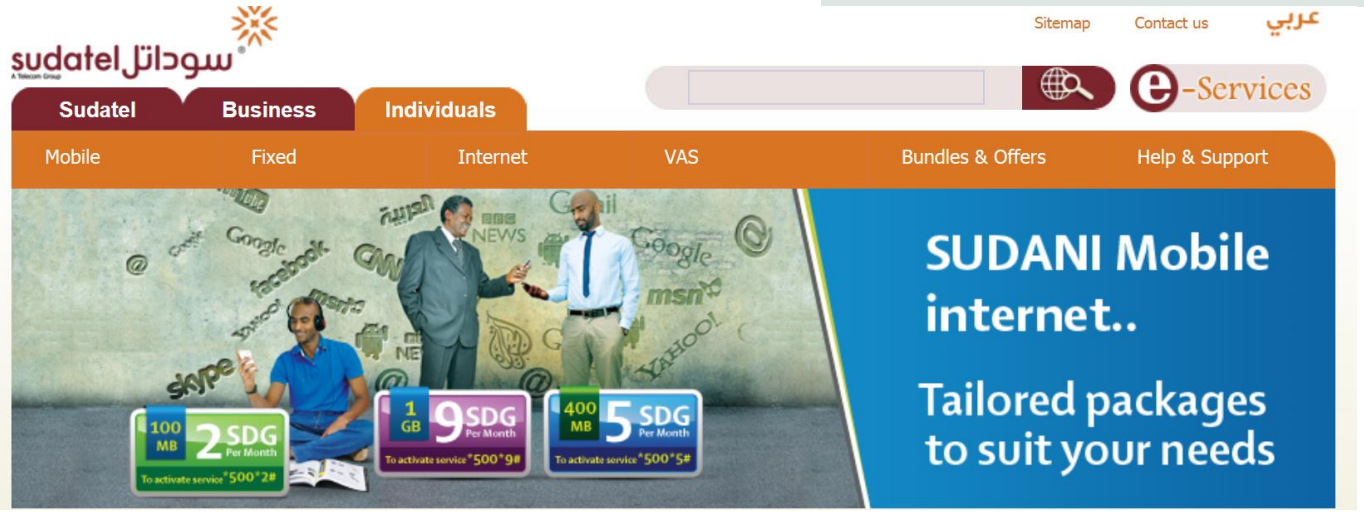
PRICING

- Interconnect commercial models
  - Calling Party Network Pays (CPNP)
  - Bill and Keep
  - Receiving Party Network Pays (RPNP)

Usage based pricing

- In 2013, the heaviest 1% of Internet users generated 12% of all traffic for both fixed and mobile broadband.
- In aggregate, the top 10% of users generated about half of all Internet traffic





Determining the cost of IP-based voice

- The key parameters in the ITU voice coding standards are:
  - CODEC sample interval (measured in milliseconds (ms))
  - ODEC sample size (measured in bits)
- These two values enable the CODEC bit rate (measured in Kbps) to be calculated by reference to sample size divided by sample interval.

CODEC	Sample Interval	Sample Size	Bitrate
G.711	10ms	640 bits (80 Bytes)	640/10 = 64 Kbit/s
G.729	10ms	80 bits (10 Bytes)	80/10 = 8 Kbit/s

- Having captured the voice signal and converted it at a given bitrate, the bits need to be loaded into a packet for transportation across the IP network. The voice payload can be configured to contain different numbers of packets although this must be a multiple of the CODEC sample size.

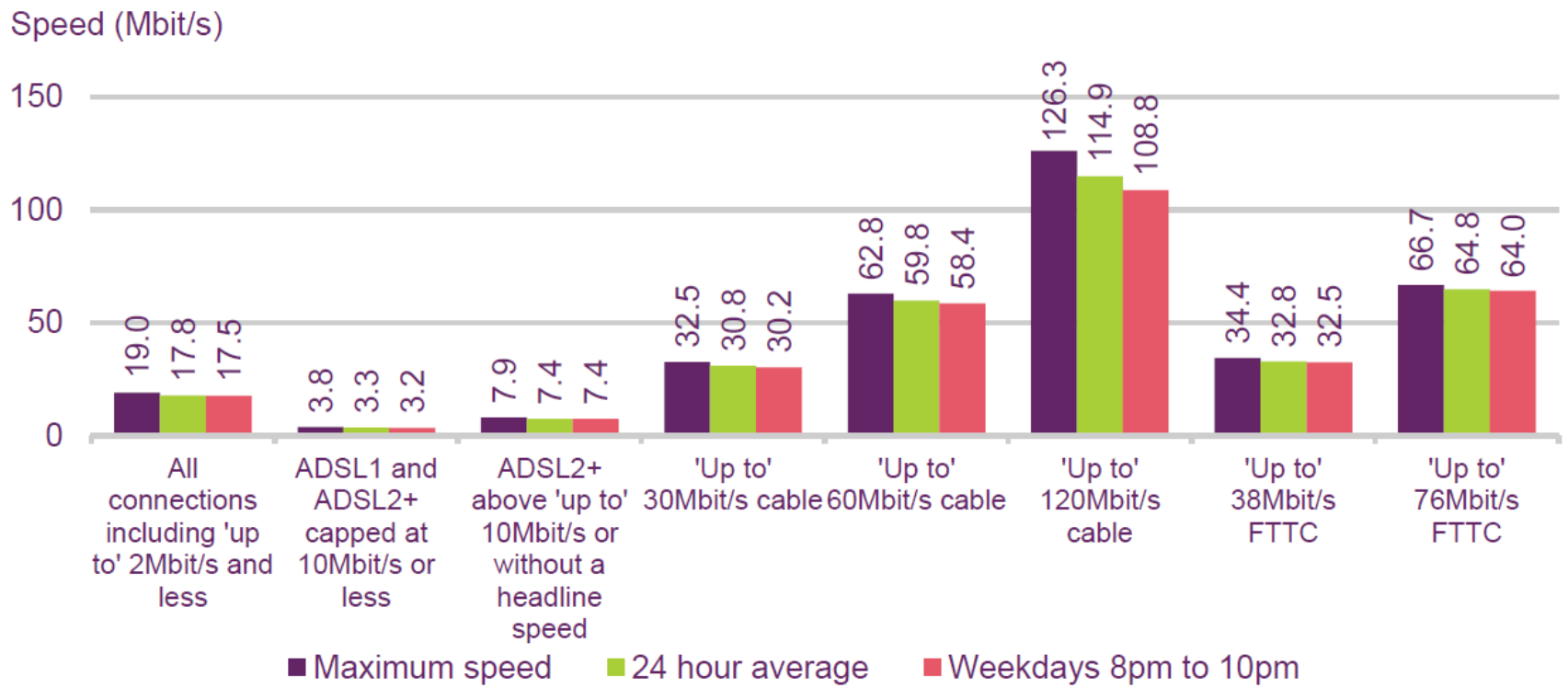
CODEC	Voice Payload Size (2 samples per packet)	Voice Payload Size	Packets Per Second (PPS)
G.711	160 Bytes	20ms	50
G.729	20 Bytes	20ms	50

- The PPS value represents the number of packets that must be transported each second in order to deliver the defined CODEC bitrate, however in order to establish the full bandwidth required, and therefore the appropriate voice/data conversion rate, it is also necessary to consider the various required headers overheads and the compression techniques that may be used.
- A typical packet header might include IP (20 Bytes), UDP (8 Bytes) and RTP (12 bytes) headers, to which the Layer 2 encapsulation used for VoIP transport needs also to be taken into account. In the case of, for example Ethernet, this adds a further 18 Bytes to the packet, however there are a range of other technologies that may be used, which incur lower packet overheads.
- Therefore, in the case of the G.711 and G729 standards and the header assumptions outlined above, the total bitrates required for a minute of voice traffic could be calculated as follows:

