E4-E5 (CM)

3G OPERATIONAL ISSUES

WELCOME

- This is a presentation for the E4-E5 CM Module.
- Module for the Topic: 3G OPERATIONAL ISSUES.
- Eligibility: Those who have got the Up gradation from E4 to E5.
- This presentation is last updated on 15-4-2011.
- You can also visit the Digital library of BSNL to see this topic.

AGENDA

- Challenges
- Good RF network Plan
- Pilot Pollution and steps to remove
- WCDMA/UMTS Optimization Methodology
- RF OPERATIONAL ISSUES IN 3G NETWORK
- IMA

Challenges

3G operators throughout the world is trying to find solutions to the same four challenges that are faced repeatedly:

1) sub-optimal RF optimization,

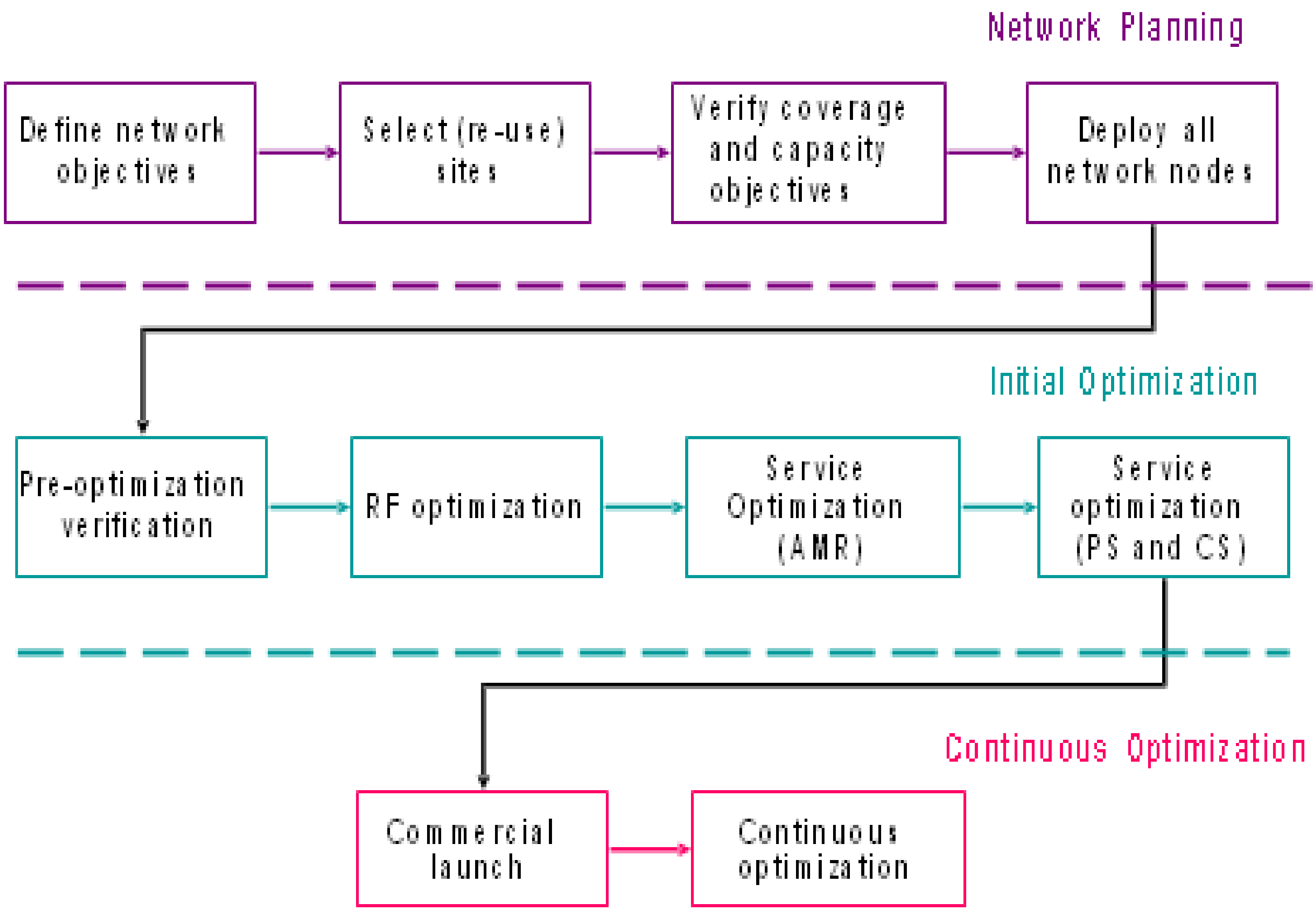
2) difficulty to tune all the parameters,

3) increasing the reliability of inter-system transition, and

4) providing better in-building coverage.

