Driving more ROI out of your existing backhaul network

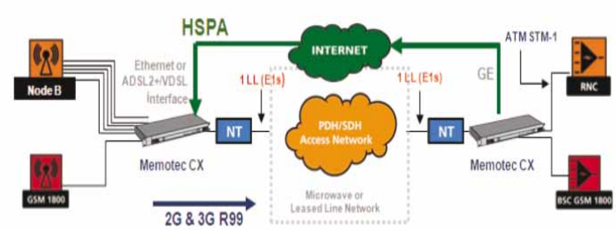
With the continuing proliferation of premium 3G mobile services such as mobile TV, video and high speed Internet, mobile operators are intensely scrutinizing their transport network infrastructure, particularly the Radio Access Network (RAN), as it has a key role in the cost-effective and efficient delivery of these services. Memotec explain.

Current RAN deployments are typically based on T1/E1 leased lines, microwave or fibre at the physical layer, with TDM/PDH as the transmission technique. While these solutions have easily managed traffic throughput requirements to date, the rapid growth of 3G high speed services – driven by the deployment of HSxPA- is stressing these infrastructures, propelling lease line requirements from one E1 per base transceiver station (BTS) for basic 2G voice services, to two E1s per BTS for 2.5G [EDGE] services, up to four E1s and more per BTS/Node B for 3G services. And it may not stop there — new technologies such as Long Term Evolution (LTE) are just around the corner which will require even more E1s per BTS! Unfortunately, E1s do not scale very well, and most deployed Radio Access Network [RAN] architectures have only been designed to support an average of four E1 per BTS, after which performance and management issues arise making it difficult to add E1 in a simple way.

Mobile operators may have to thoroughly analyze their end-to-end transport network infrastructure before they can even begin to address the E1 capacity problem. Overall RAN transmission costs already represent up to 70 percent of OPEX budgets, and therefore every effort must be made to maximize their current investments and even reduce expenditures. Within this context, one way to acquire more capacity is to upgrade the transport infrastructure to fibre. Although that would undoubtedly address the capacity constraint issue, laying fibre is a long process which is also capital intensive and might even be overkill for servicing remote and rural areas, especially considering the additional revenue loss incurred while the fibre is being deployed and turned-up.

Another solution to increase capacity is to deploy an Ethernet/IP-based RAN. Ethernet is widely considered an inexpensive and cost/bandwidth efficient alternative to E1 leased lines. It is suitable for broadband data services such as HSPA and EDGE, and will very likely be the transport technology of choice for the future. Technically, however, ATM is more efficient for voice traffic, while Ethernet is better for data. Therefore, it is reasonable to expect that TDM/ATM and Ethernet will continue to co-exist for some time. Pragmatically, this means broadband services can be deployed in a phased approach where time-sensitive voice traffic would continue to be carried over E1s, while data traffic will be offloaded over a cheaper Ethernet network. Over time, the Ethernet portion of the network will acquire the carrier-grade Quality of Service (QoS) characteristics necessary to port over the voice services from the E1 network and realize the full efficiencies possible with Ethernet.

New hybrid Ethernet/TDM radios and xDSL-based Metro Ethernet services enable such evolution. However, more often than not, moving to Hybrid Ethernet radios will require a [costly] forklift upgrade of the entire backhaul network, and will still face bandwidth capacity limitations due to limited radio spectrum availability. And Metro Ethernet services are far from being available everywhere, in particular at cell site locations outside urban areas, or in developing countries.



Use of alternative lower cost/bit transmission facility, Full IP-RAN Migration

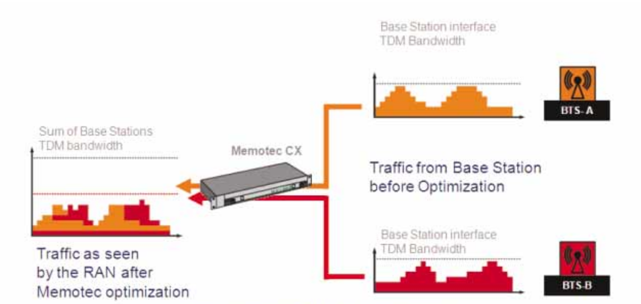
Although growing fast, IP/Ethernet RAN deployments are today de facto very limited, particularly in those developing countries or in remote/rural regions of the world. Mobile operators servicing these areas have had limited exposure to IP and are questioning the associated technology risks and the upgrade costs. It may take several years before IP/Ethernet RANs are effectively deployed and begin to address E1 shortfalls. Consequently, any short- to medium-term solution to increase bandwidth must be strategic in maximizing current investments, and pragmatic in realizing that infrastructure upgrades will not be deployed overnight.