CODEC	Voice Payload Size	IP Headers			L2 Header	Total	Total bits per packet	PPS	Total Kbps
	Bytes	*IP*	*UDP*	*RTP*	*Ethernet*	*Bytes*	*bits*		
G.711	160	20	8	12	18	218	1744	50	87.2
G.729	20	20	8	12	18	78	624	50	31.2

Capacity based charging

Figure 1.7 Variations in download speed by time of day: November 2013



UK fixed-line broadband performance, November 2013

The performance of fixed-line broadband delivered to UK residential consumers

Geographic based pricing – driven by regulation

REGULATION

- Markets have tight geographic boundaries
- Competition can vary significantly across areas
- Can help address the 'cherry-picking' problem
- Potentially increases universal service costs
- National pricing issues

Geographic pricing of broadband in the UK

Unlimited Fibre		
Market	**Package**	**Price**
Low cost areas	Broadband Only	£17.49
	Broadband & Phone	£14.99
Outside low cost areas	Broadband Only	£24.99
	Broadband & Phone	£22.49

Source: http://www.plus.net/support/broadband/products/low_cost_areas.shtml

Geographic based pricing – driven by regulation

Overview of SMP findings

		Retail Services		Wholesale Segments			
				Symmetric Broadband Origination			Trunk
Interface technology	Bandwidth (Mbit/s)	UK	Hull	The WECLA	UK except the WECLA and Hull	Hull	UK
Traditional (TI)	V Low: <2	BT	KCOM	BT		KCOM	National *No SMP*
	Low: <=8						
	Med: >8, <=45			*No SMP*	BT	KCOM	
	High: >45, <=155			*No SMP*	BT	KCOM	Regional BT
	Very High: 622			*No SMP*		KCOM	
Alternative (AI)	Low <=1,000		KCOM	BT	BT	KCOM	
Multiple (MI)	>1,000, and any if WDM at customer's premises			*No SMP*	BT		

http://stakeholders.ofcom.org.uk/consultations/business-connectivity-mr/final-statement/

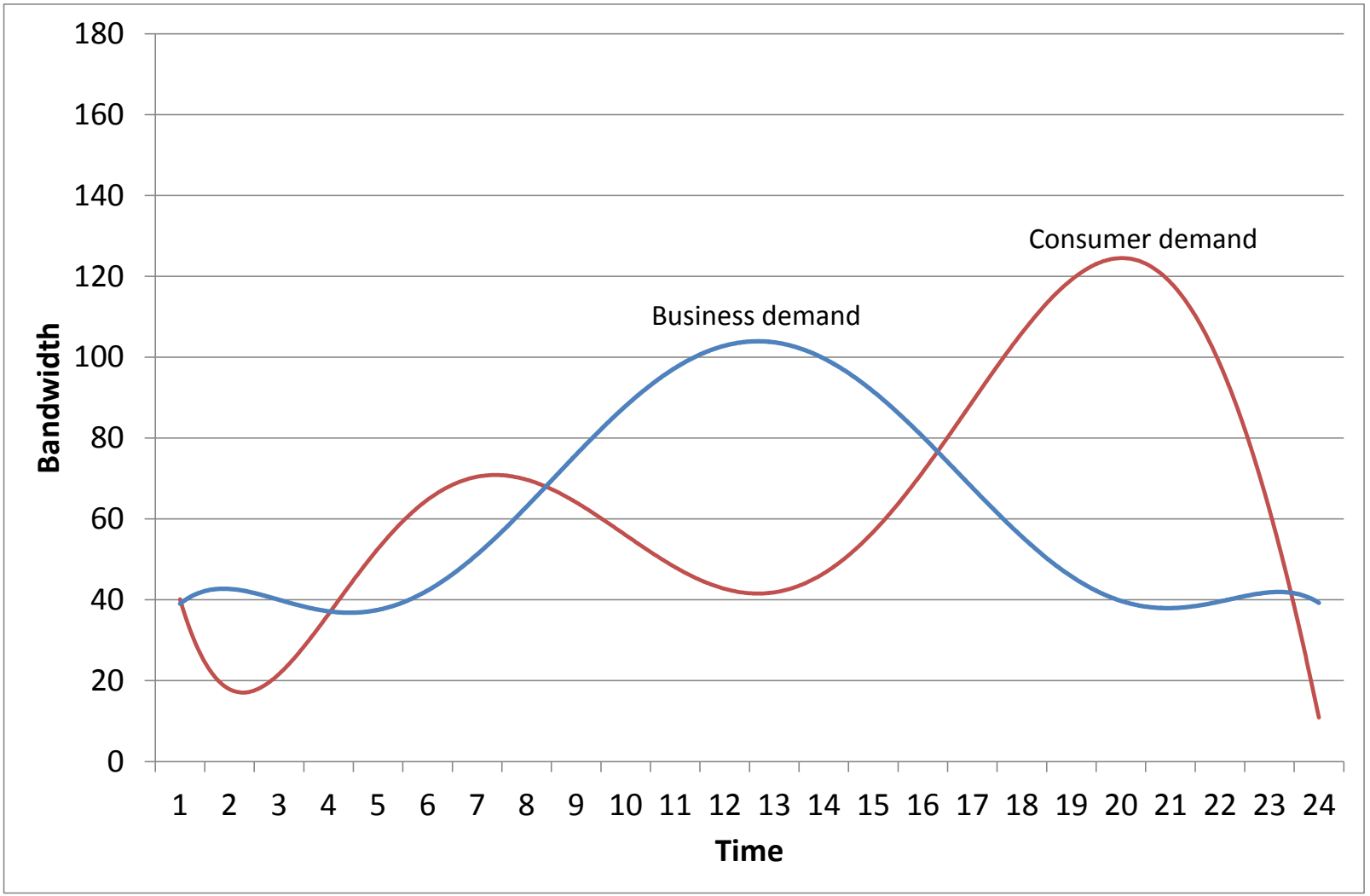
Ramsey based pricing

- Price discrimination can be economically efficient
- Maximises consumption
- Classic examples of airlines and cinemas
- Economic merits recognised by regulators but practical difficulties have tended to mean that it is disregarded
- Potential applications for telecoms:
  - Business vs consumer users
  - used to achieve social objectives – lower prices for poor, elderly, disadvantaged – light used schemes Ramsey pricing

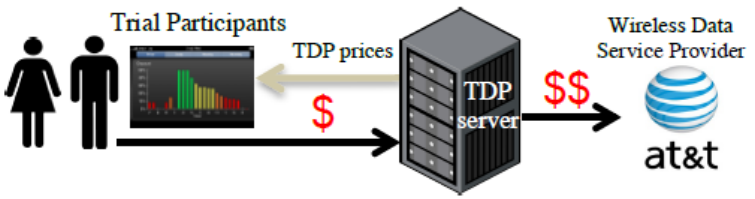
Pricing to manage congestion

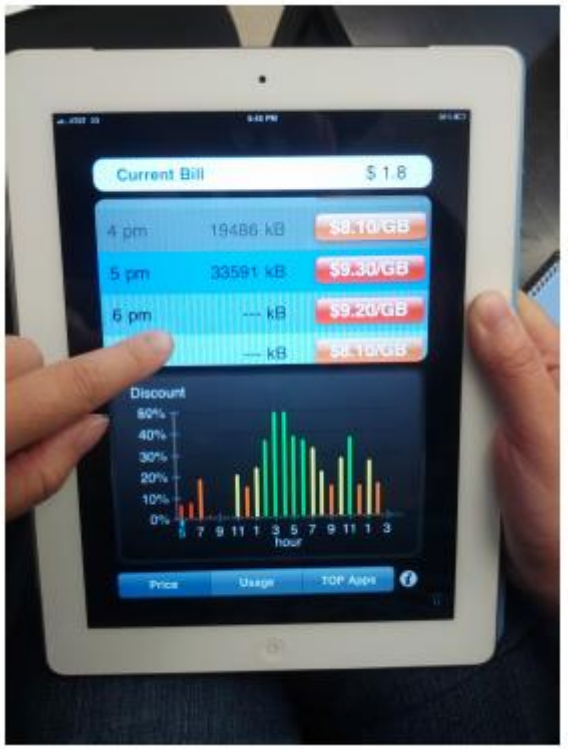
- Broadband services an example of a “club good”
  - Characteristics of a private good
    - Excludable – provider can exclude consumers who have not paid
  - Characteristics of a public good
    - Many can use it
  - Public television
- Club goods are affected by congestion costs, the marginal cost of additional network use
- Congestion costs are the costs that one consumer’s use imposes on other consumers, which in the broadband industry can take the form of packet delays or packet loss. When the network is lightly loaded, congestion costs are essentially zero. But when the network is running near full capacity, the congestion costs created by an additional user can be substantial
- Unlimited flat-rate pricing plans tend to induce excessive levels of congestion because consumers do not directly pay the congestion costs that they impose on the network