These are complex issues, but solving them can be simplified if a proper deployment process is followed as illustrated in Figure 1.This process follows a “divide and conquer” approach, focusing on a selected variable at each step.

Summary of Network Deployment Steps



GOOD RF NETWORK PLAN:

- A good network plan should address the coverage and capacity requirement of the area considered, but also be sufficiently flexible to allow network expansion without major change of the existing sites.
- In WCDMA, the coverage and capacity requirement cannot be considered independently, but should be planned at the same time with proper guidelines. This relation between coverage and capacity is often referred to as the "breathing effect" of WCDMA. Comparing with TDMA/FDMA technologies, such as GSM,

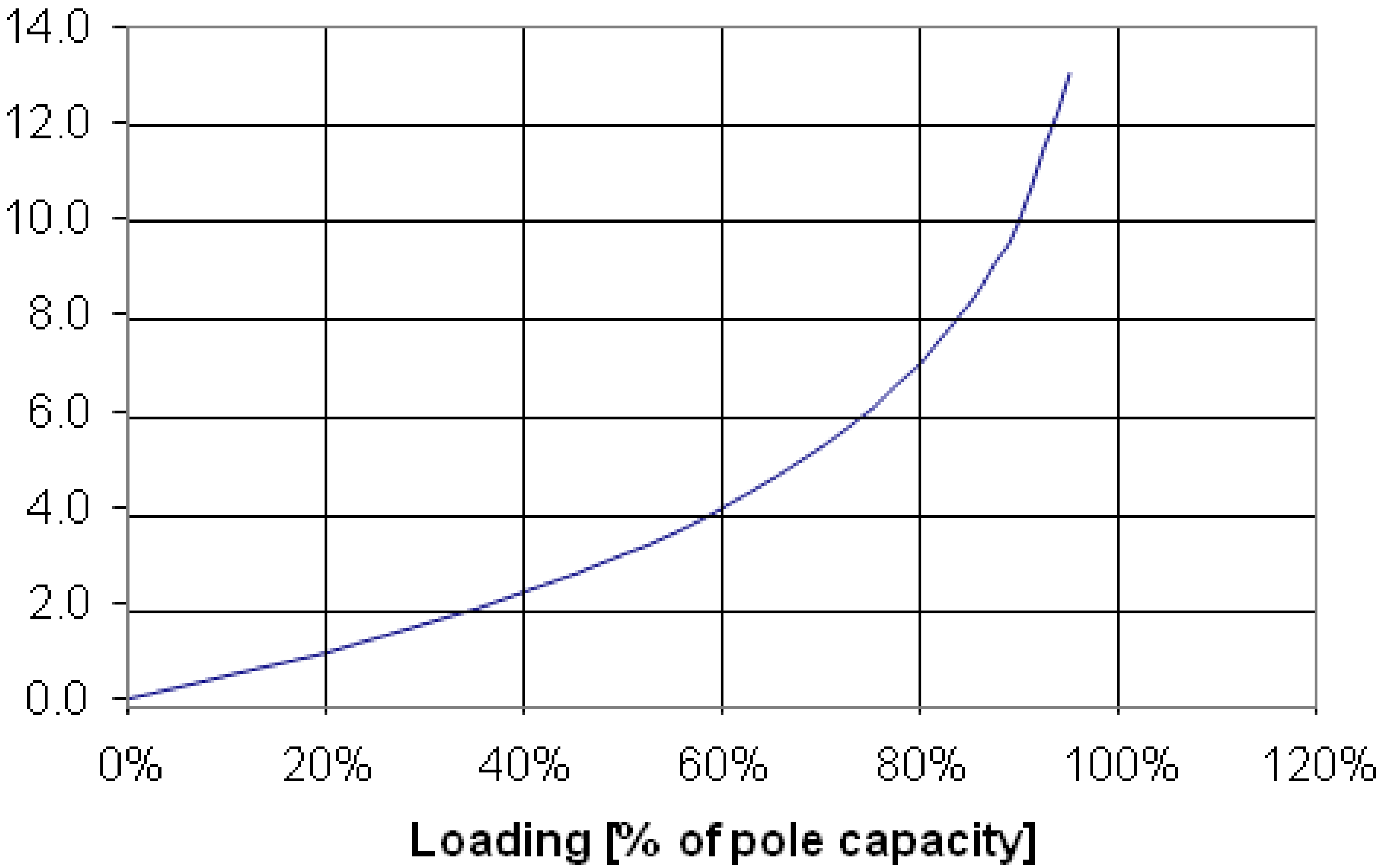
Uplink and Downlink

the coverage of a WCDMA network cannot be planned independently of the load on the network. The load on the network will impact the coverage in mainly two different ways, depending on which link (Uplink or Downlink) is considered. On the uplink, as more users are added to the network, higher noise would be detected at the node Bs. This increase in noise, called rise over thermal, requires each of the phones or data cards (UE) to increase its transmit power to overcome this noise increase: effectively the uplink coverage is reduced by this required increase in transmit power.

