

Radio Site solutions for 3G Mobile Communication Networks

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Abstract - Designing a high capacity, high growth, large coverage area, expandable and above all easy to install and operate radio system is a prime requirement of any mobile operator. Further, the major CAPEX (Capital Expenditure) of any commercial mobile network is over its radio portion, thus necessitating a requirement of a highly optimized and efficient radio system. The paper deals with the various radio solution options available and the various parameters affecting the choice of a particular radio solution for a specific site and their inter relationship.

Keywords — Radio Site Solutions, 3G Wireless Communications, ARPU, Integrated site solutions, Radio performance, Site selection parameters, and Site systematization.

I. INTRODUCTION

The ultimate aim of any mobile network operator is to build an efficient radio network that has a low total cost of ownership (TCO). Studies have shown that a good 70-75 % of the total cost of the network is built on radio network, thus any cost cut here could have a large savings for the operator. Optimizing the radio network is on the top wish list of any operator. The points to be addressed for building such a network should include primarily the radio performance of the network and that of supporting systems, such as power supply and transmission, ordering and services, site engineering, installation and integration services, to complete the list.

These unique solutions take radio network planning to the next level. In particular, the combination of innovative radio features and efficient site solutions allows operators to reduce the total number of radio sites in their access networks, thereby reducing the TCO. For existing mobile operators already having 2G+ mobile networks under their belt and desirous to operate 3G networks, a further requirement is to integrate the upcoming 3G sites with their already installed 2G+ radio sites.

II. BACKGROUND

Mobile Operators have to face many difficult decisions while deploying radio networks. The situation gets especially compounded for operators in emerging markets like India where income and average revenue per user (ARPU) are relatively low. In more mature and evolved markets, by contrast, the main emphasis is on optimizing operating expenses (OPEX), as they already have a well developed radio access network in place. But regardless of where operators do business, they all have to optimize their entry-level investments in radio networks in such a way that these

networks starts paying for themselves in months, not years. For this the operator has to consider several interrelated questions like What would be the initial demand, What should be the appropriate capacity to cater to this demand, What area is to be covered, How many sites would be needed to cover the given area providing the desired capacity, What would be the value of an improved link budget and how the capacity demand in future be accounted and deployed.

The answers to these interrelated and complex issues lies in the development and deployment of a collection of cost effective Radio Site solutions tailored to meet specific environmental scenarios. Moreover, it should be noted that multiple solutions exist for metropolitan, suburban, rural, and in-building site environments. Examples include indoor and outdoor macro sites as well as rooftop and main-remote solutions with minimum footprints. To facilitate planning prior to deployment, each solution has been optimized for a given environment and dimensioned with the most appropriate radio configuration and supporting equipment and services.

III. SUPERIOR RADIO PERFORMANCE

The radio base stations have to be optimized to deliver maximum radio performance with minimum power consumption, also the radio base stations have to be available in every frequency band specified by ITU for 3G services and for every capacities ranging from high-capacity base stations for macro sites to lower capacity products for micro sites. The most important benefit of superior radio performance is cost-effective coverage and capacity at the radio access network level. Coverage is optimized with excellent radio performance; capacity is optimized by means of unique radio functionalities and features. This translates into significantly fewer radio sites per coverage area. This straightforward translates into saving of a chunk of CAPEX, planned for initial roll out. E.g. many of the available 3G radio site solutions employ an optimized antenna system with tower-mounted amplifiers (TMA), which improve the uplink and create larger cells. A properly dimensioned antenna system can thus increase range and sensitivity. It also extends battery life in mobile phones by lowering the requirements for output power. A variety of antenna systems makes it possible to maximize radio network capacity, coverage, or both. Operators may thus precise dimension network coverage and optimally distribute the link budget. By configuring the network across the coverage area to provide the exact capacity required in each cell, operators can minimize their entry-level investments while providing ample capacity throughout subsequent phases of expansion as traffic increases.

IV. INTEGRATED FUNCTIONALITY AND BUILDING PRACTICES

Existing 2G Operators planning to enter the 3G arena should have the flexibility of combining the already installed 2G & 2G+ radio infrastructure with the upcoming 3G radio infrastructure, allowing them to share transmission and power components, thereby reducing the initial CAPEX for 3G rollout. These integrated radio site solutions are comprehensively engineered to integrate functionality in a manner that further enhances their performance. Take, for instance, power, a parameter that often dominates OPEX. An integrated site solution manages and regulates power precisely and employs an intelligent battery charging algorithm. Compared with conventional charging methods, this functionality also allows for charging methods that prolong battery life. Integrated sites enjoy the savings in transmission components as the same transmission mechanism is used to carry the increased load.

The building practices especially for macro base stations is one other area where integrated design translates into a significant reduction in power consumption. The integrated base stations can, for example, be stacked for maximum output with minimal footprint.

New integrated radio site solutions help reduce the lead time by saving time and capital for acquisition of new sites and their subsequent civil works, apart from the savings incurred using common logistic support systems like transmission, power, air conditioning etc.

V. NEW METHOD OF SYSTEMATIZATION

Indian Operators wanting to reduce TCO cannot continue to buy radio solutions in piece meal fashion. Today's competitive market and evolving full-service networks necessitate complete solutions that are more than the sum of their parts. To this end, a new method of systematizing has to be evolved that encompasses developing radio solutions that significantly lower TCO by

- attaining the break even point at the earliest;
- enhancing network quality; and
- reducing operator risk.

