Economics of Mobile Data in Frontier and Emerging Markets

Early release of spectrum by regulators in frontier and emerging markets is driving mobile operators to adopt data pricing and investment models that stagnate mobile data adoption and limit long term returns.
1. Spectrum in some of the frontier and emerging markets is being released early

**Early release.** The decision to release spectrum in some of the frontier and emerging markets is primarily led by the availability of spectrum at that point in time – there may or may not be an existing demand for that spectrum among operators. The disconnect between the time of availability (and release) of spectrum, and the time for need results in ‘early release’ situation.

**Why release early?** It has taken time for governments to fully appreciate the value of spectrum. The realization dawned after mobile penetration skyrocketed and operators started reporting 40%+ EBITDA. Regulators did not have a long-term demand-aligned spectrum roadmap in place, as no one knew the real demand, or the true value of spectrum. The spectrum was auctioned, allocated, or assigned as and when it became available – classic cases being auction of 2300MHz spectrum, used for LTE capacity in dense urban areas, being released in markets with no smartphones and 3G services.

The realization of spectrum value also led to requests from the treasury to help achieve fiscal budget. Now, making spectrum available can be an arduous exercise – sometimes it means moving broadcasters and defense to vacate spectrum marked for IMT services, and at other times resolving interference concerns, harmonization requirements and multiple such prerequisites. Getting the right band available may not be possible every year, and the next best option is to auction available bands.

Finally, lobbying by interest groups of OEMs, mobile operators and other stakeholders can also have an impact on the release decision. Figure 1 illustrates some of the early release situations – we recognize that there are cases even in emerging markets where regulators have better aligned release timelines to market demand.

**Figure 1: Timing of spectrum release and data market maturity**

Note: P: Planned; Sources: Regulatory reporting, company news and secondary sources
2. Early release has an impact on operator economics and planning

**Operator options.** If the spectrum is released early, then an operator has two options: a) buy the spectrum ahead of time to avoid competitors gaining a marketing and business advantage, or b) wait for the next round of spectrum availability. Generally the second option is not available to market leaders and they end up purchasing spectrum ahead of time and sometimes at a high price. This kick-starts a cycle of poor consumer experience that reduces engagement, limits data adoption, hurts operator returns and further weakens their ability to buy additional spectrum in the next round of release.

**Operator returns model.** All operators, whether listed or privately held, will have return targets. Increasing investments in spectrum and network requires at least a proportionate increase in EBIT and PAT. If any investment has been made ahead of time, then the focus will be on a) maximizing returns from existing assets to increase numerator of RoCE, and b) optimizing any additional investments to minimize increase in the denominator.

**Numerator (Profits).** Maximizing yield (realization per MB) from existing assets is the mantra for operators focused on returns. The following is a generic approach adopted by operators to achieve this objective:

- Operator will have a marketing focus on LTE – on-the-ground network investments will be still focused on 2.5G and 3G to delay 4G investments to market maturity
- Pure LTE and 3G packs will be priced high and with large data quotas – way beyond the paying capacity or consumption need of mass market users
- 2.5G and 3G capacity is rationed using mechanisms such as validity charge to ensure high yield per MB even for 2.5G
- Blended data packs (2G+3G+4G) are prevalent - 2G is built into the pricing of 3G and 4G, so that the actual investment required on 3G and 4G is low
- Customers buy 3G and 4G, and end up using 2.5G for 20%-30% of time due to coverage gaps or capacity constraints of the thin 3G and 4G network layer

In summary, the on-the-ground experience of users will be 2.5G and, at best 3G, 4G will be an aspirational product with no mass-market access, 3G and 4G data coverage will be patchy, and tariff plans are too complex for common user to decipher.

**Denominator (Investments).** The investments in network, over and above that for spectrum, will be focused and optimized so that user only gets a ‘good enough’ experience. GSM networks are bulked up to support data fallback from 3G/4G plans and to support 2.5G data traffic.

The 3G and 4G investments are optimized using the following investment parameters:

- **Decision on the level of indoor coverage:** Given that low frequency spectrum band is generally expensive, and competing wire line yields for home broadband are a fraction of mobile data yield, use of mobile for indoor coverage is a key investment decision
• **Decision on realized user experience:** Operators charge a premium of anywhere from 40% to 60% for delivering equal quantum of monthly MB data on 4G vs. 3G. There is a price (and a cost) for better user experience, and operators need to decide on the level of experience they plan to offer.