Pole capacity and coverage

This effect has been documented and can be summarized by the rise- over-thermal versus load curve illustrated in Figure 2: as an example, when the load is 50% of the pole capacity, the coverage is reduced by a factor of 3 dB. On the downlink, the breathing effect cannot be quantified so easily as coverage is impacted by the maximum transmit power assigned to traffic channels and the current load on the network rather than by a quantifiable formula.

Fig 2. Impact of uplink loading on coverage express by the Rise-Over- Thermal versus Interference Margin



CPICH & RSCP

- **In any case, predicting coverage is easier, in the early stage of network planning by considering only the pilot channel (CPICH). Once that necessary step is completed, the coverage should be further verified for both links (downlink from Node B to UE and Uplink from UE to Node B) and for all services.**
- **For the downlink, CPICH coverage should be verified by considering not only if the received signal code power (RSCP) of the pilot channel (CPICH) is sufficient once all the margins are included, but also by estimating the level of interference generated by the other cells. Such interference is typically quantified by the energy per chip to total received power (Ec/No) of the CPICH.**

CPICH & RSCP

Such quantity effectively estimated how much of the received signal can be used at a given location, or put it in other word, how clean is the signal received. The relation between RSPC and Ec/No is mainly impacted by the loading of the system and the quality of the network plan. This is illustrated in **Figure 3** showing the high range of Ec/No for a given RSCP value. It should be noted that the quality of the network plan would be reflected by the number of cells detected at a given location, or to word it differently, the cell overlap: a high quality network plan would be one where a single cell is detected over the majority of the cell area and transition between cells are done over clear boundaries.