Bandwidth optimization and compression solutions - an approach to adding capacity

Today's advanced bandwidth optimization and compression techniques reduce the amount of bandwidth needed to support mobile 2G and 3G [R99] cellular voice & data legacy services. In addition to lowering OPEX and maintaining CAPEX under control, reducing for example the amount of bandwidth needed to support 2G services liberates capacity to support either more 2G services [Voice, EDGE] or introduce new premium 3G/HSPA high speed services with the same equipment.

Optimization and compression solutions can be deployed at cell site [BTS, NodeB], at hub/aggregation points in the RAN, at Base Station Controllers (BSC), Radio Network Controller (RNC), and at Mobile Switching Centers (MSC) levels. They are based on three main techniques:

- **Convert all traffic to a common packet layer.** All traffic (GSM 2G, 2.5G, 3G, CDMA) is aggregated into traffic packets, and then statistically multiplexed. The resulting transport network layer is then simplified providing substantial OAM cost savings. In addition, transmission resources are then mutualized between the different cellular technologies [GSM, UMTS, CDMA, WiMAX]: no dedicated and wasting of resources allocated to each different base stations. The transmission network is then seen as one single-managed shared big pipe, allowing efficient statistical multiplexing [bandwidth re-use] between the different services and wireless access technologies, maximizing transmission resources usage. The transport physical layer itself is technology agnostic (TDM, ATM, IP, Ethernet, Optical).

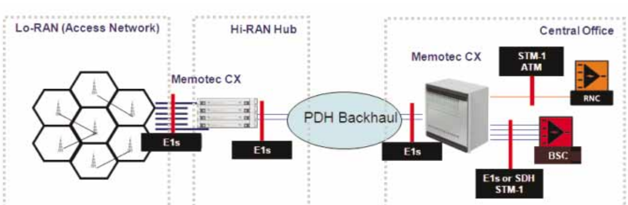


Base Station Traffic Aggregation

- **Reduce bandwidth payload.** Deep packet inspection is carried out, and compression is performed to reduce size of payload. The overhead on mobile protocol layers is reduced and unused capacity (such as idle channels) is suppressed. Drop & insert mechanisms take the effective channels used on a BTS E1 interface, drop the unused channels, and then map the channels onto the E1 network link.
- **Interface adaptation.** In the access domain, interfaces are very often vendor dependent, requiring transparent processing. Throughout all operations, service integrity and QoS must be maintained. Additional OAM must be minimal, and all optimization and compression equipment must be essentially transparent when introduced in the network.

The results derived from these optimization and compression techniques can be impressive. Substantial OPEX savings can be gained and proportional revenue can be generated with for example up to a 3:1 bandwidth reduction rate on GSM Abis interfaces (from BTS to BSC) and up to 16:1 on DCME voice trunks (from MSC to MSC, BSC to MSC and to PSTN).

These OPEX savings from optimization and compression solutions are effective for leased lines and microwave links, either for cell site, at RAN hub site, or backbone optimization. At RAN hub sites, an optimization and compression solution is applied to avoid costly forklift upgrades from PDH to SDH microwave links. The solution can be further enhanced with 3G traffic ATM grooming capabilities, thereby generating substantial savings by removing the costs associated with purchasing and managing a separate, standalone [ATM] grooming and protocol adaptation device. In this case, the RAN optimization solution will connect directly to the RNC over the core transmission network using STM-1 TDM or ATM interface or GE IP/MPLS interface.



ATM Switching + Abis Payload Optimization

RAN Hub Aggregation

For backbone, optimization and compression solutions extend the capacity of microwave SDH rings, enabling support for 3G and HSPA services and providing additional capacity for 3G and 2G traffic growth. This can be beneficial to operators with limited STM-1 ring bandwidth capacity due to spectrum allocation restrictions. Optimization and compression solutions allow existing STM-1 rings to handle more traffic, providing operators with the ability to generate additional revenue from the existing infrastructure.

Improve voice quality without brute-force bandwidth provisioning

In many regions, voice traffic is still expensive to carry. Although voice transmission costs are decreasing with the introduction of network entities such as 2G-3G media gateways which offer some level of voice compression [usually a 4 to 6 bandwidth saving ratio], operators are still challenged to deliver consistent OPEX reductions even while traffic continues to grow. However, in practice, operators often deploy voice trunks that are sub-optimized. Recent technology advances have resulted in sophisticated codec (compression/decompression) solutions that deliver high quality voice with improved bandwidth efficiency.