• **Decision on geographical areas to be covered:** Low frequency spectrum is preferable for rural coverage and it is priced higher than high frequency bands. Also, operators have different views on the growth potential and addressability challenges of rural markets, and hence geographical coverage becomes an important decision.

The access to mobile data in emerging markets is similar to access to capital for the financially under-served segments – the poorer you are, the more you pay per unit of capital (or data capacity), and the worse is your user experience!

We discuss the yield maximization and investment optimization approach of operators in the following sections.

3. **Maximize yield: 2G data users pay a high proportion of their tariff just to keep their connections active on the network**

**Understanding validity.** Validity refers to the duration for which the data pack can be used, and can range any where from 1 day to 30 days or even higher. The longer the validity of the pack, the more a consumer needs to pay for this option of being connected to the network within the defined duration. This is driven by the fact that operators dimension their networks using peak capacity demand, and with increasing number of users active at any point in time the required network capacity demand needs to be provisioned, which has a cost.

**Factoring validity into the mobile data-pricing model.** The longer the data pack is valid, the more an operator will charge for the pack, in addition to the MB capacity sold. However, given that lower duration packs are typically for lower denominations as well, as a % of total pack price, validity forms a higher proportion of the pack value for lower denomination packs, as illustrated in Figure 2.

**Impact of validity charge.** The sachet-pricing concept of charging higher per unit price for lower quantities is prevalent everywhere. Validity charge is over and above the mark-up for lesser units of capacity – it’s a payment for the option to access capacity when needed.

More importantly, validity charge as a share of overall value is higher for 2.5G/3G users, and their user experience is generally worse compared to that for a 4G user. Validity charge makes data prices even higher for users that cannot afford mobile data to start with, and hurts data adoption.
Figure 2: Subscriber charge for validity as a % of overall pack price

Source: Capitel analysis of mobile data plans for an emerging market

4. Minimize investments: All 4G and majority of 3G is out of reach – best available is blended data, and 2G data speed can be a differentiator!

4G pricing. The marketing for 4G is pervasive, but the actual access is generally limited to early adopters. Operator plans are targeted at users willing to pay 50%+ premiums on a per MB basis, and willing to commit USD20-USD60 per month to purchase 15GB of data – generally in a market with average monthly data usage of 500MB, and monthly data spend of USD2.

Blended plans for 3G and 4G. The blended plans for 3G and 4G offer a bundle of access on both 3G and 4G networks without specifying their individual traffic share. This helps in optimizing 4G investments and sets consumer expectation for using the 3G networks for at least some or majority of the time.

Although LTE has a higher spectral efficiency and hence higher capacity per MHz, the requirement of backhauling traffic and offering seamless coverage (for VoLTE) puts a demand on network investments. More importantly, if LTE has to provide a better user experience, then there is a cost of that experience. In the initial stages when operators are unsure of demand, device prices are high, and customers don’t really have a benchmark of LTE experience, its easier and cheaper to sell 3G+4G data plans.

In some markets, observers point out after many years that 3G or 4G data adoption has been slow - the issue may be that there was never a real deployment of 3G or 4G data services to kick-start adoption among mass market users.
**Figure 3: 4G plans, and majority of 3G plans are not accessible to mass market users**

All plans for 28 days validity

![Graph showing 4G plans and majority of 3G plans are priced way beyond mass market affordability or need](image)

Source: Capitel analysis of LTE plans of an emerging market operator

**Blended plans for 3G and 4G, with 2G as a differentiator.** Some operators (e.g. in Thailand) also include 2G data speed as a differentiator for increasing plan prices. These include plans with varying 2G data speed tier (64Kbps, 128Kbps and 384 Kbps). The difference across price plans is not so much due to 3G or 4G data usage, but due to 2G data speed once the 3G+4G quota is over. This is a classic example of sweating existing 2G data assets using a 3G+4G marketing edge.