Cell loading & network plan quality

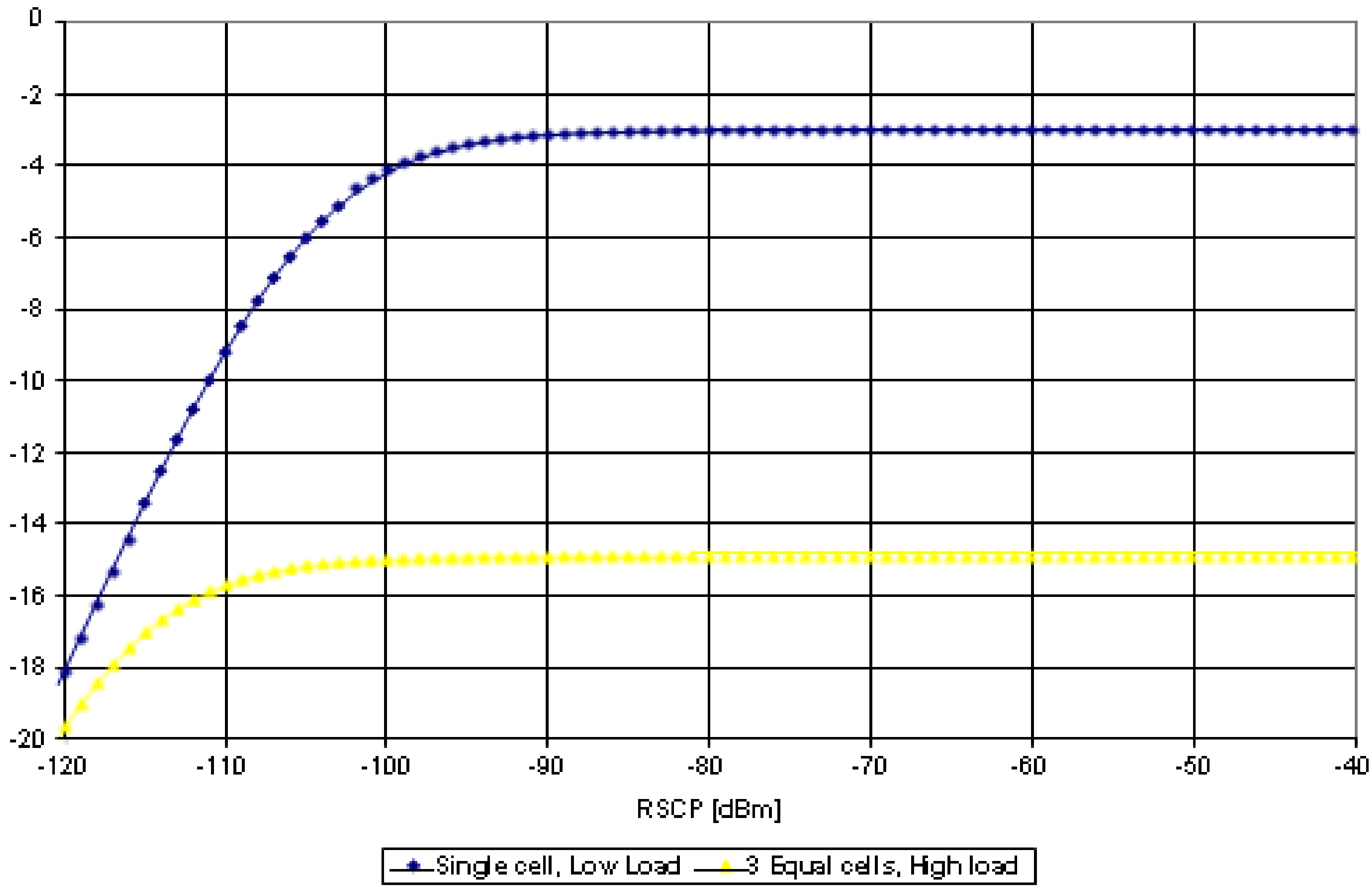


Figure 3: Relation between Ec/No and RSCP for different cell loading and different network plan quality

Ec/No degrades but the RSCP

When the loading of the system increases the Ec/No degrades but the RSCP stays constant. Degrading Ec/No is an indication of increased other cell interference which will also increase the need for downlink traffic power (DPCH Ec/Ior, when expressed in relative terms). Power being a limited resource, the higher required transmit power may not be available, thus the coverage not being met in loaded condition: this represent the coverage and capacity trade-off for the downlink in a WCDMA systems.

RSSI Consideration

In a similar way, adding sites to provide deeper coverage indoor without controlling the footprint of each of them will increase other cells interference and impact service quality and capacity of the system.

RSSI Consideration

It should be noted that the total received signal power (Received Signal Strength Indicator – RSSI) is never considered in a WCDMA system as an indication of coverage. It is mainly due to the inability to estimate the quality by this value: 10 weak cells would result in a strong RSSI, but the lack of any dominant server..

Dominant Server

would yield poor system performance. This concept is sometime called pilot pollution, where multiple servers contribute to a high RSSI, but where the signal cannot be used due to lack of strong dominant server.

- To ensure that these issues will be minimized, several simple steps can be taken as illustrated and detailed below.