Time of day business vs consumer



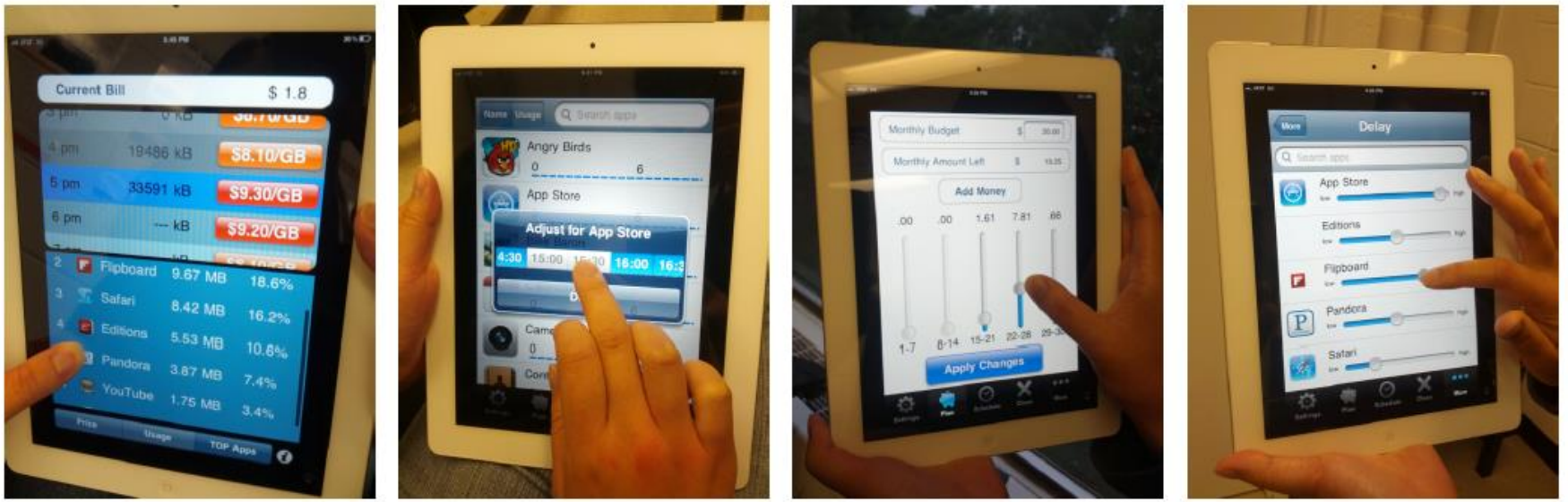
Time dependent pricing – an experiment





When the Price Is Right: Enabling Time-Dependent Pricing of Broadband Data, Soumya Sen, Carlee Joe-Wong, Sangtae Ha, Jasika Bawa, and Mung Chiang Princeton University

Time dependent pricing – an experiment



(a) (b) (c) (d)

Figure 7: View of (a) the top-5 bandwidth consuming apps in the bottom split-screen, (b) app-specific temporal blocking in parental control, (c) weekly budget adjustment screen, and (d) app-delay sensitivity settings screen.

When the Price Is Right: Enabling Time-Dependent Pricing of Broadband Data, Soumya Sen, Carlee Joe-Wong, Sangtae Ha, Jasika Bawa, and Mung Chiang Princeton University

Operators are pricing based on time of day variations across markets

"In serving the business market, many aspects of the network can be leveraged at very low incremental cost given that business demand peaks at a time when consumer demand is low, and peaks at lower levels than any consumer demand. As such, we have an advantage over competitors who serve either Consumer or Business segments but not both."

"Our network is scaled for peak evening usage by consumers, allowing TalkTalk Business to use excess daytime capacity for business customers. This together with our Ethernet capability (over 3,000 of our exchanges are Ethernet enabled, with 95% country coverage) allows TalkTalk Business to offer a wide range of competitively priced, high-margin, all-IP data connectivity products."

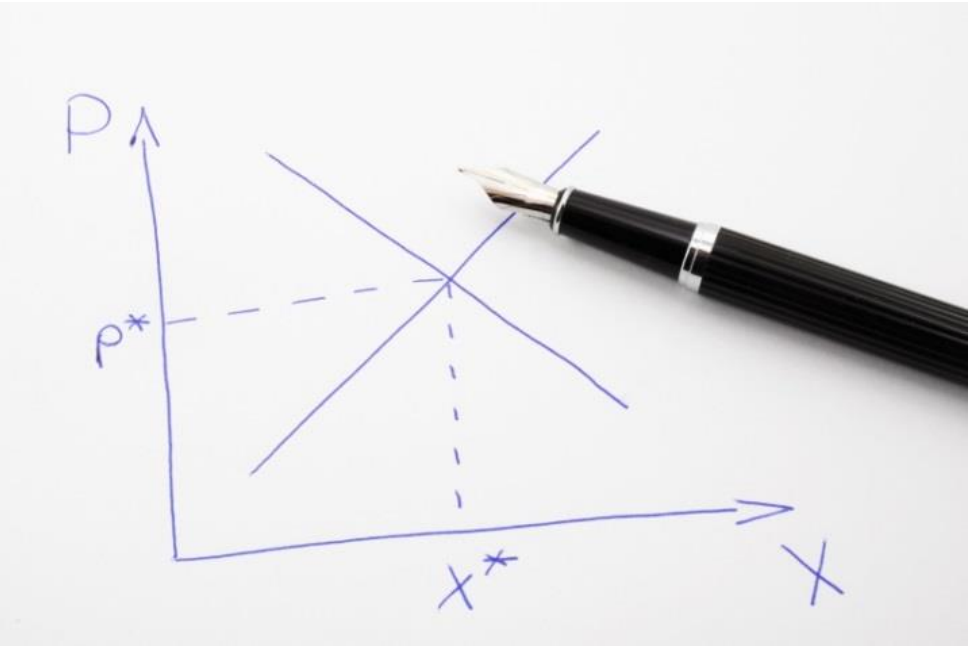
TalkTalk Annual Report 2014, Virgin Media Annual Report 2013

Implications for

- Pricing strategies
- Regulatory costing methodologies
- Regulated prices
- Competition law tests

