

Critical Review of LTE business models, and related research issues

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PREAMBLE

ACCOUNTING and CHARGING in LTE / SAE NETWORKS (PCRF node)

- It is an evolution of the *packet charging* domain charging mechanisms for GPRS and UMTS
- It facilitates seamless interworking with legacy charging systems.
- The charging filter rules are provided by the Policy and Charging Rule Function (PCRF).
- The IMS Charging Function provides information about the user's session (e.g. call control, multimedia, services).
- The Application Charging Function provides information about the content of the user's traffic (e.g. URL, file or media stream name).

ATTRIBUTES AFFECTING THE PRICE OF AN LTE USER SESSION

- Usage time or duration.
- Transferred data volume
- Number of events (units)
- Destination of session
- Location and time zone of session
- Origination
- Quality of Service (QoS)
- Radio Access Technology (RAT, e.g. LTE and 3G/2G in the case of handover, non-3GPP access such as WiFi)
- Tariff Time
- User identification

BUSINESS MODEL DEFINITIONS

- Academic definition : “A business model is a conceptual tool that contains a big set of elements and their relationships and allows expressing the business logic of a specific firm” (Osterwalder, Pigneur and Tucci (2005))
- Industry and policy making definition: « A set of agreements, intellectual property and pricing schemes, allowing a party to a service or product delivery to monetize its contribution and costs, while respecting law and social sustainability »

BUSINESS MODEL COMPONENTS

Their choice is normally task of Board

MIXTURES OF :

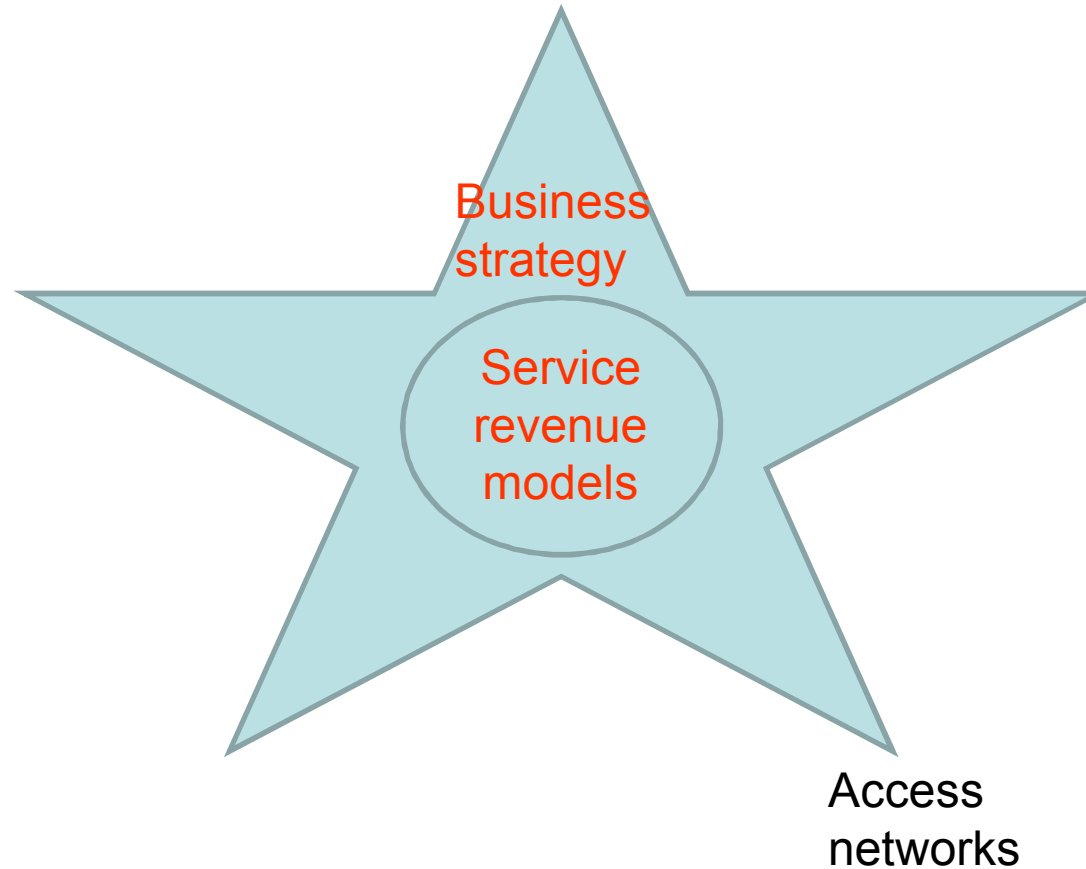
- Strategic intent in the face of disruptions and competition
- Role assumed or changes
- Threats & Opportunities
- Posture (e.g. service models, IPR)
- External processes and tariffs
- Internal processes (technology, costs, expertise, HR, social policies....)
- Risk management

OR:

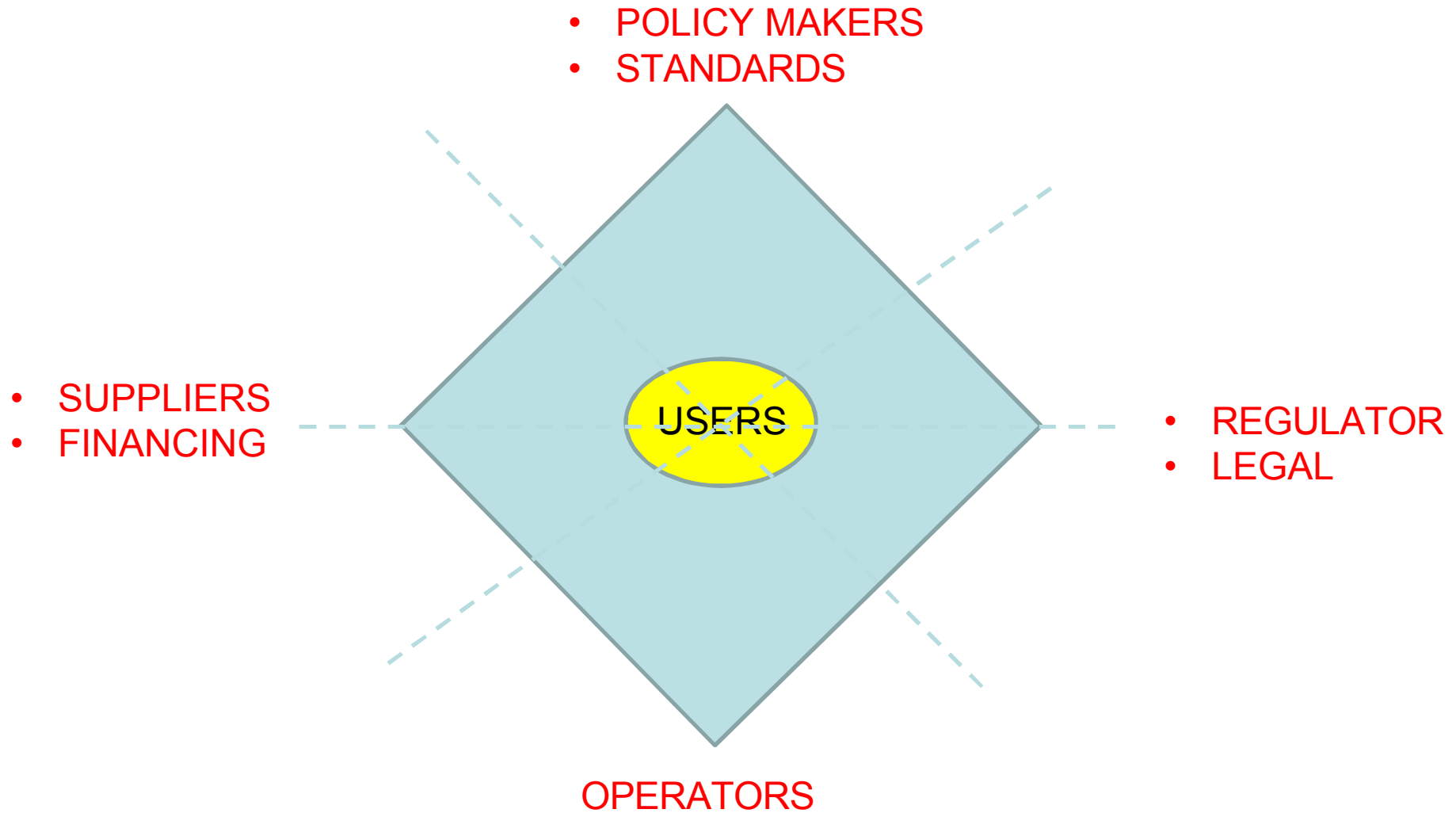
- What is goal or party to kill?
- How will you dress yourself up?
- Where, when and how to attack ?
- What are your weapons ?
- Engagement
- How to survive and repair?
- Where not to put your feet ?