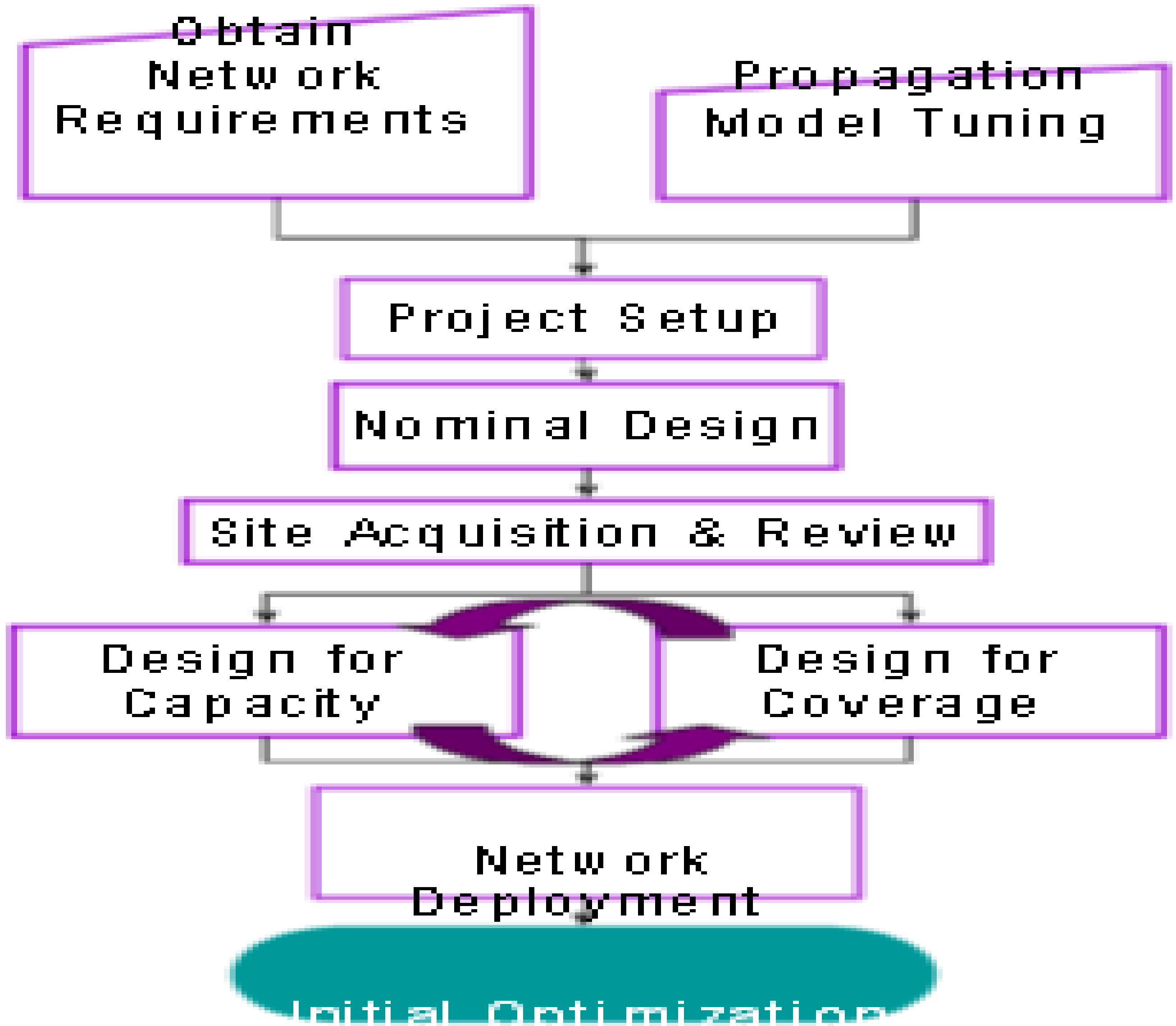
Simple steps

- Defining the network requirements (coverage area, coverage depth, expected traffic, traffic models.) is necessary to dimension the network both for coverage and capacity.
- Defining the number of site required for a given coverage depth: the site configuration, antenna height and downtilt notably, should be selected as a function of this number of site. Without selecting the site configuration relative to the site-to-site distance, the risk is to have either insufficient coverage or excessive downlink interference. Unlike in GSM network planning where sub-optimal site configuration can be compensate with frequency planning, the 1/1 frequency re-use of WCDMA does not allow such flexibility

Challenges

- Defining up front the number of sites required for capacity over the next few years: this number should be compare to the number of site for coverage to ensure that coverage, short term, and long term capacity needs are met.
- For capacity limited design, the site configuration should match the higher site count. For capacity limited design, the decision between adding sites and adding carrier should consider the possible site configurations. In particular, adding sites with limited flexibility on the antenna configuration may not always add capacity: if the added sites increase the downlink interference, the capacity of each of the sites will decrease.

See the flow chart Figure 4 below:

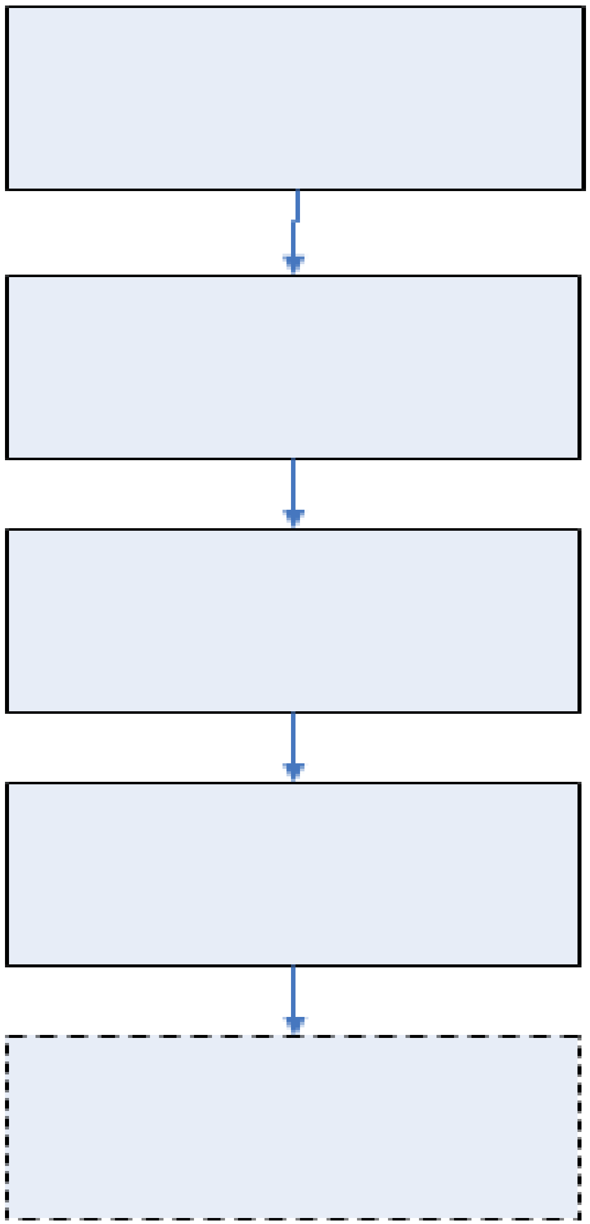


Step by step approach

- Network optimization can initially be seen as a very involving task as a large number of variable are available for tuning impacting different aspect of the network performance.
- To simplify this process a step by step approach is proposed in Figure 5. This approach divides the optimization in simpler steps, each step focusing on a limited set of parameters
- 1. RF optimization will focus mainly on RF configuration and in a lesser extend on reselection parameters.
- 2. Voice optimization will focus on improving the call setup (Mobile Originated and Mobile Terminated) and call reliability thus focusing mainly on access and handover parameters.

- 3. Advance services optimization will rely extensively on the effort conducted for voice. The initial part of the call setup are similar for all type of services and vendor have not at this point defined different set of handover parameters for different services. Consequently, optimizing these services will focus on a limited set of parameters, typically power assignment, quality target, and Radio Link Control (RLC) parameters.
- 4. Inter-system (also known as inter-RAT) change (both reselection and handover) optimization is considered once the WCDMA layer is fully optimized. This approach will ensure that inter-system parameters are set corresponding to finalize boundaries rather than set to alleviate temporary issues due to sub-optimal optimization.

Fig 5: Optimization process is simplified by isolating basics steps. Only a limited set of variable is considered at each step.



Ensure system ready for optimization

Focus on RF coverage (RSCP and Ec/Io) and RF configuration.
Limited system parameters optimization: PSC assignment, monitor list, reselection parameters

Focus on Voice performance: Access (call origination and termination) and retention probability.
System parameter tuning: access parameters, handover parameters
Limited tuning of RF configuration

Focus on quality and retention performance of different services
Further system parameter tuning: RLC (PS domain) and service specific parameters
Limited tuning of access, handover parameters and RF configuration

Focus on improving the retention during inter-system change.
WCDMA and GSM system parameter tuning: Inter-system reselection and handover parameters.
Limited tuning of intra-frequency parameters

Even after careful RF planning, the first step of optimization should concentrate on RF. This is necessary as RF propagation is affected by so many factors (e.g., buildings, terrain, vegetation…) that propagation models are never fully accurate. RF optimization thus takes into account any difference between predicted and actual coverage, both in terms of received signal (RSCP) and quality of the received signal (Ec/No). In addition, the same qualitative metrics defined for planning should be considered: cell overlap, cell transition, and coverage containment of each cell. At the same time, assuming that a UE is used to measure the RF condition in parallel with a pilot scanner, reselection parameters can be estimated considering the dynamics introduced by the mobility testing:

during network planning dynamics cannot be considered, as network planning tools are static by nature, only simulating at one given location at a time, irrespectively of the surrounding. In addition, once the RF conditions are known, dynamic simulation can be used to estimate the handover parameters, even before placing any calls on the network.

Field issues observed in UMTS Network

Field issues observed in UMTS Network

- 1. Battery Drain Problem when User toggling in 2G GSM N/W to 3G WCDMA N/W
- 2. Issue related with Antenna.
- 3. Roaming issues
- 4. Issue related with number of E1s required to connect 3G Node B to RNC

Battery drain problem in mobile sets

BSNL Connecting India

- <u>ISSUE-01</u>
- Battery Drain Problem when User of 2G GSM SIM with 3G Tri-band handset go to 3G WCDMA N/W
- It observed that when 2G GSM SIM card user containing the 3G Tri band Handset (i.e. GSM 900/1800 & UMTS 2.1 GHz) is in 3G network then his mobile try to /search the 3 G UMTS frequency band. But user is not able to connect the 3G n/w as his SIM card is only 2G GSM. But, the above process will lead to a fast drain of the Battery of MS. The battery Drain problem is generally not observed when 3G USIM user toggle 2G to 3G N/W or vice versa

Battery drain problem in mobile sets

- Remedy
- This problem can be overcome by user itself as the 2G SIM card user can choose the option as preferred N/W is GSM only. But, It is also observed that when creating the 3G user then preference in O& M parameter for user is given as 3G network, when both 3G & 2G networks are available.