The fundamentals of costing and pricing in telecoms

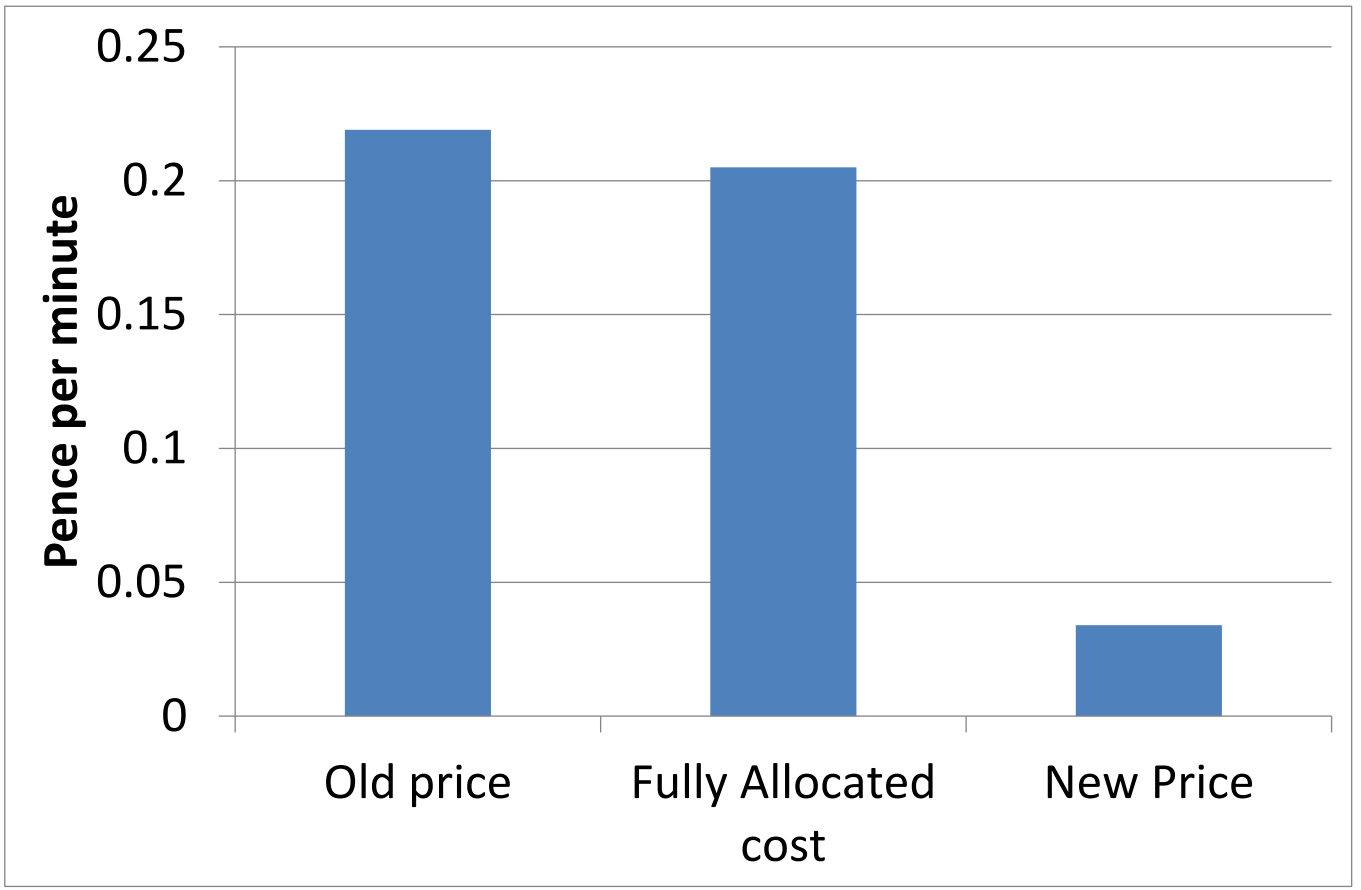
- Economic theory tells us that competition drives prices down to marginal cost
- A monopolist will price to maximise profits selling fewer products at higher prices
- Regulator's perspective on pricing has traditionally been that of constraining a monopoly provider
- Focus in regulation on efforts to attempt cost of providing services
- Difficult in PSTN world
- Even more difficult today with
  - IP networks
  - Convergency
  - Competition (!)



Regulators generally recognise the need to set prices to recover common costs

- If all prices are equal marginal costs firm will not cover fixed /common costs.
- So 'second best' pricing rules:
  - Recovery of marginal costs, plus
  - Mark-ups to recover fixed costs, and any shared or common costs.
  - What mark-up?
  - Most efficient allocation of common costs would be a Ramsey pricing approach. Mark-up would reflect strength of demand from individual customers:
  - Percentage contribution to common costs of each service is set in inverse proportion to the elasticity of demand for the service.

Marginal costing in telecoms can't be applied across all services



Ofcom moves fixed call termination to LRIC

Cost data as an input to regulation and competition policy

Ex-ante regulation: A tool to inform price controls

- Cost modelling allows NRAs to set cost-oriented prices for wholesale services (e.g. fixed and mobile termination rates)
- Wholesale prices must not be so much higher than costs as to prevent the entrance of as-efficient operators and not so low as to invite the entrance of inefficient operators

Ex-post regulation and competition policy: A tool to regulate anti-competitive behaviour

- **Excessive pricing.** Establish whether an SMP operator charges a price that is significantly above the appropriate rate of return
- **Margin squeeze**. Establish whether an SMP operator charges so much for wholesale services that its own retail subsidiary would be unable to profitably survive in the market
- **Predatory prices**. Establish whether an SMP operator is setting a retail price so low that alternative as-efficient operators are not able to compete in the retail market
- **Bundling and cross-subsidies**. Establish whether an SMP operator is offsetting losses in one specific product/service with extra profits from another product/service

Cost conventions in regulation and competition (1)

- FAC, LRIC and LRIC+ are all used frequently as references for price controls. As a general rule, with many exceptions:
  - FAC has been used for access network services, e.g LLU (2005 Openreach Financial Framework.
  - LRIC and LRIC+ have been used for core network services; e.g. MTR and FTR price regulation.
- Variations on FAC
  - FAC can be applied using Historic (HCA) and Current (CCA) asset valuation conventions, but CCA is generally preferred as a more robust basis for simulating a new entrant's make-or-buy decision.
- Variations on LRIC
  - LRIC can be applied using Top Down (TD) and Bottom Up (BU) modelling techniques. BU is preferred when NRAs seek to identify efficient forward looking costs. TD provides a more robust basis for ensuring cost recovery and maintaining investment incentives.
  - BU provides LRIC and LRIC+ calculations
  - TD provides Pure LRIC, DLRIC and DLRIC+Mark up calculations

Cost conventions in regulation and competition (2)

Cost conventions for predatory pricing (the "as efficient competitor" tests)

- Theoretical test for below-cost pricing (**Areeda-Turner rule**, 1975)
  - Price > ATC: Presumed licit
  - AVC < Price < ATC: Deserves scrutiny
  - Price < AVC: Presumed predatory
- **EC guidance on art 102** (the as-efficient operator test)
  - Price < AAC: Presumed predatory, because the dominant company would have been better-off not producing and avoiding these costs.
  - AAC < price < LRIC: An equally efficient competitor could be foreclosed from the market. No presumption of foreclosure (unless in the context of a wider plan to exclude rivals)
  - Price > LRIC: Concerns about exclusionary below-cost pricing are unlikely to materialise.
- **EU case law**
  - AVC and ATC used as benchmarks by the European Court in AKZO (1993)
  - However, in markets where an incumbent company faces competition from new entrants that do not enjoy the same scale advantages (i.e. competitors that are not yet as efficient), even prices above ATC may be found to lead to foreclosure. This however undermines legal certainty (how to know if own pricing is infringing or not?) and also risks promoting inefficient entry

Cost conventions for excessive pricing

- DSAC was been used as a relevant price ceiling standard, e.g.; in the 2009 dispute over BT's Partial Private Circuits charges

Key definitions

Fixed versus Variable

- Fixed: Costs that *do not* vary in relation to product volumes.
- Variable: Costs that vary in relation to the volume of production.