THE TRADITIONAL OPERATOR MODEL limited to « Corporate strategy vs Service models » is outdated

Goals in survival / profit game



THE INFERNAL EQUILIBRIUM and main lines of friction



Enormous technology change from LTE

but

Business models trump technology

and

Legal-Regulatory trumps all

THE GROWING DIVERSITY OF BUSINESS STRATEGIES

- Drop fixed links (except fiber) and go wireless
- Drop payment cards
- Drop set-top boxes (not covered here)
- Drop software licenses
- Drop annual support fees
- Live well by making systems very complicated
- Bundle devices with content services
- Live (well) from basic services
- Focus by sharing /sourcing with/from others
- Live (well) from others software and content
- Live (very well) from your own software or content
- Prey on others : live from search, indexing and advertisements
- Create and lead with new traffic and communications services
- Create and lead with new content delivery , preying on content owners and other media
- Create well and lead with new transactions intermediation, preying on existing trading agents

RECAP: INITIAL TECHNOLOGY and COST MOTIVATION FOR LTE

- Need for higher data rates and greater spectral efficiency
- Need for a Packet Switched only optimized system
- Use of licensed frequencies to guarantee quality of services
- Always-on experience (reduce control plane latency significantly and reduce round trip delay)
- Need for cheaper infrastructure
- Simplify architecture of all network elements

INITIAL OPERATOR VIEWS on LTE and IMS

- “LTE is an all-IP network”
 - Not compatible with legacy voice services
 - Assumes the use of IP Multimedia System (IMS)
- Initial LTE networks will be data only
- Initial LTE handsets will be multi-modal, supporting HSPA and earlier systems for voice telephony
- Voice over LTE via Generic Access



ASSETS OF A SERVICE AND CONTENT ENABLER

Monetizing revenues by synergies



Improving margins and efficiencies by shared components and functionality

Figure 1. Key Assets of a Service and Content-Enabler

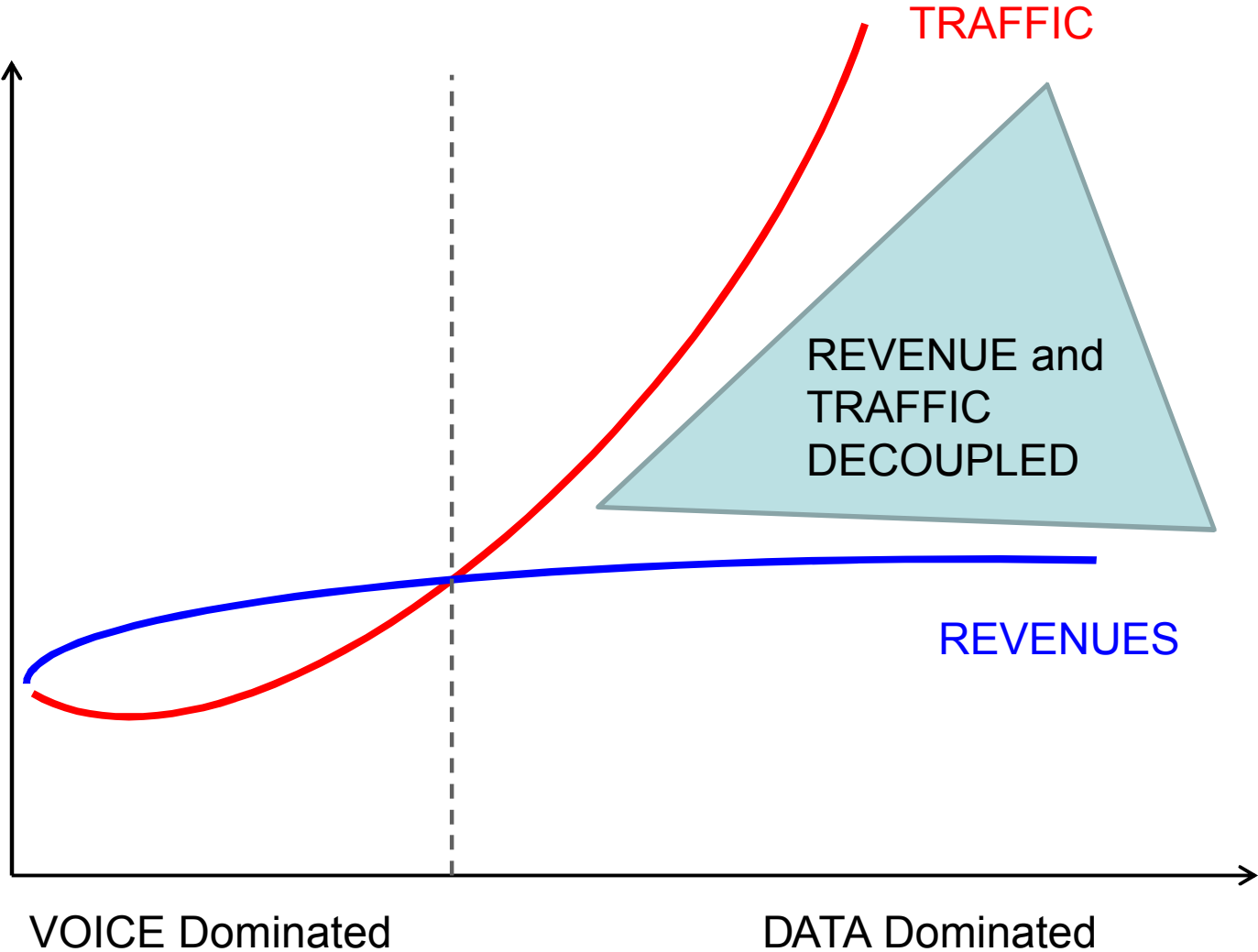
DISRUPTIONS and COMPETITION

DISRUPTION 1 : MOBILE INTERNET

- Service providers are building mobile broadband access to the Internet; “we’re not in the telephony business any more”
- Any one else, such as IT or Internet firms or enterprises, finding value in the Mobile Internet, can also provide it

DATA GROWTH NOT MIRRORERED BY REVENUE GROWTH

Mobile data traffic to increase dramatically, but operators need controls to protect revenues from user behavior, while some enterprises having other revenues do not!



DISRUPTION 2: UBIQUITY OF PRODUCTS and SERVICES

- Like it or not, a web of networked economies, nationally and globally, is being spun before our very eyes, with macroeconomic impact

MACROECONOMIC BENEFITS

- According to FCC chairman Julius Genachow : “Research has shown that consumer benefits are 10 times higher than the value the actual spectrum generates at auction. So US\$30 billion of spectrum equates to US\$300 billion of consumer benefits”.
- Every day we are not freeing up spectrum for mobile broadband is another day economic potential is not generated.
- In 2010 worldwide telecom services and products exceeded 1 000 BillionEUR (Source: Digiword Yearbook 2011) , but ICT&M is still not recognized as a macroeconomic sector; equipment and content aggregation shares are rising while access service provisioning is falling since 2002 (Source: IDATE)
- Over next 5 years, needed investments in optical fiber and LTE in Europe would represent 30 BillionEUR (Source: IDATE)(approx. 12 % of avg. turnover) , amounts which can only be obtained by asset sales, or by merger based synergies

LTE COVERAGE & INFRASTRUCTURE COSTS DRIVE EXPANDED *NETWORK SHARING*

- For 50 M users in a mid-sized european country, greenfield LTE costs are about 2 Billion Euros, plus spectrum license costs, with a strong variability due to local aspects and reutilized infrastructure (esp. Transmission)
- LTE infrastructure investments are expected to exceed those in 3G from 2013
- LTE Network sharing will emerge as a strong differentiator to historic 3G deployment, less because of costs, but more to enable much faster geographical coverage and enough spectrum

Case Tele2 / Telenor (in Sweden): have established a JV to share RAN's and spectrum (900+2100 Mhz) , becoming MVNO's on the jointly owned network

DISRUPTION 3 :

CUSTOMER CENTRIC INFORMATION MANAGEMENT

- Often customer data and needs are kept in different silos across different systems, and never put together
- There is big value and economies of scale in re-intermediation
- Example Scenario case: Broadband provider sends repeated letters to your house addressed to a previous tenant, or about an additional service which you already set up, Telco is also missing out that you have your phone, Internet and TV with different suppliers,
- LTE enabled scenario example outcome: One supplier offers you a bundle, managing my customer data more effectively, My spend would be increased from 20 Euros to 70 Euros plus, with only moderately incremental costs due to SAE,

DISRUPTION 4: NEW ROLE of MOBILE TERMINALS

- LTE is not a smartphone on your hip, in your pocket, briefcase or purse—it's a personal computer.
- We are truly at an inflection point in network history

DISRUPTION 5: THE «NETWORKED SOCIETY »

- “Anything that should be connected will be connected.” (Ericsson)
- Under this concept it is predicted that the number of connected devices will surge to 50 billion over the next 10 years, via the widespread use of embedded modules.
- LTE data flows will, alongside specialized access'es such as WiFi, support this vision

DISRUPTION 6: ENTERPRISE USE AND LTE RELEVANCE

- Enterprises are becoming increasingly mobile and looking for cost-effective, secure, high-performance wireless networking technologies that can support everything from mobile workers, converged applications to cloud computing and M2M applications, as Wi-Fi and 3G solutions are inadequate to support the coming explosion of wireless data and voice traffic.
- Enterprises are transitioning rapidly to wireless to handle mission-critical data traffic. While business uptake of fixed/mobile wireless solutions will be smaller than by consumers, the applications and their impact are expected as deep or deeper than for consumers.
- **In this process, enterprises want to, and can, bypass operators**
- LTE applications :
 - 1) Key applications inherited from 3G : mobile workers , telemedicine , law enforcement / security /emergency , connectivity of distributed offices , goods and vehicle tracking , M2M
 - 2) New LTE applications resting on converged data/cloud traffic supplementing wireline broadband services : file sharing, multisite ERP , support of NFC/RFID , retail shops, building management systems , mobile banking (beyond payments)

LTE COMMITMENTS (March 2011)

Source: Global mobile suppliers assn GSA

- 17 commercial LTE services launched
- 64 commercial LTE services available end-2012
- 140 firm commitments to deploy commercial LTE in 56 countries
- 56 pre-commitment trials

NB: As of Aug, 2011, Verizon Wireless had completed LTE installations to cover 50 % of US population

TELIA SONERA and TELENOR LTE TECHNICAL TRIALS (Stockholm, Oslo)

(March 2011 status, International connections)

Sources: Eptiro, SwissQual

- Peak download 48 Mbps , mean 36 Mbps (with 10-15 Mbps at times) , 23 ms TCP latency, 1,7 Mbps upload average , « 4,2 excellent » VoLTE quality (ITU-PESQ Mean opinion score) , call setup times of 0,6 s
- Further work on congestion, and in-motion measurements on real time applications

TELIA SONERA COMMERCIAL LTE LAUNCH RESULTS

- Launch in Stockholm and Oslo in December 2009 with a few hundred eNode-B's, few thousands of Samsung LTE modems , with 6 months free service
- Initial Data rate tariff :599 SEK (62 Euros) flat rate
- Operator chose vendors based on TCO total cost of ownership
- User's appreciate a lot uplink speed and latency as differentiators to 3G, and downlink speed as new feature; issue of 3G/4G handover
- But speed is NOT the only thing which matters, customers say; after 6 months only 1000 paying subscriptions were registered for nomadic notebook users , all waiting for LTE phone terminals

REGULATORY CHANGES

- Institutional
- Spectrum
- Network neutrality
- Others

NEW EU TELECOMS REGULATOR

- BEREC (Body of european regulators) created by Council and Parliament as part of new EU Telecom rules(Dec. 2009); it is made of 27 national telecom regulator heads, assisted by a BEREC office ; it replaces ERG; decisions are by 2/3 majority (and 50 % when BEREC gives opinions in the context of Commission's analysis of measures notified to EU by national regulators)
- Has no executive power, but help national regulators and EU provide consistent rules and competitive conditions across EU, esp. for regulatory decisions with cross-border aspects (e.g. spectrum , third party access, social services, etc..)