Tri-band Antenna

- ISSUE-02
- Vendors have supplied the tri band Antenna (Frequency Band-GSM 900/1800 & WCDMA 2.1 GHz).It means same antenna can be be used for GSM N/W as well as 3G N/W, which leads to reduce the maintenance and operation cost for BSNL. But, unfortunately when using the same antenna for GSM & WCDMA ,it is observed that there is coverage problem, arising due to GSM & 3G N/W. This problem arises because of ,coverage area for GSM BTS is more than coverage area of 3G Node B Secondly, due to different coverage area of Base station different height of Antennas as well as, tilt (Horizontal/Vertical) is required for two different technology. The above factor is forcing to use different Antenna for GSM BTS & for 3G Node B.

Tri-band Antenna

- Remedy
- Presently use the different Antenna for GSM BTS & for 3G Node B.

Co-located 2G and Node-B

- <u>ISSUE-03</u>**:** COLOCATION OF 2G AND 3G BTSs
- 2G and 3G BTSs are of Ericsson
- 2G BTS is of Nortel and 3G BTS is of Ericsson make.
- Both 2G and 3G BTSs are of Ericsson

There is no problem of handover from 2G to 3G and vice versa. 3G (Ericsson) to 2G (Nortel) the handover is not smooth. The 3G user going to 2G is not getting GPRS & EDGE. There is separate APN (access point name)for GPRS N/W and 3G N/W.GPRS N/W has separate Four APN in BSNL network.3G N/W has separate APNs. Issues shorted out with APN's uniformity.

Co-located 2G and Node-B

- Remedy: 3G (Ericsson) to 2G (Nortel) ; the clutter wise solution to be worked out. All Nortel BSCs to be parented to same Ericsson MGW.
- ISSUE-04
- Why min 3 E1 required to connect 3G Node B to RNC
- This is because that we are using the IMA (Inverse Multiplexing for ATM) technique to transfer the data from Node B to RNC In this technique we are making the IMA Group, which required the min 3 E1 links.

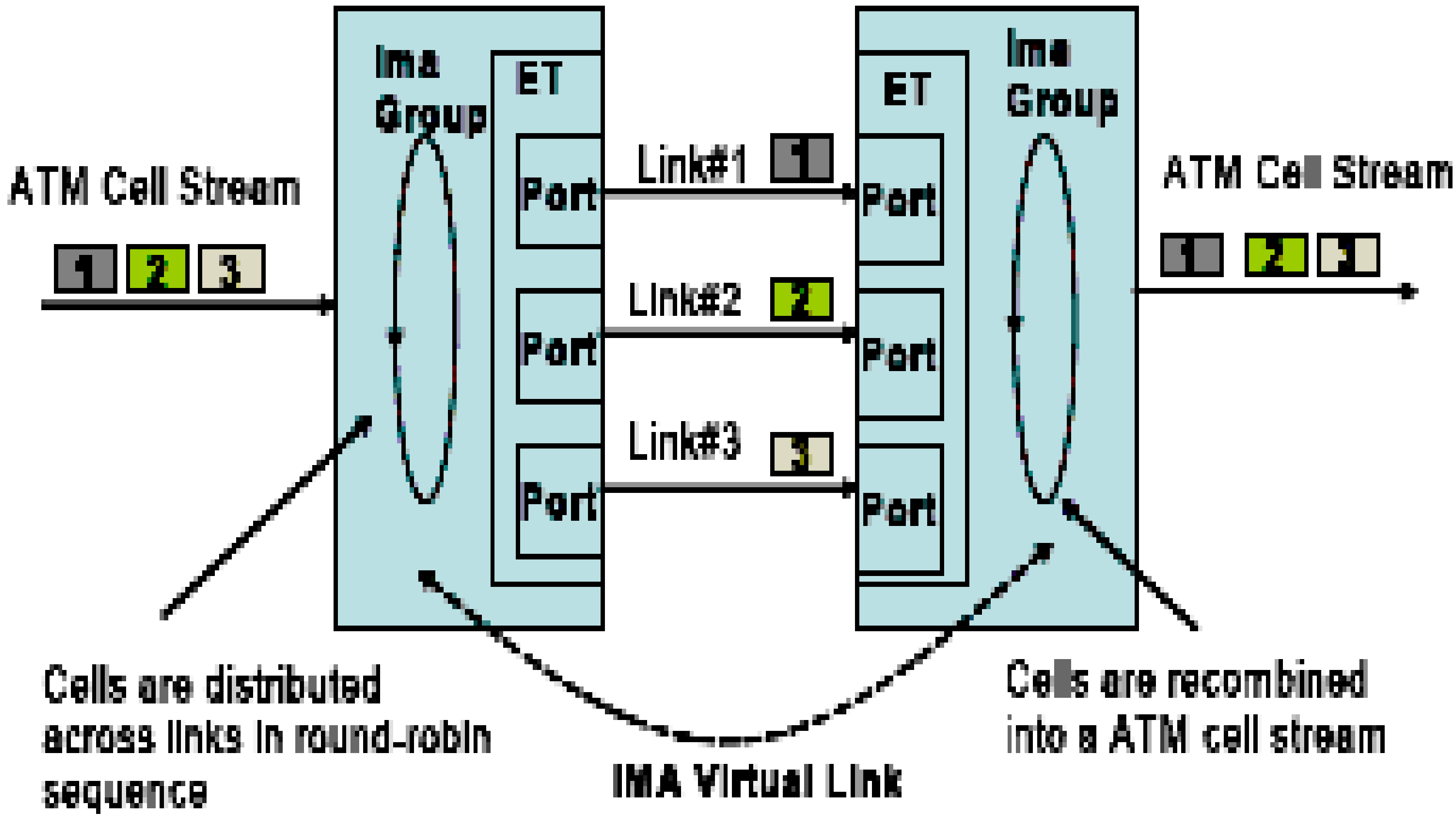
What is IMA ?