**Figure 4: Higher price per MB mainly charged for higher 2.5G speed for a 3G+4G plan**

![Graphs showing price per MB for one day and seven day validity plans](image)

Source: Capitel estimates based on analysis of reported plans for an emerging market operator
5. Minimize investments: 2.5G network is used as the backbone for carrying 3G and 4G data traffic

**How network optimization works?** For operators deploying data networks on high frequency bands such as 2100MHz, the coverage plan can never match the underlying GSM coverage on 900MHz or 1800MHz. One option is to bulk up on 2G spectrum, and use 2G as a fallback network for data and voice (for LTE). This keeps the actual network Capex for 3G and 4G limited to key urban centers, and allows operators to use 3G and 4G as a marketing edge for acquisition, with 2G network doing the grunt work of carrying traffic.

**How is it reflected in KPIs?** Operators witnessing increasing adoption of 3G services also tend to report higher usage for 2.5G on a per subscriber basis. Some of the per user traffic on 2.5G is due to an increase in usage of 2.5G users with better devices and improving network coverage/capacity, however a significant share is led by 3G data falling back on 2.5G.

**Figure 5: The share of 3G traffic carried by 2.5G network increases with 3G adoption**

![Graph showing the increase in 3G traffic on 2.5G network with 3G adoption]

Source: Capitel estimates based on analysis of reported metrics for an emerging market operator

**Impact on user experience and adoption.** Poor data experience substantially impacts the engagement level of users with mobile data, limits smartphone penetration, and delays 3G adoption. It is observed that prepaid customers keep shifting from 3G to 2.5G (and almost never to 4G), as the network experience is relatively similar, and there is no need to pay a premium for 3G.

The inclination of users to adopt applications and services that are data heavy also gets limited as the available coverage and capacity doesn’t provide any incentive to opt for heavy applications.
6. Maximize yield: Voice is even better than 2G data

**Voice-data tradeoff.** For a 2.5G network, timeslots responsible for carrying voice are replaced and committed for carrying data. For a timeslot carrying one voice conversation, the realization can be anywhere from 0.5US cents to 1.0US cents. Now, if the same time slot if marked for carrying data, then the realization can be less than 0.1US cents. 2G data networks support 3G and 4G, but operators also need to optimize provisioned capacity for 2G as the yield is even better in carrying voice.

**Packet-circuit tradeoff.** The carriage of voice as data packets (VoLTE) requires much lower data capacity, with up to 80% reduction in per minute cost of carriage. If operators price such a VoLTE offering on a per MB basis then all profits are pass through for end users and operator voice revenues nosedive. However, if operators can bundle VoLTE with data to charge a price similar to the circuit switch voice prices with incentives demonstrating lower price data package overall, then the margins can remain intact or even grow. In price sensitive emerging markets, replacement of circuit switched voice with VoLTE or even OTT voice is growing, led by good quality LTE networks.

Operators focused on maximizing returns will optimize their networks to ensure voice revenue protection on 2G and 3G. A full-fledged LTE deployment with VoLTE capability may improve user experience and service affordability, however the core voice revenues are at risk, and the operator returns may be affected.

7. Minimize investments: The Indoor mobile data coverage decision for 3G/4G

**Indoor traffic planning.** There are various options being considered by operators based on their view on market growth, focus on alignment of access economics, and investment outlay.

**No indoor data coverage on mobile.** This is primarily the case for operators that do not have low frequency data spectrum such as 700MHz or 800MHz, and are focused on monetizing 21003G or 1800LTE to target outdoor traffic. The focus is on minimizing investment in network and spectrum, and targeting only traffic segments with best return potential.

A variation of this model for urban markets is to address the indoor data using fixed line so that the access economics are aligned – within households, consumers are happy paying 0.06 USD cents per MB instead of 0.40 USD cents per MB charged for mobile data. This approach is driving operator acquisition of fixed line assets using FTTx, and expansion of such services.

**Opportunistic indoor data coverage on mobile.** In tier 1 markets, operators increase the network density around key traffic hotspots by deploying sites within apartment complexes, corporate offices and residential areas to capture as much data as possible on high frequency networks. This also works from a returns perspective as there is significant data traffic visibility using fixed line data, or 2.5G/3G usage data before operator deploys a site. The scalability of this model is generally limited to metros and tier 1 markets.
Complete indoor data coverage on mobile. This works for operators with substantial quantum of low frequency data in the 700MHz, 850MHz and 900MHz bands. Theoretically, all towns and villages can be covered using the network subject to deployment of cell sites for coverage.