REGULATORS VIEW OF LTE

- Regulators are normally technology neutral and should enforce technology neutrality, while recognizing benefits such as increased capacity for the same spectrum (spectral efficiency).
- But wrong spectrum allocations and schedules may put benefits at risk
- **CASE : UK Ofcom details '4G' benefits** : Ofcom said that '4G' mobile networks (based on LTE technology) will deliver “more than 200 percent of the capacity of existing 3G technologies using the same amount of spectrum”. However, it also said that this “will not on its own be sufficient to meet the expected growth in demand for mobile data.” The regulator highlighted that more spectrum will need to be allocated to meet future requirements – it is planning to auction 800MHz and 2.6GHz frequencies in 2012 in what was described as “the largest ever single auction of additional spectrum for mobile services in the UK.” It also noted that mobile networks will need to be “designed intelligently” to ensure the best use of spectrum and, “in particular, the research anticipates a greater use of small cells to meet demand in specific areas.” The 2012 auction will make available spectrum equivalent to $\frac{3}{4}$ of that in use in the country today, and 80 percent more than was made available at the 3G auctions which took place in 2000. Some stakeholders have expressed concerns about the potential process, due to the spectrum allocations already held by operators, so that they would get “squeezed out”(e.g. Everything Everywhere, 3 UK). The regulator has said it will put frequency floors in place to ensure the survival of the smaller players.

POLITICAL BATTLES FOR LTE SPECTRUM

- LTE spectrum can come from old expiring licensed bands, or from analog TV bands (« Digital dividend », or from miscellaneous small bands (defense, etc..))
- Licenses are typically for 20-25 years, mandate 99% of population coverage within 15 years, and for LTE a new priority to rural areas
- There is pending issue of lost/ unutilized WiMAX spectrum
- Which bands are released to whom are often more a political decision, than one based on benefits for all and improved coverage
- **CASE 1: Communications operators win digital dividend spectrum :**
Germany : T-Mobile, Vodafone and O2 win LTE spectrum in Europe's first digital dividend auctions
- **CASE 2: TV and media companies renew and expand their licenses** under migration to Digital TV diversity & richness: Brazil, Italy , Russia

LTE SPECTRUM AUCTION OUTCOMES

- CASE Spain : Spain's big three mobile operators – Telefonica, Orange and Vodafone secured LTE spectrum in the 800MHz and 2.6GHz bands as part of an auction that raised EUR1.65 billion for the Spanish government. Vodafone paid EUR518 million for 20MHz in the 800MHz band and 40MHz in the 2.6GHz band, and also plans to re-farm some of its 900MHz GSM spectrum for LTE services. Telefonica said it had won five frequency blocks in the 800MHz, 900MHz and 2.6GHz spectrum but details of its holdings, and those of Orange, were not disclosed. Earlier in the year, Orange and TeliaSonera/Yoigo won the first round of LTE sales and, a further round of 4G auctions is expected in the autumn which could raise a further EUR2 billion.
- CASE Italy : Italy's four main mobile operators - Telecom Italia (TIM), Vodafone, Wind and 3 – plus broadband provider Linkem, have declared their interest. The Italian government is looking for the auction to raise at least EUR2.4 billion, with a forecast of EUR3.1 billion if all the frequencies up are sold.
- CASE Germany: 4,4 BillionEUR from digital dividend 800 MHz with DT, Vodafone and O2(Telefonica) as main winners; spectrum divided into 41 blocks
- Case France : 2,5 Beuros per bid (spectrum award cannot exceed 15 MHz duplex in 800 MHz band and 30 MHz in 2,6 GHz band)
 - This means LTE spectrum sofar costs 1/5-1/10 of 3G spectrum awarded in late 80's/early 90's in the same countries
 - This means indirectly that data traffic (compared mostly to 3G's voice and messaging traffic) should lead to Operating expense assessments (OPEX) reduced in the same proportions in operator's minds, if licensing cost share stays the same

SPECTRUM BLOCK ALLOCATION ISSUE

- The issue centres around frequency band allocations, where no carrier has (or gets awarded) licences allowing them to create blocks larger than 15MHz in any one region while most are limited to 10MHz in metropolitan markets, compared with the 20MHz of contiguous spectrum that is needed to deliver the best possible LTE performance.
- In addition, the 1800MHz spectrum is also currently in use for 2G services, meaning that only a limited amount is available for LTE (e.g. Telstra, Vodafone)
- 700MHz and 2.6GHz spectrum has often not yet been allocated .

REGULATORS MUST RELEASE SPECTRUM

- In US, FCC plans to free up 500MHz of spectrum over the next decade for mobile broadband use, but warned that the industry needs to go further.
- Key to avoiding a spectrum crunch, are voluntary incentive auctions for TV broadcast spectrum

REGULATORY SPECTRUM RISKS FOR LTE

- Due to normal 20 MHz band needs for “best capacity” , spectrum licensing policies and regulatory plans may “make” or “kill” LTE
- Additional spectrum will only provide modest gains and will not satisfy the rapid growth demand in data services
- Move to ever higher reaches of the radio spectrum (to build data capacity) is driving a shrinkage of ‘effective’ mobile coverage with enhancing capacity
- Network competition is weakening with shared infrastructures under reduced spectrum allocations, whilst retail competition is intensifying putting into question the emergence of the right new mobile infrastructure platforms to support the creative industries and consumer choice

EU's LTE SPECTRUM REFORMING RULES

- In view of too many political games, and/or squeezing out auctioning processes (like in UK) , the European Commission has adopted technical rules on how the 700-900MHz and 1800MHz frequency bands should be opened to 4G technologies, stating that the move is “an important step to bringing wireless broadband access to more EU citizens and businesses.” It said that national administrations have until the end of December 2011 to adopt the decision into their national rules, so that GSM bands are “effectively made available for LTE and WiMAX systems.”
- One measure is to enforce a minimum amount of spectrum in each band for each incumbent operator

UPSTART COMPARISONS FIXED BROADBAND (xDSL,Cable) vs. LTE

- Initially mobile broadband performance is likely to remain significantly below fixed broadband performance until the rollout of additional spectrum and infrastructure for mobile services. Optical fiber will always dominate where available
- Despite the weaker performance when compared to fixed networks, there is a fast growing percent of households which use mobile broadband as their only means of Internet access, compared with <1 % percent in 2009.
- Virtual operators dependent on an incumbent to offer fixed broadband, may want to migrate a significant part of the customer base to LTE
- Case Vodafone Germany : Vodafone Germany is looking to persuade up to four million of its *broadband DSL* subscribers to migrate to LTE. Vodafone is currently being charged €500 million a year by Telekom Deutschland for using its fixed network, and that LTE offers adequate bandwidth to replace DSL as a broadband technology. The company is thought to be preparing a bundle of services aimed at tempting its existing DSL users to adopt LTE. Those that fail to migrate could be sold to another fixed broadband provider, indicating the Vodafone plans to terminate its DSL operations.
- Case Telnet (BE): is a *CATV operator* which runs LTE trials and is an MVNO on Mobistar, to defeat Belgacom on all broadband segments

NEXT DIGITAL DIVIDEND ?

- The move from analog FM radio to digital audio broadcast (DAB) raises debates
- Will it be used by small and local community stations (UK) , or sold for LTE (US) ?

NETWORK NEUTRALITY REGULATIONS (I)

- “Network neutrality” regulation bans operators from blocking or charging for Internet services (such as Skype or Google) over their networks . In other words, this prevents operators to become “self appointed toll collectors” on the Internet, including the LTE based mobile Internet.
- European Commission and European Parliament have endorsed network neutrality guidelines but have not yet taken legal action against operators that block or impose extra fees on consumers.
- Countries having voted favorably on network neutrality: Netherlands and Singapore
- **CASE Netherlands** : The proposal was passed by “a broad majority” in the country’s lower house and is expected to be signed into law soon by the Dutch Senate. Under the new Dutch law, local operators could be fined up to 10 percent of their annual sales for violations by the regulator, OPTA. Patrick Nickolson, a spokesman for KPN, said that the measure could lead to higher broadband prices in the Netherlands because operators would be limited in their ability to structure differentiated data packages based on consumption. “This will limit our ability to develop a new portfolio of tariffs and there is at least the risk of higher prices, because our options to differentiate will now be more limited”.
- Under network neutrality , Microsoft / Skype could evolve from its mainly PC-to-PC voice calling model today. But integrating Skype with Windows Phone could also strain Microsoft’s relations with operators. With voice-over-4G services still an issue for many operators, Microsoft has the opportunity to use Skype’s scale and heritage to provide a *de facto* 4G voice standard, potentially creating a serious challenger to operator-led initiatives such as VoLTE.

NETWORK NEUTRALITY REGULATION IMPACT (II)

- **Case KPN:** Dutch operator KPN announced a number of changes to its tariff portfolio, stating that it “has decided not to block any services, or to set separate rates for different services,” in line with forthcoming net neutrality rules in the country. However, it also acknowledged that “mobile data will become more expensive” within its bundles, and that “the consumer will pay more for a new smartphone because these devices are becoming increasingly expensive.” In a statement, it argues that “the traditional propositions based around SMS and voice traffic have become inadequate for the consumer and for KPN.”