Increment

- A unit of production – could be a product/service, or a network element, or coherent group of increments that share the same cost driver

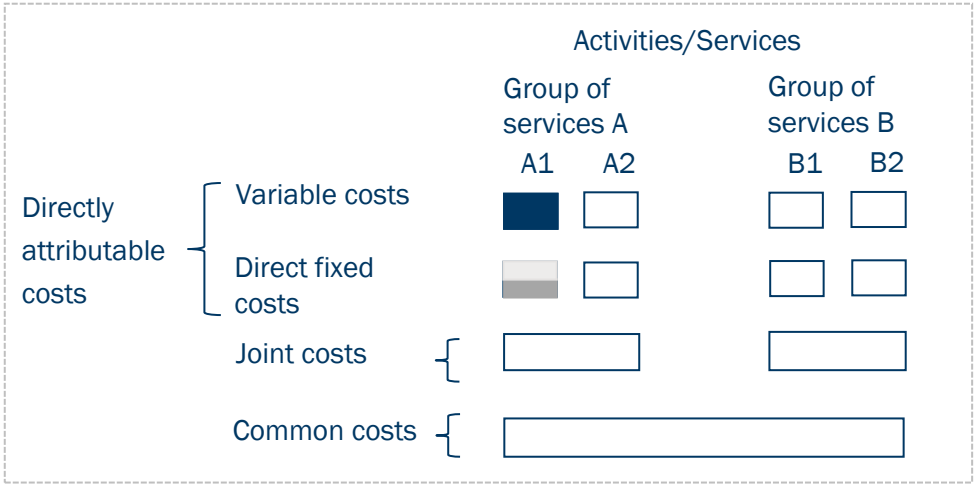
Directly attributable versus shared versus common costs

- Directly attributable (or incremental): Can be associated with a specific increment of production (network element or product)
- Joint or Shared: Generated by and attributable to a defined increment group.
- Common: Costs that are not causally attributable to any specific increment or increment group.

Avoidable versus sunk costs

- Avoidable: Recoverable upon exit, i.e. not incurred if the service/activity is no longer provided
- Sunk: Not recoverable in case the service/activity is no longer provided

Translating definitions into cost conventions
Variable, Avoidable and Incremental Costs



A **variable cost** is a cost that varies in proportion to the level of a specific activity.

Avoidable costs are those costs that are avoided (i.e. no longer incurred) if the production of service A1 is stopped in the short run, These are:

- Variable costs
- Avoidable direct fixed costs, that is, those direct fixed costs that are not sunk (i.e. recoverable) in the short term.

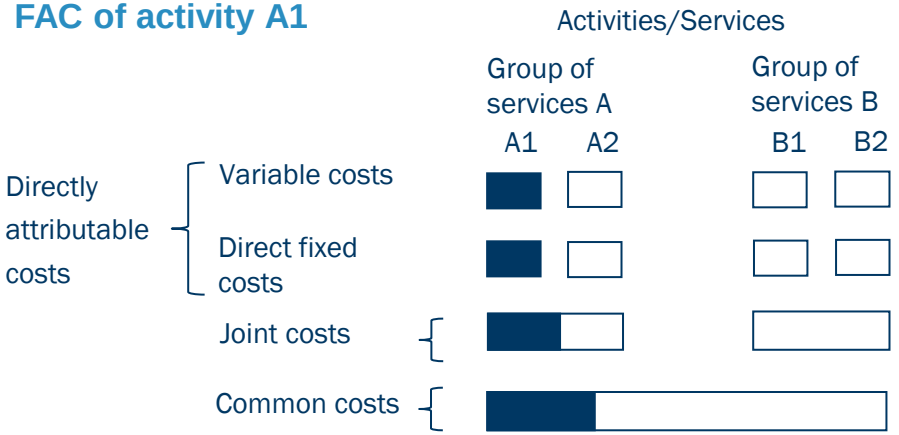
Long Run (Average) Incremental Costs include:

- Variable costs
- Direct fixed costs

Direct fixed costs are included because in the long run all costs are considered to be variable.

Translating definitions into cost conventions
Fully Allocated Cost

FAC of activity A1

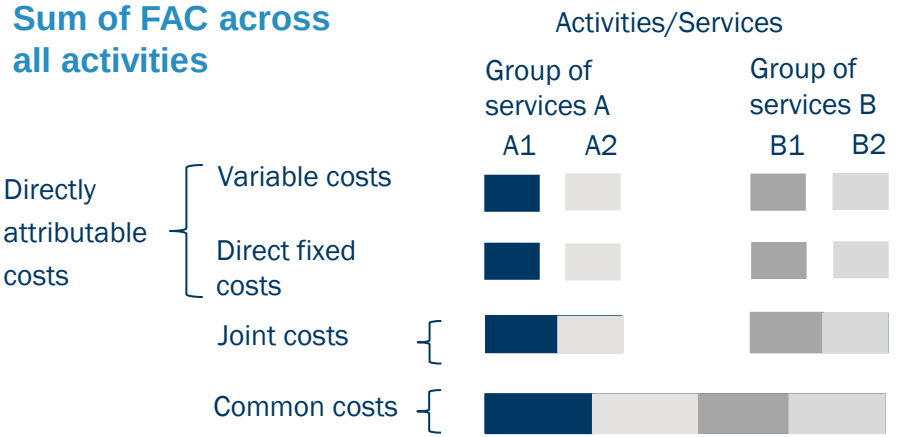


Under FAC all costs are attributed in an exhaustive way across the all activities and services

The FAC of each activity will therefore include:

- All directly attributable costs (variable and fixed)
- A proportional share of shared/joint costs
- A proportional share of common costs

Sum of FAC across all activities



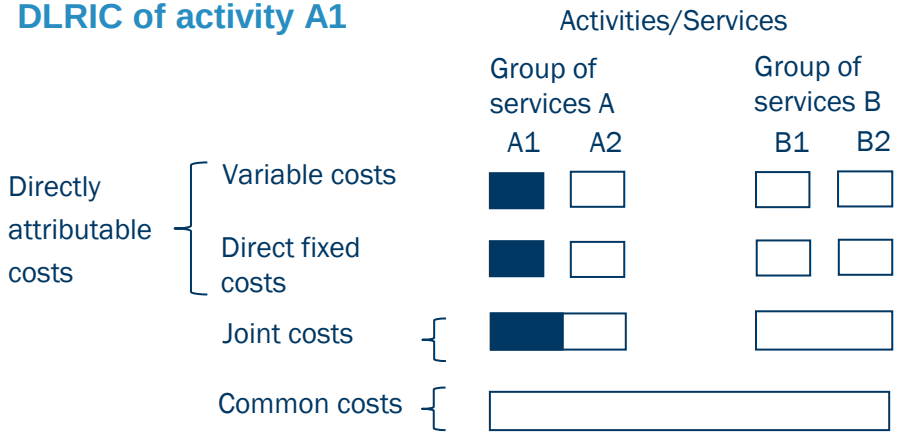
Note:

The sum of the FAC across all activities (A1, A2, B1, B2) *equals* the total cost

This is because the sum of the proportions of joint and common costs attributed to the FAC of each of the four activities is 100%

Translating definitions into cost conventions
Distributed LRIC

DLRIC of activity A1



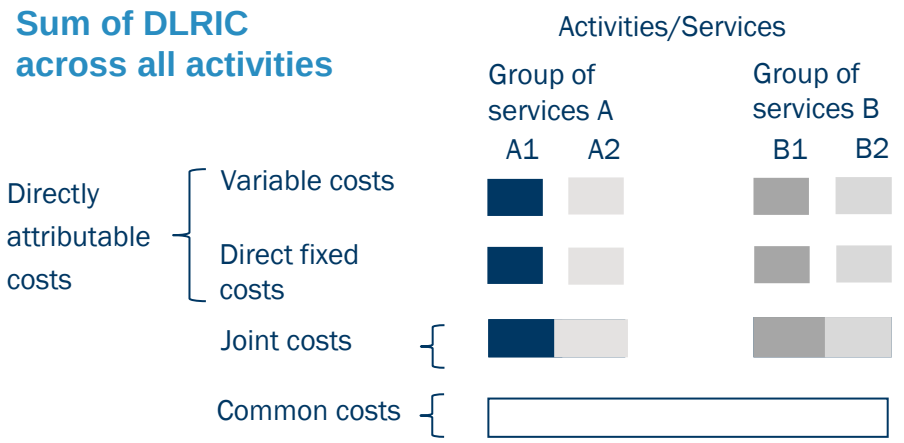
DLRIC consists of:

- All directly attributable costs (variable and fixed)
- A share of shared/joint costs

DLRIC does not allow for recovery of common costs

Joint costs are allocated according to an EPMU, i.e. in proportion to the incremental cost already allocated to the products/services.