In urban areas, such usage can be complemented with high frequency spectrum such as 1800MHz and 2300MHz, and also with FTTx/Cable based offerings to a) ensure relatively lower cost per MB due to alignment of access technologies with user needs, and b) capture traffic market share in tier 1 and incremental primary SIM led data in tier 2 and rural markets.

8. Minimize investments: User experience and throughput

Target user experience. To take an example, a 5MHz spectrum deployment for 3G on a three-sector site will provide an average throughput of 10Mbps, and even lower for a majority of sites – close to say 6Mbps on a blended network basis. On 6Mbps capacity, at any instant of time, six users can actively download at a speed of 1Mbps, twelve users can download at 0.5Mbps, or even 24 users can download at 0.25Mbps.

The capacity installed remains the same, and there can be a trade-off allowing a larger subscriber base to experience poor quality data, or a smaller base to experience good quality data. This is reflected in pricing of LTE vs. 3G, with LTE priced at 40% to 60% higher than 3G on a per MB basis for same validity plans.
9. Minimize investments: Urban vs. rural coverage

**Target geographies.** The selection of geographical regions and sub-markets (markets within a region such as urban, semi-urban and rural) informs the spectrum plan (mix of low frequency vs. high frequency bands), network coverage plan, capacity sites and the target customer base.

**Existing assets.** The economic evaluation of all spectrum purchase and valuation decisions typically become non-viable due to the cost of spectrum, or due to the cost of network. In markets such as India where the co-location of a new data base station on an existing site results only in a 15% additional fee, the economics of rolling out data services in areas with existing sites is much more attractive as compared to deployment of standalone tenancy sites.

**Market share.** Some operators prefer rolling out mobile broadband services in a region where they are a marginal operator, although with a focus on areas under-served by incumbent operator such a tier 2 markets. This model works in cases where the investments in spectrum are limited to say 2100MHz 3G, operators have existing sites to co-locate 3G on a GSM site, non-network Opex are controlled, and the voice and data pricing mechanism is geared to drive high yields on a per-minute and per MB basis.

Such a horizontal expansion model with a focus on providing data services to tier 2 markets is prevalent globally, with major operator groups having fine-tuned the approach of serving low data ARPU customers at much higher margins than that from high usage customers in urban areas. In countries such as Myanmar, Pakistan and other frontier markets, 2G data is expensive, and even though a data subscriber consumes lower MB on a monthly basis, the mobile operator makes a higher yield, and better returns.

The existing market share position is taken into account only if the region contributes to a significantly high proportion of overall revenues, and the operator has the willingness and ability to acquire spectrum assets, roll-out networks, backhaul and other infrastructure to be able to protect and nurture the user base. This is a high investment play with declining marginal utility as the overall size of the data market does not increase with operators purchasing additional quantum of spectrum to improve user experience – especially if the user is value conscious and is focused more on spend than experience.

10. In case of stagnant growth, operator’s ability to further invest in spectrum is further limited for the next rounds of release

**View on data market growth.** Unlike the voice business, the value of user ‘experience’ in mobile data consumption increases especially as the market matures, and operators differentiate on speed and throughput and network experience, rather than coverage. This experience has a significant cost because to provision a network for 2Mbps throughput vs. 0.5Mbps throughput means a substantial increase in investments.

If the market doesn’t grow, then operators end up deploying additional spectrum to serve the same limited set of customers. The user experience improves but the ARPU does not improve at the same pace constrained by affordability and multiple other factors.
In such a scenario, the returns from purchase and deployment of additional spectrum will result in declining returns, and reduce the overall returns of the business, as illustrated in Figure 6.

**Figure 7: Blended RoCE with purchase of additional spectrum bands, low data growth**
Illustrative, based on operator specific assumptions

![Blended RoCE with purchase of additional spectrum bands, low data growth](image)

Source: Capitel analysis

11. **The focus on yield maximization and investment optimization can delay the rate of mobile data adoption and user engagement**

Operators have a right to maximize returns as they are answerable to shareholders and investors. If the burden of purchasing spectrum in every cycle begins to weight down on operator financials, then its gets reflected in their approach to maximize yield and minimize investments, as detailed above.