OPPONENTS TO NETWORK NEUTRALITY

- Lobby of 30 operators and suppliers (incl. Deutsche Telekom, Alcatel Lucent) met EU in July 2011, using the « European digital agenda » as a pretext, to present 11 measures against network neutrality
- They want « differentiation » of Internet pricing and quality, at the expense of best-effort minimal service, with free negotiations and preferred agreements with content suppliers

BUSINESS CHANGE REGULATORY STRATEGIES

- 5 GHz spectrum maybe better than 700 MHz
- 2020: LTE* >80%; WiMAX* <5% or dead
- Should ask: Wi-Fi vs. or with LTE
- Value of TV white spaces: Secondary access
- Open 3 GHz – 10 GHz to all : License exempt on secondary access basis

ROLES

- Roles evolve from unilateral decisions, OR
- Roles evolve due to engagement in networks / ecosystems

« MAKE IT » or « BREAK IT » FAST

- THERE IS NO VENDOR DEFINED KILLER APPLICATION UNTILL USERS HAVE ADOPTED IT AND MADE IT SUSTAINABLE / ADDICTABLE
- THERE ARE ALWAYS KILLER APPLICATIONS FOR SOME IN LTE: THOSE OWNED & CREATED BY USERS
- INDUSTRY (computing, integrators, services, content) RESTRUCTURING IS INEVITABLE AS MISTAKES IN THE ABOVE MAKE YOU WIN /OR KILLs YOU FAST !

HOW HYPE CONFUSES USERS (Source: Retrevo)

- 34 % of iPhone users in June 2011, on the question of whether they would buy a 4G LTE phone in 2011, answered that they thought they already had it with their iPhone; similar rate is 24 % for Blackberry and 29 % for Android smartphones
- Confusion due to digit 4 in iPhone 4

FUNDAMENTAL ECOSYSTEM SHIFT resulting from LTE

- The « consumer electronics/ circuit-switched connections / operator centric/ ISP/ content » inherited wireless value-chain is too complex and costly to manage, and leads to excessive fragmentation
- LTE enables a new simpler paradigm : « consumer electronics- IP cloud- distributed software creation- content » with collapsed data-and-voice networks ;
- This cut's out over the short term most OSS , BSS , proprietary client software ; it disbands single vendor-single element Element management systems and centralized performance management databases; it also undermines retail access providers and distribution franchises; it enables both end-to-end proprietary or open links and relations
- LTE also triggers the categorisation of suppliers between innovators and service improvers
- Operators as high dividend investments for investors may be days gone by

FUNDAMENTAL SHIFT IN CUSTOMER RELATIONSHIP resulting from LTE

* Whether customer has a 1-on-1 or 1-on-N relation with suppliers, he must choose between different types of relations with each (wider than QoS / QoE / Bandwidth /Congestion and extending to tariffs , apps, eCommerce and content access exclusivity):

- Best-effort/ « I am no one special » level
- Customized/ « Just what I need » level
- Quality class dependent/ « Selecting what to care for » level
- Barter / « I swap my contributions against part of your contributions » (time, information, community-access, user generated content,.....)
- Social / « Don't isolate me »

* Above effects are only reinforced by network neutrality regulations : all users can potentially have access to the same performances and prices irrespective of technology

LTE AS A REBIRTH PROCESS TO UPGRADE CORE TECHNOLOGIES AND BECOME CLOUD OPERATOR RATHER THAN PIPE VENDOR

- Some forward looking operators, aware of future battles with new categories of players, want to exploit the IP basis of the LTE core networks, to scrap old technologies and enable data servers, cloud computing and content servers
- CASE NTT DoCoMo : "Most of the investment will come from mobile operators as they not only build out their LTE networks, but also modernize their core networks to support an all-IP platform"

USER SELECTING PROVIDER(s) or WHICH IP CONNECTIVITY APPLIES TO LTE

-Wireless operator becomes Internet service provider (ISP)

-Wireless operator must compete with other ISP's (fixed broadband, Digital TV, many companies in their own domains)

-Impact of multipath TCP (MTCP)

- Scenario 1: one physical connection to IP access provider (ISP)
- Scenario 2: user has multiple physical connections to multiple ISP's
- Scenario 3: end user has multiple connections to a single IP access provider

LTE WHOLESALER OPERATORS (I)

- As an alternative to network sharing , there is the LTE wholesaler operator business model where one party gets spectrum, build, owns and operates the LTE access network and leases bandwidth to LTE Virtual operators , subject to QoS controlled by dynamic SLA's. Contrary to most providers to 3G MVNO's , the LTE wholesaler operator has NO end customers of his own. The customer may own a network of his own, such as a legacy network.
- This is likely to be a more cost effective option for all than acquiring spectrum in auctions, although the rents will have to be strongly regulated
- This business model is akin backbone ISP's (Level 3 etc.), and there is no regulatory protection of neither LTE Virtual operator and wholesaler operator, as enterprise data traffic is unregulated.

LTE WHOLESALE OPERATORS : CASES (II)

- **CASE Lightsquared (US):** US wholesale LTE operator Lightsquared is in contract negotiations with 15 possible customers, according to chief executive Sanjiv Ahuja. Time Warner Cable is among those in talks to use Lightsquared's network so that it can offer mobile web-access to its users. Other customers include Cricket Communications, Leap Wireless (operators), Best Buy (retailer), Lightsquared is using a combination of mobile and satellite spectrum to provide LTE network access to partners on a wholesale basis.
- **CASE YOTA (Russia):** The LTE network will be built by Yota and will enable MegaFon, MTS, Rostelecom and VimpelCom to provide high-speed mobile broadband services across 180 cities (with a total population of more than 70 million citizens) by 2014, without building separate networks. “
- **CASE Kenya:** Kenya's government is poised to launch a tender for a consortium firm to “implement and manage” the LTE wholesale network. Those operators that do not form part of the consortium will be able to lease connectivity for a fee. “We are putting an advertisement of the 4G spectrum licensing either by the end of the week or early next week which is going to be done through Public Private Partnership,” said Bitange Ndemo, Kenya's Permanent Secretary for Information.

FROM « OPERATOR » ROLE to SERVICE-and-CONTENT ENABLERS

* The new core asset of operators is no longer access provisioning (SIM, socket, cable) , no longer the customer database with telephone number (after number portability and multiple identities), but the information set made of:

- Customer profiles and preferences
- Usage intelligence
- Performance intelligence
- Contextual and eventually location information
- Service focus on user needs and capabilities
- Capability to add value to over-the-top applications

* Such information set must be exploited and updated to the fullest in policy and quota servers , identity management , open application and network interfaces , performance analytics, and fast connect/disconnect applications

TERMINAL and OPERATOR SHARED REVENUES

- For selected services, terminal vendor share non-exclusively revenues from those services with operators
- Case Nokia/ (Telefonica, Orange, TIM Mobile, T-Mobile, Vodafone) for some mapping and Ovi services ; contradicts non-revenue generating agreements with Yahoo / Google / YouTube which are an exchange

TELECOMS SECTOR NEW POSSIBLE BUSINESS PROSITION TO INTERNET GIANTS

- It could be to treat Internet giants as partners and clients, by offering them services to enhance quality of their own services for end users
- But Internet giants have treated such initiatives with arrogance and disdain, waiting just to collect the goodies on their ageing bodies (patents, spectrum, etc.)

BYPASS THE MOBILE OPERATOR AS VENDOR OF UE's

- In this business model, prepared for LTE, third parties ally with SIM card producers (and IPR owners !) to produce mobile phones WITHOUT SIM card to be sold directly on the Internet, by passing the operators
- Case Apple/Gemalto : Apple and Gemalto (FR) are rumoured by G5 (european mobile operators) to design SIM-less iPhone (succeeding iPhone 4). Activation would be on-line on AppleStore via iTunes platform. Reactions are mixed, as some operators who do not subsidize phones don't care much, Most terminal vendors are horrified (except RIM) , as this would remove operators in their role of creditworthy consumer loan providers to subscribers, and also as UE prices would then go further down. Regulators are worried as the risk is perceived of the creation of a monopoly in the control of the content delivery chain, reflecting Apple's goal to achieve exclusivity in the relation to end-customer. Open issue is whether Apple would appear as an MVNO to use networks, even if chosen party would end up being just a pipe-provider.

INTERNET TV

- The television industry is at the beginning of a generational change which will eventually see a new type of television service – *Internet Television* – being delivered directly to TV sets in broadband-enabled households around the globe. In the end, practically all new TV sets will incorporate internet television functionality as a standard feature that viewers will be able to use alongside their existing television services, as well as embedded communications with fixed and/or wireless access feeds (WiFi and/or LTE).
- By 2014 there will be 785 million fixed broadband connections around the world which means that over 50% of TV households will have a broadband connection, most of which will be capable of supporting the delivery of high quality video and, therefore, Internet Television services.
- Knowing that change is coming, public service broadcasters, cable TV companies, satellite providers and terrestrial broadcasters around the world are busy rolling out their own Internet Television services. Meanwhile, they are trying to understand how Internet Television will affect their existing revenue streams.
- Many companies are rushing to develop the network infrastructure that will be needed to deliver the enormous volume video traffic implied if television programming is to be delivered over the internet on a mass scale.

CONTENT PROVIDERS « FREE RIDE » ON MOBILE NETWORKS

- In the context of LTE, European operators strengthen call for charging content providers (esp. video : Google, TV media, etc..) by changing the peering systems, under which operators exchange traffic where their networks meet ; charges would be based on how much data content traffic travels over operator infrastructures.
- Operators, esp. France Telecom and Telefonica, have stated that current peering agreements are no longer viable. It's not certain the operators will succeed with their goal, noting that unless they receive widespread operator backing, then the content providers could try to restrict their material to operators that promise not to introduce traffic-related charges. Also, if the operators do all act together, it could open them up to accusations of cartel-style behavior.