Sum of DLRIC across all activities



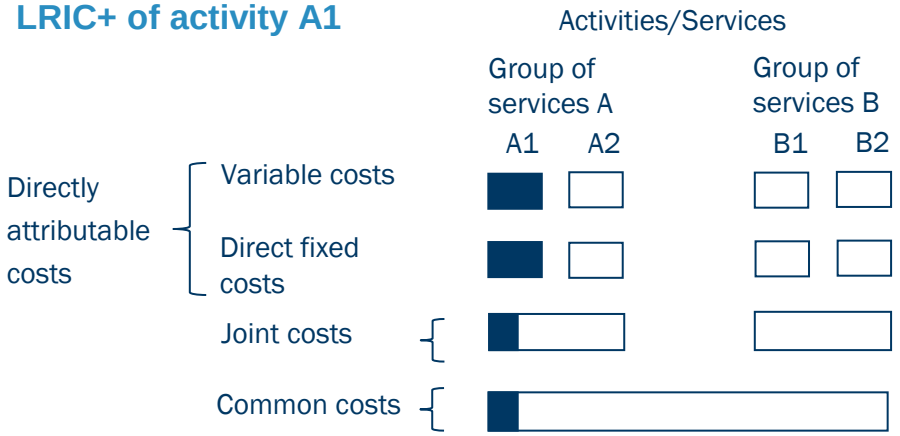
Note:

The sum of the DLRIC across all activities (A1, A2, B1, B2) *does not equal* the total cost

This is because DLRIC allows for full recovery of joint costs but not common costs

Translating definitions into cost conventions
LRIC+

LRIC+ of activity A1

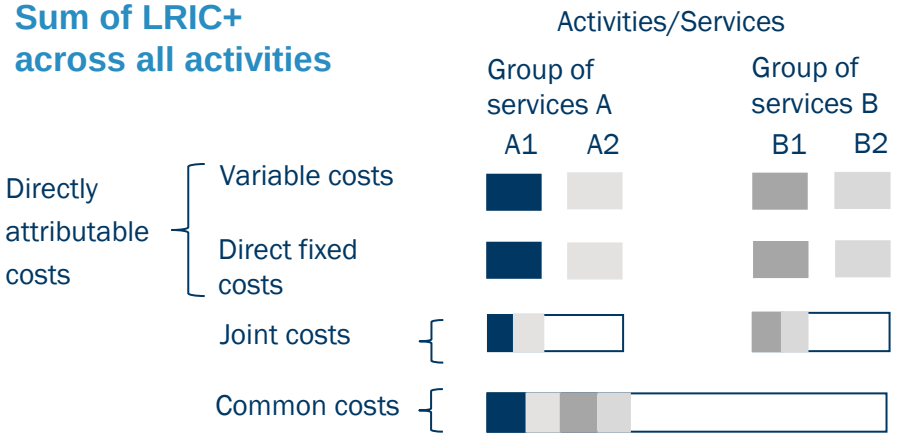


LRIC+ consists of:

- All directly attributable costs (variable and fixed)
- A portion of shared/joint costs
- A portion of common costs

The portion of shared and common costs that the operator is allowed to recover depends on an assessment of which proportion of joint and common costs would be avoided in the long run if the activity is no longer produced.

Sum of LRIC+ across all activities

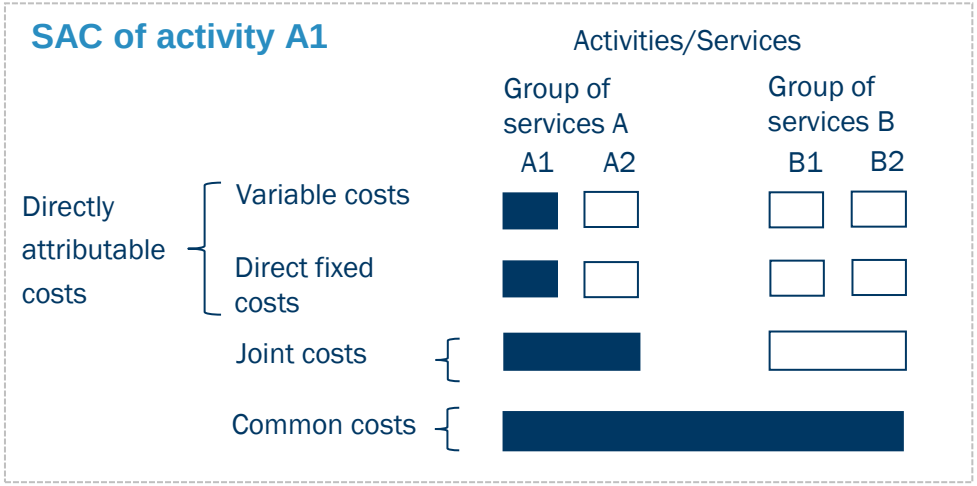


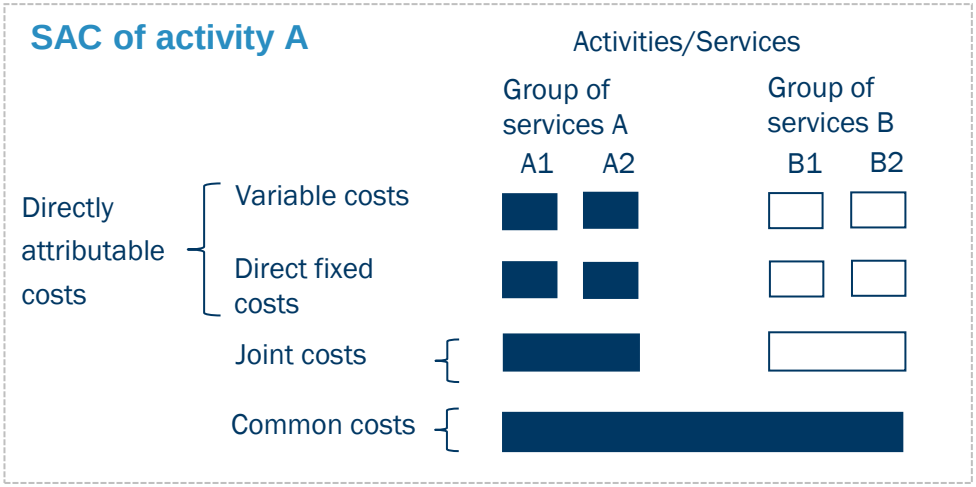
This method involves a degree of arbitrariness in the choice of the recoverable proportion of joint and common costs.

Common costs are allocated according to an EPMU, i.e. in proportion to the incremental cost already allocated to the products/services.