The advantage of above technique is that if any one E1 out of 3E1 get faulty then traffic of faulty E1 can automatically diverted to other two E1,with condition that other two E1 are under utilized. IMA for ATM is used when there is a need for more than one physical link between two nodes. With IMA it is possible to distribute the traffic over all links configured for the interface in order to create n+1 redundancy. This means that if one link fails the traffic of that link will be lost, but the traffic on the other links will be undisturbed. If the capacity is left on the remaining links new calls are set up using these. It is a configuration issue to over provision for high network quality or to save on transmission cost and degrade the traffic capacity at network failure.

IMA

Inverse Multiplexing for ATM (IMA) makes it possible to transmit large-bandwidth ATM cell stream over a number of low-bandwidth. Physical links and to retrieve the original stream at far-end. The multiplexing of the ATM cell stream is performed on a cell-by-cell basis across the multiple physical links. The IMA technique involves inverse multiplexing and demultiplexing of ATM cells in a cyclical fashion among links grouped to form a logical link with higher bandwidth, where the rate is approximately the sum of the link rates. This is referred to as an IMA Group. Figure below shows the principle of IMA Group inverse multiplexing and de-multiplexing of ATM cells in one direction. The same principle is applied in the opposite direction.

Fig : Inverse Multiplexing and de-multiplexing of ATM cells via IMA Groups



IMA

The IMA Group terminates at each end of the IMA virtual link. In the transmit direction, the ATM cell stream received from the ATM layer is distributed on a cell-by-cell basis, across the multiple links within the IMA Group. At the far-end, the receiving IMA unit recombines the cells from each link, on a cell-by-cell basis, recreating the original ATM cell stream. The aggregate cell stream is then passed to the ATM layer. Inversed multiplexing for ATM (IMA) is supported by ET-MC41 and ET-MC1 boards (in Ericsson technology) present in the node. The maximum size of one IMA group is 8 E1 interfaces. Up to 30 IMA groups can be defined for one STM-1. The exact number of groups depends on the group configuration. An example scenario about the utilization of IMA is to use it between M-MGw nodes where a pair of Synchronous Transfer Mode (STM)-1 links gives far too high bandwidth. Instead of STM-1 links, few E1 links (for example six) would be sufficient to provide enough bandwidth for the traffic. Now E1 links are grouped together to form an IMA virtual link with higher bandwidth instead of separate E1 links.

IMA

- The main benefits of the IMA are:

1.Simplification of the ATM O&M procedures (single ATM VP/VC instead of several separate ones).

2. Higher trunking level and statistical multiplexing gain

3.Redundancy and robustness

4.To achieve ATM layer failure protection, the IMA Group physical capacity should be configured larger than the sum of capacity of all VCs.


Thank You!