DISINTERMEDIATION or NEW ECOSYSTEMS :

LTE Mobile operators as banks, or banks as LTE mobile operators

- Acknowledging that 3G operators had core architectural elements alike bank's, as well as vice-versa, this is even more so for data driven LTE, which offers a technology upgrade from both's costly infrastructures to IP based functionality, operating costs and value-added services
- LTE operators allowed a limited banking license (Asia, Africa) will monetize their assets not just in data traffic but in money flows and transactions
- Banks (subject to investment capacities) will want to monetize their ATM networks and control mobile banking in a coordinated way enabled by LTE
- **CASE : LIVE FROM GSMA MOBILE MONEY SUMMIT 2011:** Citibank and Standard Chartered – shared their perspectives on mobile money during this morning's keynote session, claiming that their traditional strengths in areas such as trust, security and regulatory compliance means they must continue to play a key role in the emerging mobile money ecosystem. Dickson Chu of Citi acknowledged that banks remain “conservative organisations” and admitted that “most of the great innovations in payments didn't come from banks.” And he warned that the rapidly evolving mobile money market “must not relegate us to becoming a dumb pipe.” His solution was to work towards a so-called “hybrid model” that combines the “bank grade” traditional payments model with the new advertising-funded models being rolled out by the likes of Google and Apple. “It is about players within an ecosystem understanding each other's roles, but there are business model complexities that need to be solved,” Chu said. “Providing a great user experience, retail distribution and customer service – this is a role for the MNOs. Trust, safety and regulatory compliance – this is something the banks do well. Once these players come together, they will figure out how to co-operate and make money.” Meanwhile, Standard Chartered's Aman Narain outlined progress on the bank's 'Breeze' mobile app, which he said was available on more than 700 devices in India alone. “The mobile device is a phenomenal opportunity for us to create exceptional user experiences for people,” he said.
- **CASE : UK :** The UK payment council has essentially ruled against operators, allowing banks to have a separate mobile payment infrastructure, and only using operators as pipe providers; needless to point at the banking lobby in UK

SMART BUSINESS NETWORKS

- LTE enables the quick connect/ disconnect esp. between SME's choosing to share dynamically expertise and resources in dynamic alliances
- SAE being SOA compliant, it can support risk minimization and trust building tools by dynamic Service level agreement management between partners, while monitoring QoS attributes, assuming back-up legal contracts
- References: EU FP7 Trustcom project , and Smart Business network research

LIVING... WELL FROM LTE Intellectual property

- Contrary to earlier mobile generations which had a heavy radio/hardware focus, LTE will have a balanced hardware /software / management intellectual property base, with software part growing
- This even enables the possibility from some key players to monetize a larger part of their IPR, at higher rates, also as a means to disrupt new entrants from computing and Internet
- Major LTE IPR owners (Amortized IPR portofolio values > 1 Billion EUR): Qualcomm, Nokia Siemens, L,M, Ericsson, Agilent , NTT ;
Upcoming: IBM, Hewlett Packard, Intel, Huawei , Broadcom, Cisco, Technicolor/ Fraunhofer; Very low: Apple, Google, Microsoft

MERGERS OR ACQUISITIONS NOT FOR REVENUE BUT FOR SPECTRUM

- If you have invested early in upgrading your SAE core network architecture, spot targets to buy who have won later on favorable LTE spectrum chunks
- Case AT&T: it's long-term LTE strategy was dependent on how much spectrum it could obtain, an issue which was a major driver behind its 39 B USD acquisition of T-Mobile

IS LTE RELEVANT FOR MICRO-NICHES ?

- The long-tail effect of the demand-volume curve (diversified small offers for small-volume products) applies to LTE more than 3G, because of virtual storage, distributed application developments, global coverage, and therefore distributed distribution aimed at tribal micro-audiences driven by the large volumes of LTE subscribers in the future
- Due to the ubiquity offered by LTE , it will be a trend setter for some services
- Example: mobile blogs are the long tail of media ; micro-cultures e.g. for youngsters and seniors

...AND FIXED BROADBAND vs. LTE ?

- Case: Saudi Telecom global operations (Interview of 09/8/2011 with Telecoms.com for WW Broadband Forum) :

To what extent do you see next generation wireless technologies such as LTE as a threat to your fixed line business?

- “As an operator, we want to be able to use all available technologies, and we do not see them as competing but as complementary. Each technology has its advantages, and considering the large variety of configurations in our markets, between Western Europe, Eastern Europe and Africa, we will rely on both wired and on wireless. Typically, in Western Europe, the wireless technologies are and will remain complementary to wired technologies at a higher cost and lower performance in term of overall throughput. In other geographies however, LTE may well become a very efficient fixed wireless access solution.”

LTE is also ...



Images courtesy of Jon Stern

OPERATOR'S CONTROL OF TERMINAL SOFTWARE IS SLIPPING

- Affordable open mobile Internet access is possible helped by smartphone diffusion
- Operators' control of handset software slipping
 - iPhone, Android , Nokia application stores initiatives
 - Mobile OS :now under IT industry (Microsoft, Google, Linux... even Symbian now Arthur Andersen)
 - Distribution by third parties grows

THE RIGHT TERMINALS FOR USER UPTAKE ...

- Business model: Terminal and other UE suppliers target entry markets based on data usage, pricing power for products, operator independent channels, mobile data plans and network availability, while supporting the migration of apps and content
- A top 4 terminal CEO : “Selling LTE now is like selling the best grammophone with Deutsche Gramofon’s full collection for at customer’s fingertip, all for the price of a 33 rpm record”
- **Consequence**: the above business model will project and maintain the current Digital divide in all markets
- **Case HTC**: “CEO Peter Chou has confirmed that the Taiwanese smartphone vendor is to launch its first LTE handset in 2010, and expects the US to be the key market for its new devices in 2011. “We think that the US mobile operators will be taking the lead and pushing 4G LTE in the US market, HTC’s new LTE smartphones are based on Google’s Android and Microsoft’s new Windows Phone 7 (WP7) operating systems. Chou said that the firm was focusing its efforts on these two platforms as part of a “portfolio strategy” aimed at offering consumers the broadest possible choice. “[Customers] may want Windows or Android; or they may want big screen or small screen, they may want keyboard or tablet; HTC will let the consumer decide,” he said. Chou also talked up HTC’s commitment to cloud computing, pointing to the recent launch of HTC Sense.com, which allows users of HTC’s Android-based devices to manage smartphone data on a regular website. “HTC Sense is a very important step for the HTC brand,” he said. “We see HTC Sense as an extension from the device to the cloud, [allowing users] to manage their portfolio, their data and their user experience from the cloud.”

DRIVERS

- Mass customization (with personalization amongst discrete choices a simpler instance)
- Simplicity
- Open ecosystems and interfaces in networks (e.g. IEEE P1520)
- Time preference incl. Casual usage

3G/4G DATA ONLY SUBSCRIBERS

- Soaring adoption of 3G “USB Data Modems”
 - 92% of all 3G data bytes in Finland already in 2H07

Enormous growth, from a relatively small base...

CONTENT KEY TO LOYALTY

- It is Apple, Google and changing players like France Telecom that are benefiting from customer stickiness, in line with their central positions in the mobile content ecosystem.

« Zuckerberg's law »

- Every 12-18 months the amount of information being shared between people on the Web, doubles »
- Over time, people will by-pass general sites in favor of sites built atop social networks, where they can rely on their friends' opinions
- You pick the network, and the network then filters for you

ECOSYSTEM ADAPTATIONS

- Wireless operators must collaborate for software, app and content development with new players with shared revenue streams
- IT and content providers must collaborate for apps, browsers, functionality and service provisioning with wireless industry with shared revenue streams
- **Nothing new in this ever since France Telecom started Minitel , copied by NTT with WAP , and then later by Apple**
- **CASE Verizon Wireless:** opened its Innovation Center in Waltham, Massachusetts, billed as a place where “companies large and small, entrepreneurs and others across the LTE ecosystem would come together to create the next generation of products that wirelessly connect people, places and things.” A sister Innovation Center on the West Coast is due to open later this summer in San Francisco, focused on application development for LTE technology.
- **CASE Google collaboration with France Telecom :** the big Internet companies will not agree to invest in network capacity, but are ready to collaborate with operators to develop more intelligent/reduced uses of operators' networks and to educate consumers

MIGRATION GAMES: « MILK » HSPA, DELAY LTE (akin milk 2G, delay 3G)

- Case T-Mobile (USA) (now bought up by AT&T): The company made numerous references to its '4G' strategy, although this refers to its 42 Mbps HSPA+ deployments rather than LTE (or an alternative). The company said itself as being in an “excellent position for the coming years to provide customers with products and services that enable them to get the most out of the mobile internet,” and that “LTE technology is to be introduced once devices are readily available and once device quality is on par with the HSPA+ network, although that will probably not be for a few years.”
- Effect of LTE announcements on churn : T-Mobile USA noted that its HSPA launch had a positive impact on churn development.

PROPRIETARY TERMINALS AND CONTENT PROVIDERS MAY DELAY OPERATORS PUSH TOWARDS LTE

- Because of terminals, content and applications “stickiness” with some users of proprietary systems such as Apple iPhone, Apple is hindering US moves towards LTE (LTE compatible iPhones only > 2013) ; Microsoft has not yet integrated VOIP Skype clients into Mobile Windows 7

EVOLVING USER SERVICES

- New services will center on data and multimedia communication alongside or within the context of voice.
- New services are expected to become major growth drivers. While voice remains the most popular application for large user segments, several distinct trends will influence mobile communications in the years ahead.
- Common, access-independent Internet applications will replace silos for mobile applications and residential applications

Service packaging evolution

from old gold coin deposits/payments to converged experiences

- One bill
- One prepaid balance
- Separate Voice / data /content
- Cross-product discounts

Converged services

- Account /service / payment method agnostic pricing
- Multi-service « vouchers »
- Unified balances for voice /data / content

Converged payments

- Services interleaved to create differentiated experiences
- Dynamic personalization driven by user
- Integrated view of customer usage
- « Exclusive « content
- Real time sampling of any service

Converged experiences



Increased value to user

Evolution of service revenue model (thanks to operations and network management policies)

- *Towards a data-centric world (and not voice centric) as a result of massive growth in data throughput, esp. Mobile*
- *Free Internet services are vanishing*
- *Free copyrighted content is vanishing*
- *Flat-rate data plans are unsustainable*

« New » service models (**subscription or prepaid**) :

- Speed-rated
- Time-based (by min of mobile data, not MB; e.g. TIM)
- Bandwidth usage and application specific
- Time-of-day
- Location-based
- QoS based
- Ad-funded solutions
- Pay per content, rather than via ads revenue, including via streaming

Does it sound familiar or are you too young to remember ?