An alternative to the EPMU approach is the Ramsey principle, which suggests calculating mark-ups that are inversely proportional to the demand elasticity

Translating definitions into cost conventions
Standalone Costs





SAC represent the cost of providing a service in isolation from the other services of the company

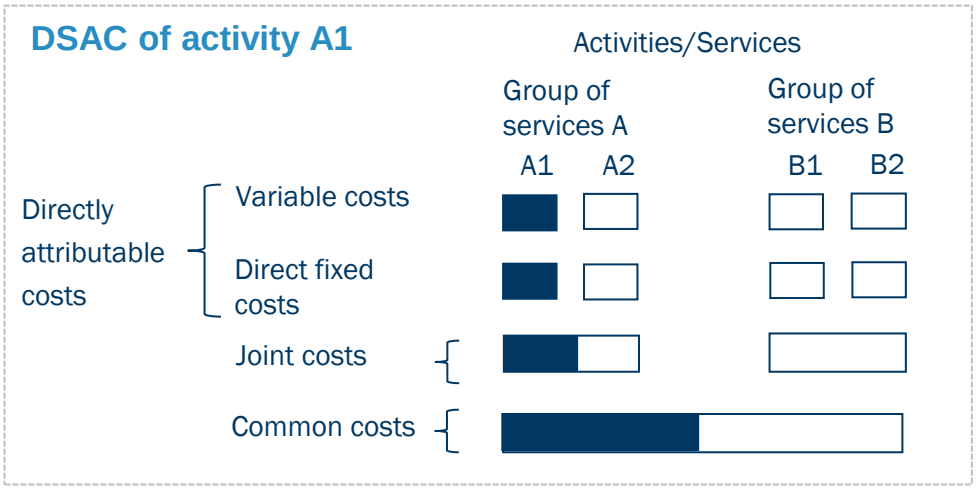
SAC comprise:

- All directly attributable costs (variable and fixed)
- All shared/joint costs
- All common costs

Under this attribution method, the shared costs are totally supported by the service under consideration

SAC is generally *not* calculated at the lowest level (e.g.A1 here) as it would lead to unreasonably high costs. It is generally calculated at a higher level (e.g. A here)

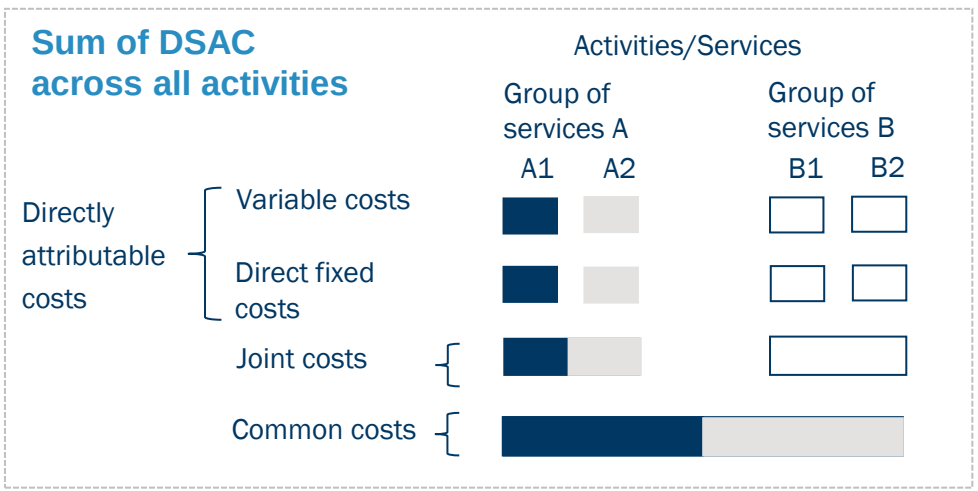
Translating definitions into cost conventions
Distributed Standalone Costs



SAC is calculated at higher levels (e.g. A)

DSAC is calculated at a lower level (e.g. A1 and A2), and consists of distributing the SAC of the parent (A) to the children (A1 and A2)

The joint costs are distributed to A1 and A2 according to the LRIC of the two activities, while the common costs are distributed according to the DLRIC

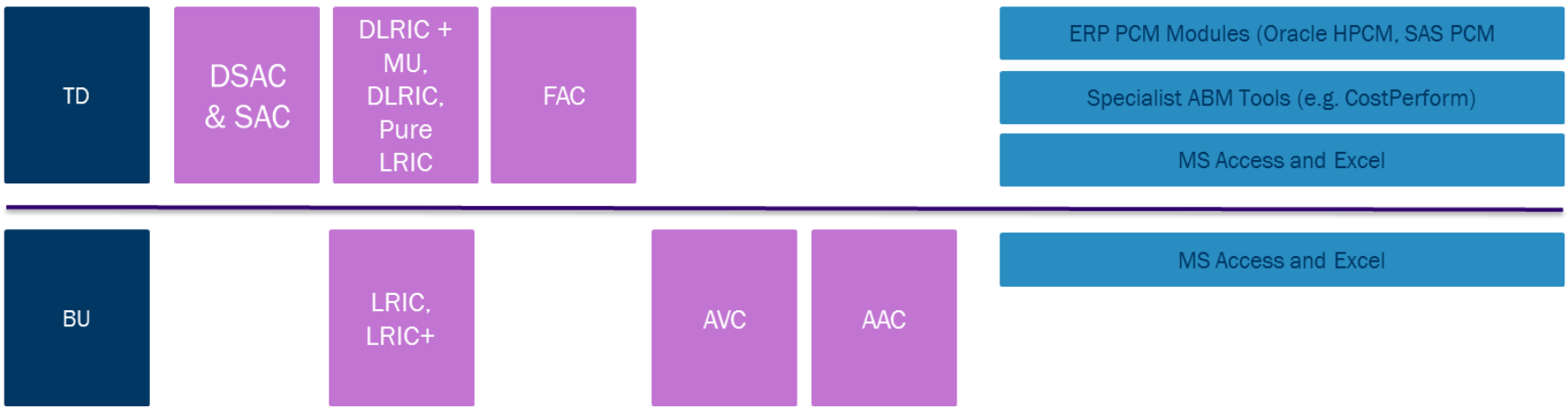


Note:

The sum of the children's DSAC (A1 and A2 here) *equals* the SAC of the parent (A here).

Top down v Bottom up

- Top Down: Calculated by reference to the general ledger and reconcilable to statutory financial statements
- Bottom up: Driven by a given demand for products, which is translated into a theoretical efficient network (based on prevailing engineering rules) for which costs can be calculated (based on current costs)



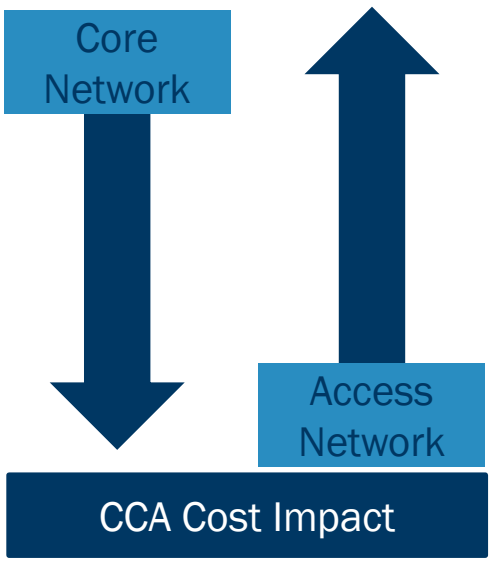
Other costing definitions
Asset valuation conventions

Historic versus Current

- Historic: Assets are valued at the level recorded in the fixed asset register.
- Current: Assets are valued at today's prices, and, when applied to top down analysis, the impact of movements in prices across the reported period is reflected as an adjustment to the historic depreciation charges.