For this the radio base stations are worked upon to identify and eliminate unnecessary differences between base station and site components. As a result, the solutions provided by technology providers are now more tightly integrated. To cater to the specific needs of particular scenario, obviously a general solution would not work, accordingly a whole range of radio site solutions are now available to service every need of the operator. Regardless of whether the site is located in a desert, on an urban rooftop, or in an indoor environment where silent operation is essential, these solutions can help operators to leverage market

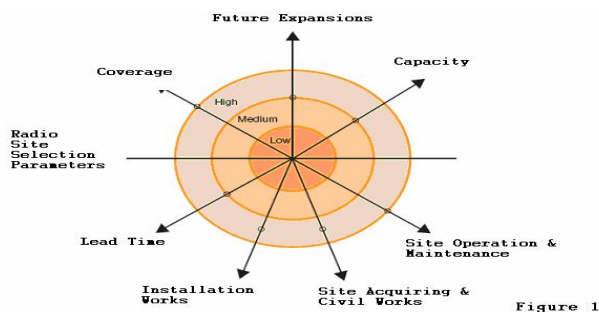
opportunities and tap into new streams of revenue. Different radio site solutions available to Indian Operators depending on the terrain conditions include:

- **Rooftop Site solution for dense & busy environment**
One of the most commonly used and omni present, this rooftop site solution is a pre-defined solution for easy placement and installation. The design supports various configurations and has been optimized for rapid network rollout for all possible locations. The carry-to-site solution is thus ideal for city & busy environments; because installation is extremely easy merely two people can carry the site solution to a rooftop via a building's stairwell or elevator.
- **Rooftop Site solution for suburban like environment**
The suburban rooftop site solution is a pre-defined main-remote solution with a low weight segmented radio base station main unit which simplifies the site acquisition because of less interference with the building structure and the site rent can be reduced due to no or very small foot print. With the main remote concept, expansion of capacity and coverage can be implemented gradually. This means that the solution corresponds to medium to high capacity needs and provides excellent macro coverage.
- **Indoor Site solution**
The Indoor Site solution is a generic indoor macro solution with a pre-defined installation pattern. This building-block solution is suitable for almost any indoor location where a medium- to high-capacity solution is required. The Indoor Site for 3G systems can be co-located and co-sited with 2G systems fitted with different antenna systems to optimize coverage and capacity. Operators can expect this solution to provide best-in-industry efficiency in terms of minimizing power consumption, optimizing radio performance, and minimizing environmental impact.
- **Street-smart Site solution**
The Metropolitan Street-smart Site solution is designed for sites where minimal depth and quiet operation are required. The solution includes power backup and an antenna system that can be visually integrated with a lamp post. The Street-smart Site requires less maintenance and therefore fewer site visits than traditional solutions.
- **In-building Coverage site solution**
The In-building Coverage Site solution provides coverage and enhances capacity inside buildings. The solution thus offers a high degree of flexibility in the context of different business solutions.
- **Shelter Site solution**
The Rural Shelter Site solution is a macro base station and provides a complete solution for Greenfield deployments and also includes a shelter. It comes with an integrated transmission solution in form of a flexible microwave link. Normally, the included shelter has space for further expansion – that is, a 3G base station can be installed together with 2G equipment. The solution supports all radio features and functionalities to maximize coverage, capacity, or both. The solution is ideal for places where the capacity

requirement is medium but the coverage requirement is high.

- Outdoor site solution for Leanly populated places
 This versatile Outdoor Site solution is ideal for expansion in areas where wireless and perhaps even fixed services were not previously available. It includes all components and relevant services to profitably extend coverage to areas with low population density. This solution could be one of the most sought after in the Indian rural areas during the upcoming 3G rollouts by the operators.

However, to arrive at an optimized radio solution, the operator has to carefully choose the right solution for a given site. Operators have to build an optimized radio network to specific requirements, taking one or the other solution described above. To arrive at a particular radio base station solution, the operator has to consider a number of conflicting parameters. These parameters have to be weighed together to arrive at the right decision, Figure 1 shows important dimensions for qualifying site characteristics.



The figure quantifies the various parameters deciding in favor or against a particular site location. Also the affecting factors are 'mutually exclusive' sort, for eg. The capacity and the coverage are diverse requirements. In the figure the markings are done for a site that has requirements/traits like medium capacity, high coverage, medium to high installation time and site acquiring plus civil works time and above all a high site operations and maintenance time. Such a site would most likely to be in rural areas, where the coverage is the prime requirement, the capacity could be low or medium. Due to geographical location, such a site would need medium to high installation times and the same is also true for site acquisition plus civil works and above all the subsequent maintenance.

As an operator, one has to weigh all these contradicting requirements in a way to zero down on one of the seven radio solutions being provided off the shelf by the technical providers. The operator can further assign weights to these conflicting parameters and design a simple algorithm taking into account these parameters, which would help them to arrive at the most optimal radio solution. The operator can use simple weighted algorithm or in turn can use multiple iterative

weighted algorithm. The same figure could very well be used to compare a number of site location and thereby arriving at the most suitable solution, within the given parameters and limitations. By following this scheme operators can swiftly dimension for needs in the radio network buildup phase, by choosing the right site for the right purpose.

CONCLUSION

Operators who want to reduce TCO cannot continue to buy bits and pieces. Today's competitive market and evolving full-service networks necessitate complete radio solutions that are more than the sum of their parts. To help operators build more efficient radio networks a whole range of radio site solutions are defined. Each solution has been designed to cater to a specific market need. Regardless of whether the site is located in a desert, on an urban rooftop, or in an indoor environment where silent operation is essential, the solutions can help operators to leverage market opportunities and tap into new streams of revenue. With major operators planning to rollout their 3G services in India, the discussed aspects acquires all together new and important dimensions for every prospective new and existing operator.

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