LONG TERM PARALLELS: Intelligent Networks (IN) & IP Multimedia system (IMS)

Intelligent Network

- Free operators from equipment provider lock-in
- Separate applications from basic call control
- Open protocols and APIs for applications

IN Application Successes

- FreePhone, Mobile (HLR), Pre-paid, Voice mail, ...
- 25 year summary:
 - A few applications, very widely deployed

SOCIAL NETWORKS BUSINESS MODELS or the LACK OF THEM

- Lack of suitable business models is and has been a barrier to social networks
- *Research question:* What are the possible business models for LTE based social networks?

SOME CATEGORIES OF SOCIAL NETWORK BUSINESS MODELS

- Subscriptions with premium modes
- Sponsored advertising: Sponsored spots that works like sponsored advertising on Google
- Viral Social Ads (ads targeted based on member profile data): provide advertisements alongside related actions your friends have taken on the site ; they spread company message virally through the social graph. These ads will appear both in people's feeds and as a personalized banner ad
- Beacon (a way e.g. for Facebook members to declare themselves fans of a brand on other sites and send those endorsements to their feeds)
- Insight (marketing data that goes deep into social demographics and psychographics which can be provided to advertisers in an aggregated, anonymous way
- Connect with real people and create your own pay per click (CPC) or impression (CPM)
- Virtual goods in Virtual currency (e.g. "Facebook credits") ; the goods are centered around holidays, special events: Valentine's day, birthdays, as well as just for fun ; 1 gift = 10 credits , 10 credits = 1 Euro
- Advertising revenue generated by deals for "Branded virtual gifts" ; branded virtual gifts receive 10 times the interaction level of their non-branded counterparts ; branded virtual gifts turns customers into brand advertisers
- Enabling eCommerce : by promoting real goods ; e.g. Flowers.com : 12 roses = 450 credits
- Pre/post-roll advertising : Pre-roll ads are short video clips that you must watch before the video; regular video banners; post-roll advertising: if you don't click on an overlay ad when it shows up in a clip you're watching, the video ad it would have played rolls automatically at the end of your video.
- Tracking progress with real-time reporting
- Gain insight about who's clicking on your advert.

EXTERNAL PROCESSES AND TARIFFS

LTE EARLY MOVER STRATEGIES

- Pricing : Encouraging customers to adoption by pricing, based on a growth in smartphones and associated data use (e.g. Tele2)
- Leapfrogging : Move straight from a 2,5 G technology or to drop WiMAX (e.g. Metro PCS in the face of insufficient 3G capacity moving straight from CDMA to LTE)
- Enhancing user experience: promote e.g. video offered by LTE ,rather than speed and technical performances
- MVNO model (e.g. Cyfrový Polsat, PL)

WHOLESALE PIPES TO CONTENT PROVIDERS

- One business model is for network owners to charge content providers for delivering this content to end users with QoS guarantees, so they can invest in needed infrastructure, based on :
 - either data amounts (Telefonica)
 - value of content charged to users (Vodafone)
- This is opposed by supporters of network neutrality

LTE Tariffs plans (2011)

- **Globally comparable tariff plans span from 25 Euros/month (Estonia) to 110 Euros/month (Austria)**
 - **CASE Verizon Wireless** : for download speeds of 5 Mbps -12 Mbps and uplink speeds of up to 2 Mbps - 5 Mbps, there are two 4G LTE Monthly Broadband plans, on a 24 month contract term:
 - A- 5 GB monthly data allowance with a \$50 USD (38 Euro) per month plan
 - B- 10 GB monthly data allowance with a \$80 USD (60 Euro) per month plan
- The 4G LTE modems available include: LG VL600 and Pantech UML290 4G USB which both cost \$99.99 (75 Euro) USD – again based on a 24 month contract term (after a \$50 USD (38 Euro) mail-in rebate).
- **CASE Vodafone Germany** : LTE “Surf Stick” USB modem offers a minimum speed of 3Mbps and is positioned as an alternative to fixed Broadband, esp. in so-called “white DSL spots” DSL services, and in 1500 towns (March 2011). Modem costs 1 Euro to purchase with a 2.50 Euro per month fee. There are 3 usage based tariffs called the LTE “home internet tariff”:
 - A- 39.99 Euro per month up to 7.2 Mbps download speed
 - B- 49.99 Euro per month up to 21.6 Mbps download speed
 - C- 69.99 Euro per month up to 50 Mbps download speed
 - **CASE AT&T**: 29,99 USD/month plus ‘AT&T Mobile Hotspot Elevate 4G’ with LG & Sierra Wireless HSPA+ modems that are software upgradable to LTE; they fall back onto AT&T’s HSPA+ network when out of reach of its new LTE coverage area

TEMPORARY HALT TO UNLIMITED DATA PACKAGES?

- Early deployment customers were often promised unlimited data transfer quantities for a flat fee (still : Sprint, Telia , Tele2) , which lead to overloaded core networks and delays / losses in non-LTE services (often due to HSPA enabled iPhones). As a result, either you sur-charge for excess data over a cap (“overage”) or you throttle down speed beyond the cap
- Most uncapped plans have been scrapped (AT&T, O2, ...) , with migration of tariffs offering useful insights
- Capped data packages are unsustainable , and can be alleviated by personalized bundles, as users do not want to differentiate between wired and wireless broadband
- **CASE O2:** O2 UK scraps unlimited data for smartphones with usage capped at between 500 MB and 1GB depending on monthly tariff. New and upgrading smartphone customers received unlimited data as a promotion until 1 October 2010. From that date, they could buy additional data ‘bolt-ons’ which include 500MB for £5 or 1GB for £10. Equipment provider: Nokia Siemens Networks
- **CASE AT&T :** AT&T had marketed the fact that the vast majority of its customers (97 percent) would not need to buy additional data allowances with the new capped model, to be swiftly contradicted. It replaced the US\$29.99 unlimited plan with two new plans; DataPlus cost US\$15 / month (200MB of data) , whilst DataPro cost US\$25 / month (2GB of data). If users exceed the monthly allowance, they will receive an additional 200MB of data for US\$15, and an additional 1GB of data for US\$10, for use in the cycle, respectively.

LTE ADAPTIVE TARIFF PLANS with Bandwidth / Value adaptation

- Mobile operators can use adaptive self-managed rate plan structures to help solve the bandwidth/value gap.
- Example of adaptative plan :
 - €20 for 3GB/month
 - and if over the cap, then €7/GB+ peak bandwidth limit
 - User Self-care Portal
 - * €1 for 1 hour “turbo” button when peak hour bandwidth limit applied
 - * €5 “add-on” for unlimited* use of a user-selected URL subject to peak hour bandwidth limit if > 1GBof usage/month
 - * User may enable daily or monthly usage caps for all devices under the account
 - * User may self-manage other value-added options such as content filtering, security settings, etc.
- Such a rate plan would deliver several key enhancements over the typical cap + overage rate plan approach:
 - Directly addresses peak bandwidth utilization and the true cost of marginal network growth
 - Drives users to make value decisions based more in line with operator cost
 - Extends sticky, revenue-generating features such as account and parental controls to service-based consumption limits
 - Offers ARPU-expanding options in search of market share growth rather than simple discounts

LTE REVENUE EROSION EFFECTS

- Subscribers will use bandwidth and data volume hungry services (e.g. mobile video)
- IP enabled LTE will put pressure on tariffs with flat rates
- Internet and VOIP players will cut voice and content delivery revenues

LTE REVENUE EROSION EFFECTS: THE « SIMPLE » COUNTERMEASURES

- Improve customer experience by service creation, better content , personalized information, and safe browsing
- Increase customer loyalty by customization
- Better operating efficiencies

OTHER SERVICE REVENUE MODELS

- Personal tariffs: user initiates a reverse auction process for user-selected service / content and usage bundle, with a max. price and duration
- Zero-tariff: Zero cost calls and emails with restrictions, balanced with a fixed subscription charge; calls to other networks and roaming overcharged
 - *Case: Softbank Mobile's purchase of Vodafone Japan and using this model ; goal of 20 % market share; high technical risks leading to KDDI winning....
- Bond service offerings to specific terminals : Nokia (GPS service from Gatefive, Mapping from Navtec, On-line-Music from Loudeye, all acquired); leads to confrontation with operators

LOCATION BASED ADVERTISING

- For GPS / Galileo enabled terminals, or areas where LBS are deployed, advertising push information can be pushed onto users based on their location, when privacy consent has been granted ; highest penetrations of this functionality are US, Japan, Korea
- It is too early to determine which share of consumer LTE terminals will be location enabled, but share in some vertical domains will be high
- “The different components of mobile advertising (including search, display and messaging) are all growing,” with local search dominating driving location-based advertising revenues.
- Examples: Poynt, Yelp, Publicis group , local business advertising specialists Yellow Pages, and vertical aggregators such as Toptable and HotelBooker.

EDUCATING USERS ON LTE DATA USE

- Users must be educated on data use to avoid overspending and chronic addiction
- Operator must help, or see to it that users learn how much data is in their allowance, and how not to go over their limits. In time they will “really begin to understand it,” much like going into a gas station to fill up their vehicle.
- **CASE Verizon** : User feedback to the 5 and 10GB monthly data allowances that come with Verizon Wireless’ new LTE service has been a mystified “What is a gigabyte?” says Dick Lynch, EVP and CTO of Verizon and a key architect of its LTE strategy. “This is a problem that the whole industry will have and I think it’s an important problem to have now,” he states. Mobile operators have a limited amount of capacity to share among all their customers, continues Lynch. Growing data demand each year will push costs in a direction where the flat-rate model of yesterday “is not possible in any realistic fashion”, he warns.