This ultimately results in a situation where a 2G data user or a 3G data user is subsidizing the user experience for a 4G user, making data unaffordable for majority of mass-market users. As operators keep accumulating spectrum, and the market adoption and usage slows, the ability of operators to further invest in even buying spectrum becomes constrained.

The annual release of spectrum bands that cannot be deployed immediately kick-starts a cycle of declining marginal returns is illustrated in Figure 8.
In general, operators focused on quarterly or periodic returns generally have a short term focus and follow the above approach, or some variant of the above.

The above view excludes operators that have committed significantly excess capital into the marketplace with a view for long term returns. These operator groups create significant capacity, and the focus shifts on asset utilization rather than yield management. There are such investors in Pakistan, India and few other markets, but in general, operators focused on quarterly or periodic returns generally have a short term focus and follow the above approach, or some variant of the above.

12. Eventually, operators decide on their investment appetite for the market, and align their return model accordingly

Operating companies that are part of MNC groups. The investment decision in such a case is led by the relative attractiveness of the market opportunity, in the context of alternative investment opportunities available in other markets.

The holding company may have other invested operating companies that are positioned well in other markets, have cheaper access to resources such as spectrum on a per unit basis, have easier geographical access to these markets, and many other parameters including market maturity and regulatory certainty.
For some of these portfolio operators, there may be a decision to restrict investments until the market is mature, and align returns model to monetize existing investments.

**Standalone operator with local market operations.** For operators that are standalone for the purpose of investment planning, the decision will be driven by a) availability of funds based on the strength of their balance sheet, and b) returns from other business verticals of the telecom operations is part of a broader local market conglomerate.

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**Table 1: Operator investment and returns models**

<table>
<thead>
<tr>
<th>Spectrum band: &gt;1GHz</th>
<th>1. Poor user experience, No indoor coverage</th>
<th>2. Good user experience, Optimized indoor coverage</th>
<th>3. Good user experience, Seamless indoor coverage</th>
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<tbody>
<tr>
<td>2100MHz, 1800MHz</td>
<td>2100MHz, 1800MHz, 2300MHz, 2600MHz</td>
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<tr>
<th>Spectrum band: &lt;1GHz</th>
<th>900MHz, 800MHz or 850MHz: 5MHz in select areas</th>
<th>900MHz, 800MHz or 850MHz: 10MHz+</th>
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<tbody>
<tr>
<td>NIL</td>
<td>900MHz, 800MHz or 850MHz: 10MHz+</td>
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| Traffic coverage     | Only outdoor                                     | Mainly outdoor – indoor optimized in dense urban through in-fill sites | Outdoor and Indoor |

<table>
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<tr>
<th>Quality of user experience</th>
<th>Low (0.25Mbps to 1Mbps)</th>
<th>Medium (2Mbps+)</th>
<th>High (4Mbps+)</th>
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<tr>
<th>Geographic coverage</th>
<th>Urban and sub-urban</th>
<th>Urban and sub-urban</th>
<th>Urban and rural</th>
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<tr>
<th>Marketing model</th>
<th>Position broadband as a non-discretionary purchase for mass market users with primary use cases with low data</th>
<th>Focus on user experience for consumers already using mobile data through good experience and content / service bundling</th>
<th>Offer value to customers and position broadband as a productivity / entertainment offering to drive capacity utilization</th>
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<tr>
<th>Typical deployments</th>
<th>Frontier markets</th>
<th>Frontier markets</th>
<th>Emerging markets</th>
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<td></td>
<td>Emerging markets</td>
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<td>Developed markets</td>
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Source: Capitel analysis

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Except for operators that are well funded and have long term plans for the market (Model 3 in above table), other operators will have to make a compromise in terms of indoor coverage, user experience and geographic reach to deliver returns. This has a longer-term impact on the service availability and quality, and may further delay the adoption process.
13. Regulators need a spectrum release framework to help operators better plan their investments, and help grow the data market

The alignment of spectrum release timelines with market readiness also allows regulators to realize a market value closer to the intrinsic value of the spectrum, and avoids loss to exchequer. This is visible in secondary market deals, or follow-up auctions for the same spectrum bands at a later date, where typically the realized price points are higher even after discounting for the accrued interest cost.