Other vendor-proprietary techniques reduce the number of compression/decompression cycles, and smart algorithms provide management tools to handle voice congestion situations. When combined with optimization and compression solutions, these techniques allow substantial improvement in bandwidth utilization, including in networks where media gateways are deployed. The result is less OPEX and improved profitability (without procuring additional bandwidth capacity) on what still constitutes the core revenue of most mobile operators — voice traffic.

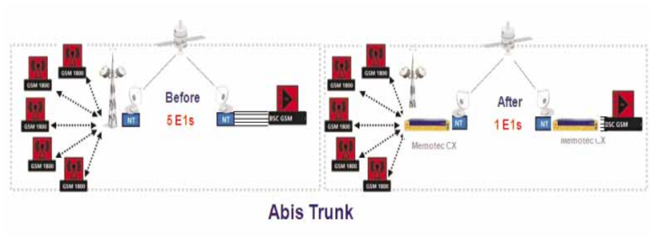
Instantly extend reach

There are still hundreds of millions of potential subscribers in underserved rural/tier 3 regions. However, several aspects make it difficult to provide affordable coverage to these regions. In isolated areas, the cost of deploying microwave links becomes substantially inflated. Long-haul link costs (CAPEX/OPEX) increase by a factor 3 or 4; daisy-chaining of mobile infrastructure sites is limited by the PDH microwave capacity; and radio range limitations force operators to deploy additional radio capacity and costly dedicated E1 backhaul lines to cover the entire subscriber area. This extra capacity will not be fully used in practice, but the RAN must still be configured accordingly, making the business case even less attractive. There are also simple geographic issues such as the curve line of the earth and hilly landscapes which limit microwave reach to 20 miles or less (line of sight), requiring more stations to provide decent cellular coverage.

In these areas where service reach is challenged, satellite based solutions, known as Very Small Aperture Terminals (VSAT), enable instant cellular coverage for large, previously under-served remote regions, while offering operators a solution that drastically reduces the inefficiencies and costs of dedicated digital T1/E1 backhaul lines. VSAT solutions offer reliable connectivity that is applicable to GSM cellular coverage and DCME voice trunking, for traffic backhaul or disaster recovery.

An intelligent optimization and compression solution and a satellite modem solution that have been precisely engineered to work together can considerably reduce bandwidth requirements and improve performance, allowing operators to ensure bandwidth is accurately aligned with subscriber growth. This can represent a tremen-

dous advantage in operating costs, deployment flexibility and return on investment. In most cases, the ROI is a matter of weeks!



In addition, such external backhaul optimization solution can be deployed selectively, only where and when it is really needed, grooming multiple cell sites for example and not at every single cell site location.

Getting the most from your bandwidth

A Mobile operator in Africa, currently servicing over 2.5M subscribers, wanted to increase his service area for 2G voice and begin offering premium-priced 3G services. The deployment plan required 172 3G Node B for an extra 221 E1 leased lines, bringing the total number to 400 E1.

The operator was already leasing four STM-1 rings to support the existing GSM network at $34k/month each, and was faced with two upgrade options in order to provide short term additional capacity: either lease four additional STM-1 rings that would run an additional $136k/month, or find a way of optimizing the existing GSM network capacity in order to support the additional bandwidth requirements of the new 3G services.

The operator implemented an optimization and compression solution at each cell site on the 2G GSM BTS and 3G Node Bs, at the BSC and RNC levels. The solution more than doubled the traffic capacity of the network, allowing the operator to service an additional number of 2G subscribers and 3G subscribers without procuring any additional capacity.

The bandwidth efficiency gains generated by the solution reduced overall E1 requirements from 400 to 172, freeing an equivalent of 228 E1s from the existing capacity — a saving of US$5 million on OPEX over three years. The savings realized from reduced spending on bandwidth alone was enough to cover the costs of the 3G service roll-out.

In addition, had the operator chosen to wait until the fibre installation be completed in order to provide the additional capacity instead, the long deployment cycle would have resulted in revenue losses— $20 million/year loss for example for each block of additional 100,000 2G subscribers @$200 ARPU/year, and additional $20 million/year loss from each block of 50,000 3G subscribers @ $400 ARPU/year.

Conclusion

Optimization and compression solutions extract additional capacity from existing networks without any forklift upgrades, extending the lifespan of network assets and therefore capital investments. Operators can control OPEX budgets while simultaneously building market-share by cost-effectively supporting subscribers in remote/rural regions, immediately opening up new, premium-service revenue streams.