INTERNAL PROCESSES

LTE LAUNCH TIMING

- LTE launch timing is a competitive feature which 2 nd tier operators can use to capture customers esp. for vertical applications and enterprise customers
- CASE Singapore operator M1: switched on commercial LTE services in 2009, claiming to be the first operator in Southeast Asia to go live (beating Singapore Telecom and Starhub) . The third-largest operator in the city state has deployed LTE at both 1.8GHz and 2.6GHz, offering theoretical peak speeds of 75Mb/s in the downlink and 37.5Mb/s in the uplink. M1 says these speeds will be upgraded to 150Mb/s and 75Mb/s, respectively, by the end of 2011. The initial launch covers Singapore's financial district (including Marina Bay, Suntec and Shenton Way), while nationwide coverage is expected in the first quarter of 2012. The operator initially markets LTE services to its enterprise customer base. These customers will be able to access the new network via USB modems on existing mobile broadband plans costing SGD59.40 (US\$48) per month. An expanded range of LTE devices, including tablets and smartphones, was introduced in 2011.
- Case Public emergency networks: Harris Corp. Is now offering almost only LTE based solutions

LTE LAUNCH COVERAGE CHOICE

- Acknowledging that in some developed markets fixed broadband, and especially FTTH, may be unbeatable for many stationary uses, some operators choose for LTE launch areas not covered at all (or badly) by broadband, reaping exclusivity very fast
- Sometimes, the regulator has stipulated that operators using LTE allocations must first look to serve areas where broadband is currently limited, before moving on to potentially more lucrative built-up areas
- Case German 800MHz operators: begin deploying first LTE services to areas underserved by broadband
- Case UK operator Everything Everywhere: has partnered with the wholesale arm of BT for the country's first live trial of 800 MHz LTE services, with the companies using the technology to serve customers in rural Cornwall.

CHINA LAGS in LTE ADOPTION

- *China Daily* has reported that China, the world's largest mobile market won't launch commercial, nationwide LTE services until 2014. Citing comments from the Chinese Minister of Industry and Information Technology, Miao Wei, the report claims that the timeframe will allow maturity of TD-LTE technology, which is still in the relatively early stages of development. The report also cites Miao as stating: "It is obvious that the Chinese government doesn't want to adopt a 4G service too soon as that would disrupt the carriers' efforts to develop 3G services" further.
- Although a 2014 rollout would put China a long way behind other mobile markets in terms of LTE progress, in reality it is a realistic timeframe as the country also lagged in deployment of 3G services. 3G services currently make up only 15 percent of the country's total mobile market.
- All three Chinese operators – China Mobile, China Telecom and China Unicom – are expected to deploy variants of LTE technology as their 'next-generation' platform; China Mobile is focused on a specifically Chinese variant called TD-LTE while the other two are likely to deploy LTE based on the FDD variant of the technology.
- There are problems with availability of TD-LTE UE chipsets , and also roaming with global FDD-LTE , 3G and 2 G are not resolved yet

PEAK DOWNLOAD PERFORMANCE SETTING

- Some LTE networks want to launch only when they beat early movers on peak speed
- Example: 150 Mbps : Telstra/ Huawei in laboratory LTE (69.3Mb/s in the field) , using 20MHz and 10MHz of spectrum, in the 1800MHz spectrum band

LTE Evolved packet core (EPC)

- Centralising service and policy management means operators can manage traffic and users in a holistic manner across 3G and LTE networks
- EPC includes the central control plane, with : main repository for subscriber and device information (HSS Home subscriber server) , authorisation and authentication functions(3GPP AAA) , policies to manage network resources & subscribers (PCRF policy controller), and interoperability support to other access networks (EVDO, WiMAX, WiFi)
- PCRF policy controller applies : tiered network policies (more flexible than just bandwidth caps) , shifts in data across different access networks (i.e. WiFi), application and device policies , subscriber policies (incl. User-defined policies and special offers)

SMARTPHONE and MOBILE MESSAGING HASSLES

- Always on applications such as push email, location , IM , found typically in smartphones, are much heavier (8:1 avg.) in signalling resources than others with heavier data load, because they continually « ping » the network with or for updates
- Solutions from femtocells and LTE device policy management

LTE BUSINESS ISSUES

- Revolutionizing current regulatory regime to stimulate broadband access towards economic growth and social sustainability
- Realizing profitable new devices and services through LTE
- Building and launching LTE in partnership: what are the considerations to be taken into account?
- Network sharing: evidence of a new business reality. Is network co-operation a viable option for rolling out LTE?
- Realizing the objectives of the EU Digital Agenda with the launch of LTE 800 MHz
- What are the results of Europe's First LTE 1800 deployments
- The road to convergence of FDD and TDD LTE
- What new business models do smartphone & tablet users generate and how must operators respond?
- Enabling LTE notebook connectivity , and LTE embedded devices
- Improving the wireless experience and reaching into new vertical markets
- Wholesale LTE network approach (USA)
- How can carriers make LTE more attractive to consumer electronics companies and to App developers?

IMPLEMENTATION OF LTE BUSINESS MODELS

BUSINESS MODEL SPECIFICATION by BUSINESS PROTOCOLS

- For each class of customer-supplier-ecosystem engagement, one can specify the transaction flow and fine-grained functionality needed for an implementation (« business engines »)
- While in 2G / 3G such business protocols were limited more-or-less to authentication and look-up by rating engines in tariff tables, LTE services and applications requires full specifications of the business processes
- Business model specifications can be modeled and instantiated by e.g. UML 2 or MDA using jointly communications and business protocols

PERSONALIZATION: TIERED SERVICES

Linking usage and preferences with payment levels (e.g. time-based tiers, bandwidth tiers, application /location/ QoS tiers, speed-based tiers)

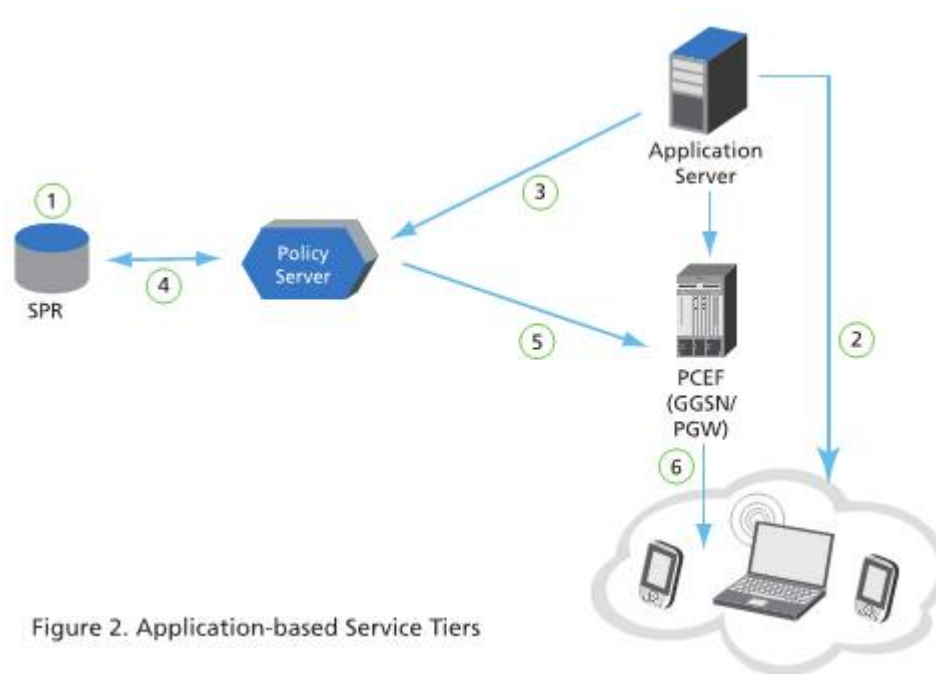


Figure 2. Application-based Service Tiers

1. Application service tiers specified in the Subscriber profile repository (Spr)
2. Application server initiates application session
3. Application server triggers a policy request to begin quota
4. Policy Server (pcrF) performs real-time quota management for each application
5. When the application usage limit is reached, the policy server sends a policy decision to the policy and charging enforcement function (pceF)
6. Customers are notified that they have reached their limit and redirected to a portal to get a temporary limit increase or to select the next service tier

By combining network and subscriber intelligence with advanced policy management tools, operators can meet the requirements of different customer and market segments with a diversity of personalized service tiers