A policy framework that evaluates the market readiness on demand and competitive parameters with the availability situation of spectrum will allow for faster growth of data market, improved consumer experience and better realization of spectrum value.

Such a policy framework needs to consider the parameters summarized in Figure 9.

**Figure 9: Framework to inform spectrum release (and purchase) decisions**

Source: Capitel engagement experience

**Understanding the spectrum demand context.**

**Consumer demand context.** This essentially revolves around understanding the fundamental ‘need’ and ‘affordability’ parameters of the user base. This translates into understanding the need for coverage (tier 2 demand), and capacity (tier 1 usage), and aligning the selection of frequency band, and quantum of spectrum accordingly.
Options available to operators. Return focused operators with disciplined investment policy will avoid purchasing spectrum early, unless market share is actually at significant risk. Such operators will explore options such as spectrum re-farming, deployment of WiFi and fixed line assets to optimize mobile capacity for outdoors and coverage use cases with higher yield and spectrum sharing opportunities.

The second situation that forces operators to buy spectrum is network congestion – understanding current levels of capacity utilization in key cities and dense urban areas also provides input on whether the operators really need spectrum and can utilize it from day one for serving customers and generating returns.

Technology roadmap of operators. As discussed earlier in this paper, understanding the general investment planning models of operators and their returns approach helps identify operator’s technology roadmap. Operators are generally in discussions with regulators on various issues, and having a better understanding if operator roadmaps help align the release accordingly.

Understanding the spectrum supply context.

Spectrum availability. The availability of spectrum for required use cases may require shifting of non-IMT incumbents such as broadcasters and addressing other issues such as interference. A timeline with expected availability of spectrum is a useful input to the release roadmap.

Spectrum policy. Policies spectrum sharing and trading, liberalization, mergers and acquisition and re-farming among others determine the alternative options available for operators to access spectrum, and influences spectrum demand.

Spectrum pricing. Based on release timing, regulators may be able to realize the intrinsic value, or have to sell the spectrum at a discount. However, we realize that in cases where spectrum supply is constrained, the value realized is higher even when there is an early release – however, the consequences can be declining returns and reducing investor interest.

Developing a spectrum release roadmap.

Spectrum band. This needs to consider that operators will build a mix of low frequency and high frequency band mix to optimize their coverage and capacity. Based on capacity utilization in key cities, coverage studies, and traffic pattern along with above considerations, the timing of release for various bands can be determined.

Spectrum quantum. The quantum of spectrum released will depend mainly on capacity needs, and auction structuring - understanding population density of key cities, tower availability, WiFi and fixed line solutions can inform need for data capacity.

Release approach. This will depend on historical approach to spectrum release mechanism in the market including auctions, assignments, bundling with license, and the objective of government from spectrum release (e.g. revenue maximization vs. service quality for end users).

Commercial structure. For value realized through auctions, assignments or other administered pricing or market discovery mechanisms; there is a trade-off between upfront realization vs. staggered payments among other options.
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Pankaj has been a consultant in Telecoms, Media and Technology for more than fifteen years, with experience of leading national positions at consulting firms such as Analysys Mason and large mobile operators such as Bharti Airtel. He has worked in the US, India, Asia and Middle East, and was a Judge at the Global Mobile Awards at MWC Barcelona, and a speaker at MWC Shanghai, TMT Finance Asia, TowerXchange Asia among other major forums.

Pankaj currently advises boards and senior management teams on major investment decisions, including investments in spectrum, networks, private equity transactions and public equity positions. He has recently advised on a proposed USD3bn transaction in India, and an USD2bn+ network Capex optimization engagement. He brings in a strong understanding of techno-commercial planning, spectrum management and transaction advisory.

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Puja is a Chartered Accountant with prior experience in the telecoms team of PriceWaterhouse, and has exposure to multiple engagements with operators in India and Asia. She has experience in planning and conducting financial statement analysis for major operators, commercial due diligence for large transactions, financial modeling, statutory audits and techno-commercial planning.

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