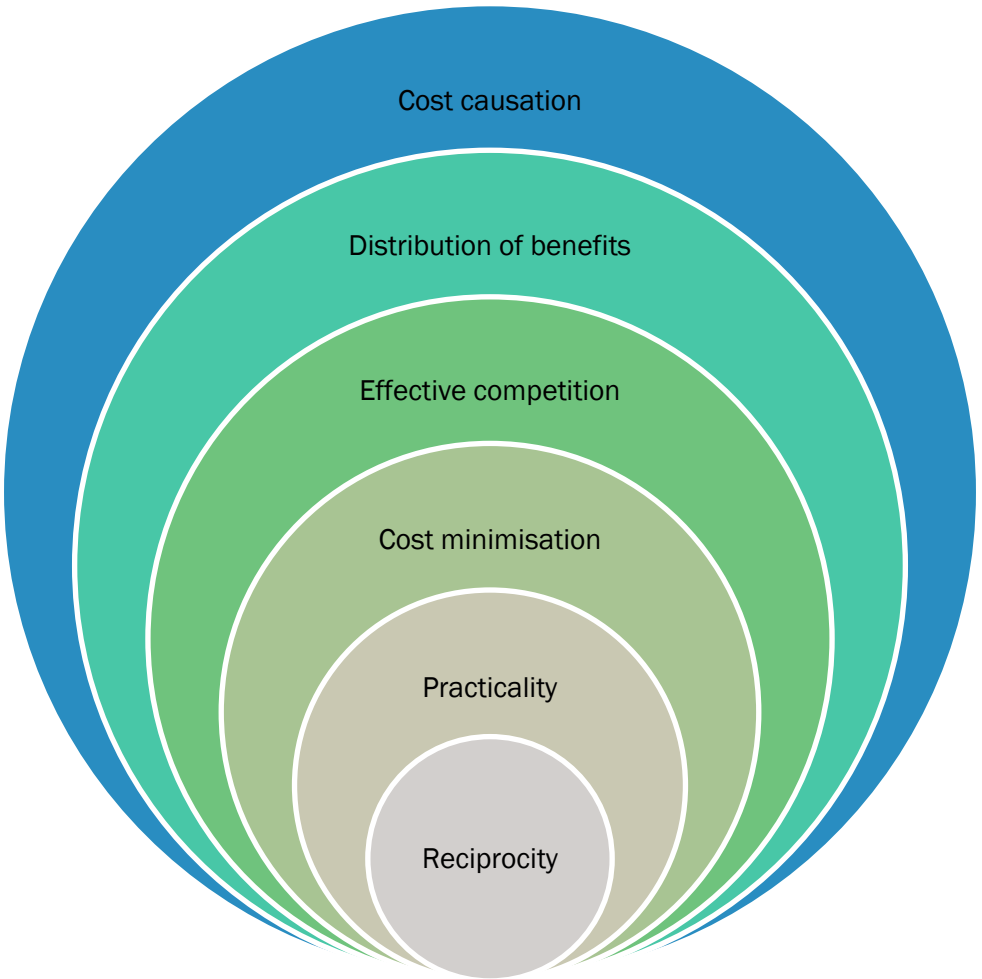
Rationale for Current Cost Accounting

- Integral to achieving a forward looking view of costs. Provides better insight into a make-or-buy decision faced by a new entrant operators. Reflects the cost to investors of holding assets (increases and decreases in the valuation of assets).

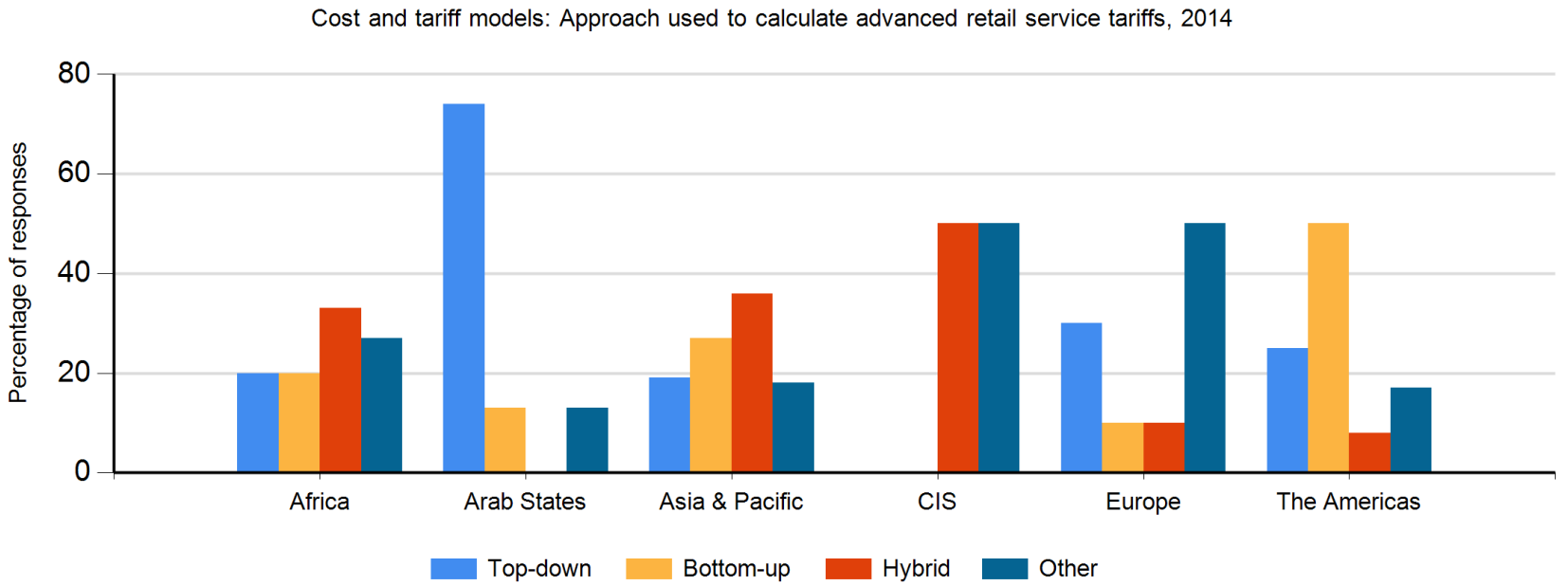


Regulatory principles of cost recovery

The WTO Reference Paper requires "*cost-oriented rates that are transparent, reasonable, having regard to economic feasibility*".

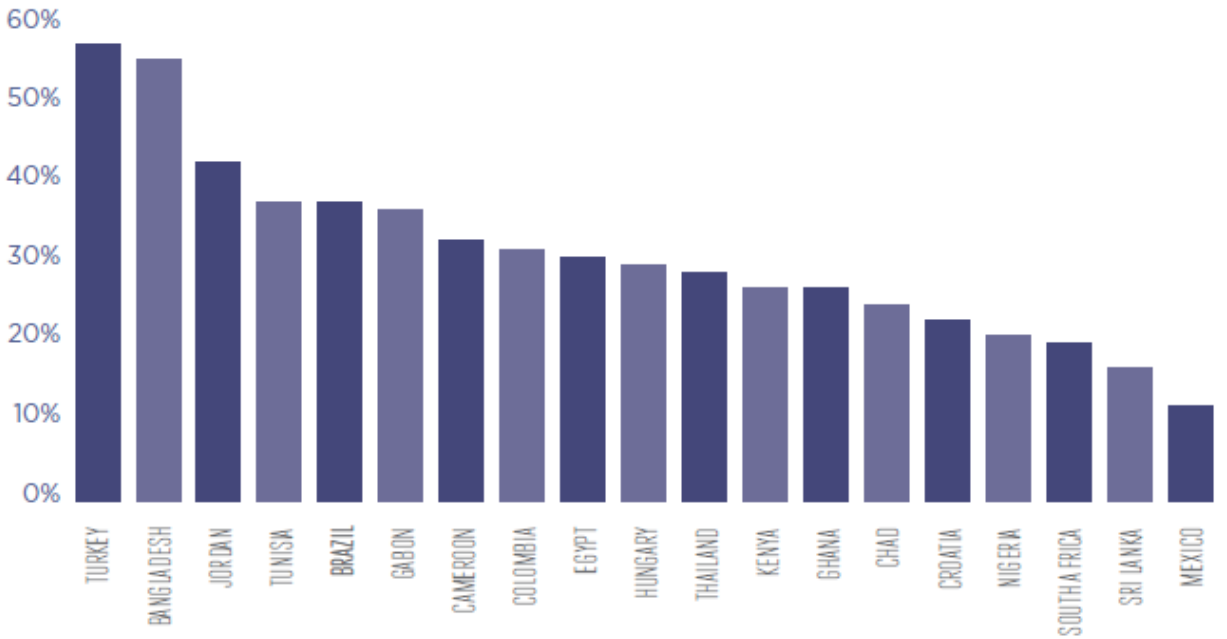


Different costing methodologies



Tax is often a major element of cost and price

THE BURDEN ON MOBILE SERVICES AND AVERAGE TAX BURDEN ACROSS MARKETS[5]



Deloitte, Mobile taxes and fees, A toolkit of principles and evidence, report for GSMA February 2014