OPEN ECOSYSTEM : Adding Value by enhancing Applications

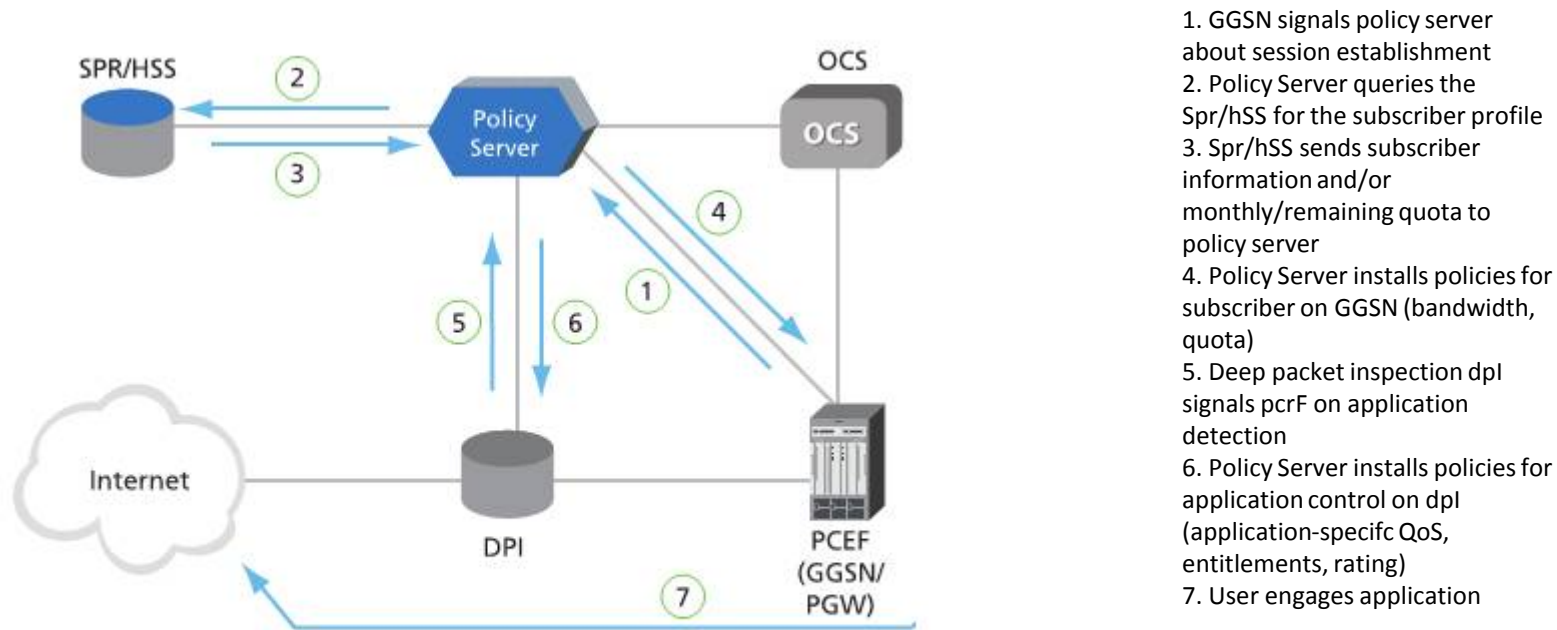


Figure 4. Over-the-Top Applications with a DPI-based Architecture

« Over-the-top applications » offer monetization opportunities by enabling operators to enrich and personalize applications with subscriber data profiles and usage data, opt-in's, presence and location information, payment and rating services, and analytics

CASUAL USAGE AND LOYALTY PROGRAMS

Time-limited usage access, loyalty points, promotions to modify usage pattern

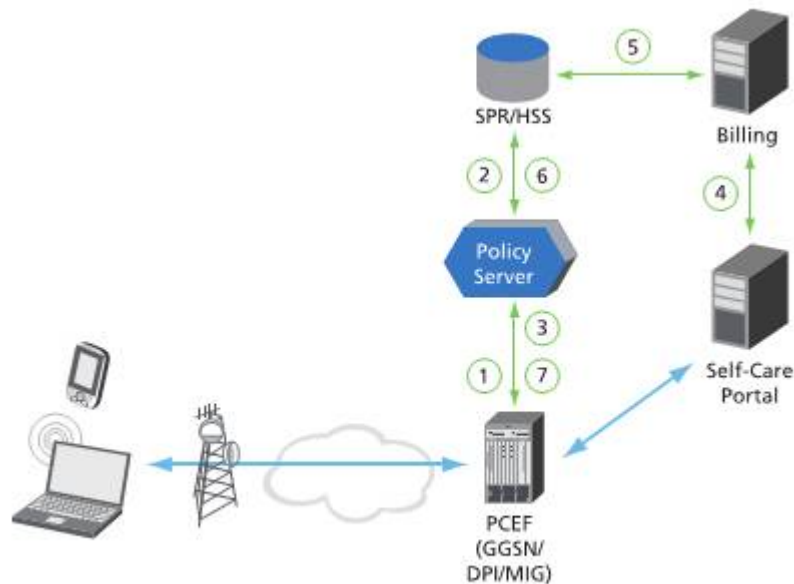


Figure 5. Casual Services

1. Policy enforcement point – GGSN, Deep packet inspection, or mobile Internet gateway (MIG) – sees new packet data protocol (pdp) context and asks policy Server for appropriate rules
2. The policy Server checks Subscriber profile repository Spr for entitlements; Spr returns “unknown device”
3. The policy Server replies to policy enforcement point to redirect the customer to the casual use portal
4. User selects day pass package
5. The rating engine in the policy server and the Spr are updated
6. The Spr notifies the policy server of new quota and other rules
7. The policy server instructs the policy enforcement point to allow data under new rules

Many such business models rely upon real-time modifications to the real-time charging system ,but this system can be by-passed by using the rating engine in the policy server

FURTHER READING

- Erik Dahlman, Stefan Parkwall, Johan Sköld, 4G LTE/LTE-Advanced for mobile broadband, Elsevier, April 2011, 455 p. , ISBN: 978-0-12-385489-6
- Sassan Ahmadi, Mobile WIMAX, Elsevier , ISBN: 978-0-12-374964-2
- 3GPP tutorials on LTE (made by aWaves.com):
<http://3gpp.org/Tutorials>

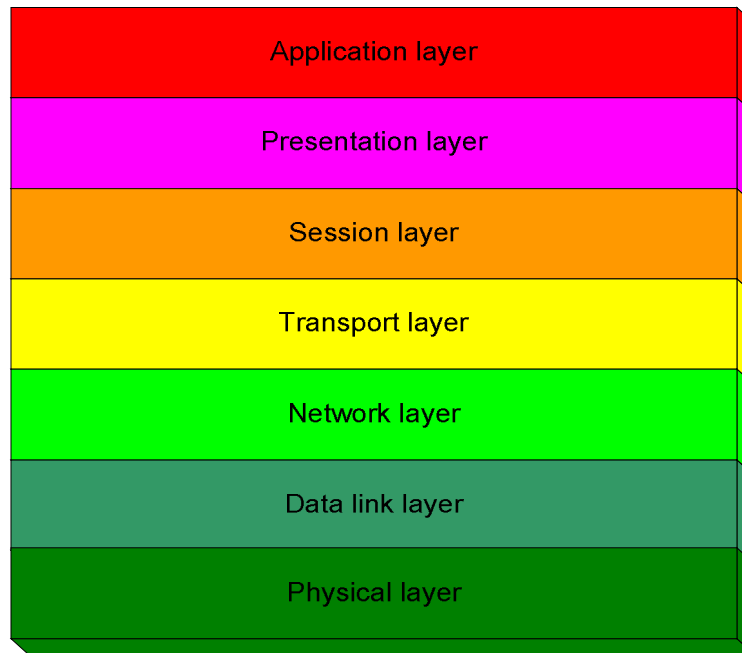
ABBREVIATIONS

- AM Application Manager
- Apn Access point name
- dpl deep packet Inspection
- ggSn gateway gprS Support node
- hSS home Subscriber Server
- MIg Mobile Internet gateway
- ocS online charging System
- ott over the top
- pceF policy and charging enforcement Function
- pcrF policy and charging rules Function
- pdp packet data protocol
- pgW packet gateway
- Qoe Quality of experience
- QoS Quality of Service
- SdM Subscriber data Management
- SMS Short Message Service
- SMSc Short Message Service center
- Spr Subscriber profile repository
- Volp Voice over Internet protocol

ADDITIONAL SLIDES

ISO/OSI CROSS LAYERS

- The International Standardisation Organization (ISO) began its work in the 1980s
- This work led to design the Open System Interconnection(OSI)



OSI model

Transmission Control Protocol, TCP

- One of the core protocols on the Internet
- Provides a reliable delivery of data streams
- Congestion control
- Currently works over a single path



Multipath TCP, MPTCP

- The traffic of a TCP connection is spread on multiple paths between the end-points
- Improves the resilience of the network connection
- Enables better utilization of the network resources



SCENARIO 1

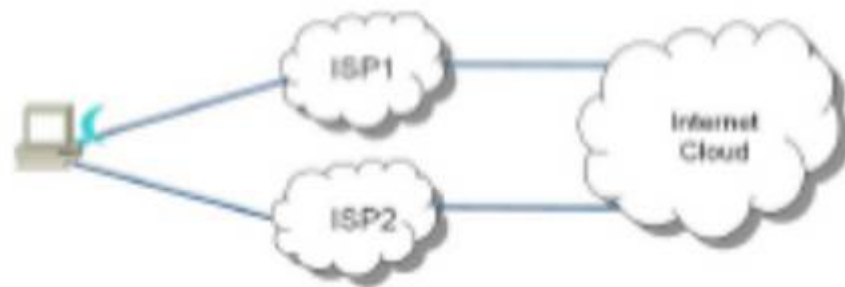
End-user has one physical connection to the ISP



- MPTCP benefits are highly dependent on ISP performance
- ISP can offer MPTCP upgrade as a premium feature

SCENARIO 2

End-user has multiple physical connections to multiple ISP s



- Gives more bargaining power to the end-user but entails a burden of handling multiple contracts
- Possible new service provider: Virtual Multipath Operator

SCENARIO 3

End-user has multiple connections to a single ISP



- ISP can develop lucrative access connection bundles which enables multihoming

End-user SWOT analysis of Scenario 3

<p>Strengths</p> <ul style="list-style-type: none">- Transparency of link performance	<p>Weaknesses</p> <ul style="list-style-type: none">- Increased cost for double access and provision of disjoint MPTCP connectivity
<p>Opportunities</p> <ul style="list-style-type: none">- More reliable and higher network throughput- Redundancy through different access technologies	<p>Threats</p> <ul style="list-style-type: none">- ISP may be bottleneck

ISP SWOT analysis of Scenario 3

Strengths <ul style="list-style-type: none">- Existing customer relationship will be fully maintained- Provider lock-in can be increased	Weaknesses <ul style="list-style-type: none">- Full benefits of MPTCP require offering routing functionalities
Opportunities <ul style="list-style-type: none">- Warranty of reliable throughput can be charged- Load balancing between the links	Threats <ul style="list-style-type: none">- Possible visibility of bad performance- Customers may not be willing to pay double price for dual access

ISP SWOT analysis of Scenario 3

Strengths <ul style="list-style-type: none">- Existing customer relationship will be fully maintained- Provider lock-in can be increased	Weaknesses <ul style="list-style-type: none">- Full benefits of MPTCP require offering routing functionalities
Opportunities <ul style="list-style-type: none">- Warranty of reliable throughput can be charged- Load balancing between the links	Threats <ul style="list-style-type: none">- Possible visibility of bad performance- Customers may not be willing to pay double price for dual access