Wireless Backhaul Optimization:
A Market Waiting to Happen

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Wireless Backhaul Optimization: A Market Waiting to Happen

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Agenda

- Wireless market overview
- Evolving backhaul requirements
- Service provider business model evolution
- Impact of wireless backhaul on service provider OPEX
- Technology solutions for improving wireless backhaul efficiencies
- Conclusions and recommendations
2.5G/3G Migration: Technology Driven Acronym Chowder

Throughput estimates based on February 2004 commercial service offerings by U.S. carriers and confirmed by the Yankee Group as follows:

- Sprint PCS claims 50-70 kbps average with peak speeds up to 144 kbps for CDMA2000 1X;
- Verizon Wireless claims 40-60 kbps with bursts up to 144 kbps for CDMA2000 1X;
- AT&T Wireless claims 25-40 kbps average for GPRS and 100-130 kbps for EDGE (bursts up to 200).
Implications of Technology Evolution on Wireless Backhaul Requirements

- Wireless networks are becoming increasingly complex
  - GSM/EDGE overlaid with WCDMA
  - TDMA overlaid with GSM/EDGE
  - TDMA overlaid with CDMA2000
  - GSM overlaid with CDMA2000 (e.g. China Unicom)

- Wireless network capacity requirements are increasing

- Networks are becoming increasingly extensive to include macro, micro and pico-cells
Service Provider Business Evolution — Mature Markets

- Service providers have focused on rapid deployment and CAPEX minimization, with insufficient regard for OPEX
  - Transmission network design and optimization has been neglected
  - Minimization of CAPEX has resulted in inefficient designs from an OPEX perspective
- Service providers in mature markets are becoming increasingly focused on OPEX
- For network overlays (e.g. WCDMA) OPEX management becomes more challenging
  - Service providers are paying a great deal of attention to the design and optimization of their transmission networks

Significant opportunities in mature markets for advanced transmission solutions
Service Provider Operational Expenditures Create Opportunities for Backhaul

Total OPEX

- Technical Operations: 43%
- Customer Care: 34%
- Field Maintenance and Product Support: 7%
- Site Rental: 29%
- Transmission: 15%
- Utilities: 13%
- Marketing Sales and Admin: 6%
- Other: 3%
Leased Line versus Microwave Transmission

- Some operators use microwave transmission to reduce leased line expenses
- Microwave typically used by pure-play mobile operators in Europe
- Microwave rarely used in North America
  - 10-15 percent of all transmission
  - Consequence of tradition and focus towards lower CAPEX
  - Difficult to transition because of existing lease obligations
- Microwave used more extensively in emerging markets
  - Limited availability of robust landline infrastructure
  - Leases are often particularly expensive
Wireless Service Provider Business Analysis — Emerging Markets

- Greater focus towards minimizing both CAPEX and OPEX
- Benefit of green field (or near green-field) implementations
- Significant subscriber growth and deployment occurring
- Challenged by lack of supporting infrastructure (e.g. terrestrial transmission)
- Less “tradition” and greater receptivity to alternative network architectures

Emerging Markets represent a significant opportunity for advanced transmission solutions
Technology Solutions for Optimizing Transmission

- Independent transmission
  - GSM
  - UMTS
- Grooming
  - GSM
  - UMTS
  - Consolidated transmission
- Grooming
- Packetization
  - GSM
  - UMTS
  - Optimized transmission
Business Case for Backhaul

- Average monthly price per T1/E1 is $500 in US, EUR600 in Europe
- Average cell site has between 1 and 2 T1/E1s
- Upgrades such as EDGE and WCDMA create demand additional T1/E1s
- Operators planning a network overlay (EDGE or WCDMA) can expect more than 30 percent savings in backhaul costs

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<thead>
<tr>
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<th>Before Optimization</th>
<th>After Optimization</th>
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<tbody>
<tr>
<td>Number of sites</td>
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<td>Average T1/E1 per site</td>
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<td>1.925</td>
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<td>(with overlay)</td>
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<td>Monthly lease cost per T1</td>
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<td>Annual Lease Costs ($)</td>
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<td>Optimization ($ million)</td>
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Conclusions and Recommendations

- Wireless service providers business models are changing
- Network efficiency as opposed to speed of deployment becoming increasingly important
- Transmission networks in need of optimization solutions to reduce operational costs
- Service providers are retrofitting grooming and packetization solutions to optimize their transmission networks
- Expect more than 30 percent savings in transmission costs when optimization used for GSM/EDGE overlaid networks
Mobile Operator Considerations for Backhaul Deployment: Experience in Backhaul Opex Reduction

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Backhaul Opex Reduction

DRC Experience with NMS AccessGate application

- Celtel Network:
  - Currently 4 MSC’s, 5 BSC’s and 168 BTS sites
  - Celtel are owner of fixed backhaul MW network.
  - Completely Ericsson NSS and BSS network.
  - Currently using 24 VSAT links for remote BTS installations over a vast geographic area.
- Initial trial on one VSAT link
  - Expanded to two more.
  - Experiencing up to 50% reduction on capacity required over VSAT.
Backhaul Opex Reduction

Operational Experience

- Only in service for a few months.
- No degradation of speech quality experienced
- GSM Fax and Data fully functional over the link.
- Easy to set up and Operate.
- Stable and reliable.
- Currently in process of expanding to another 7 links
- Expecting a total of $250 000 per month on VSAT costs.
- Considering application over Microwave links.
Backhaul Opex Reduction

Application Example

- E1 cable
- Ethernet cable

3 E1 links (2 carry A.bis traffic)
1 E1 link (backhaul)

Butembo Nord RBS
Cell side AccessGate
Satellite modem
Satellite modem
MSO side AccessGate

1 E1 link (backhaul)

3 E1 links (2 carry A.bis traffic)

BSC
IP LAN

OAM Workstation with AccessView

Application Example
Ericsson Expander solutions
What if the most cost-efficient alternative available comes at a price of 10,000 € per E1 per month?

What can be done?
Call routing of a PLMN-PSTN call:
Via the BSC and MSC
- 16 kbps on the PCM
- Circuit-switched Abis
- Transmission TS allocated to every Basic Channel in TRU
- Std: 10 TRU per E1 or 8 TRU per T1
- LAPD-C: +20–30% capacity/Abis
- LAPD-M: +30–50% capacity/Abis
The Layered Network Architecture !!

- Each layer can grow independently
- Control
  - Centralized location of servers reduces O&M cost
  - Independent of transport technology
- Connectivity
  - Same transport for all services
  - Free choice of transmission technology
  - Distributed MGws enables transmission savings
  - Enables transport of coded voice
  - Pooled media stream resources
Other Transmission-Saving Functionality

1) Bandwidth optimization
   - Silent call suppression, 30–50% savings on CS
   - Flexible Abis, up to 30% savings on packet switched
   - AMR subrate switching, 50% savings on CS

2) IP Abis
   - 30–50% lower cost per Mb over Abis (xDSL, Ethernet vs. E1/T1)
   - Bandwidth optimization possible on top of this

3) Local switching
   - Additional 20–50% savings on top of bandwidth optimization
The Silent Call Suppression Solutions

Saving:
- Discontinuous transmission
- Saving up to 50%

NW impact:
- HW: NMS AccessGate
- SW: BSS

One box handles 8 E1
AMR Subrate Switching

AMR subrate switching over Abis:
- Subs are ordered to AMR 7.15 kbps
  ⇒
- Two subs can be squeezed into every 16kb Abis TS
- Savings: +50% on Abis
- AMR mobiles needed
The IP Solution

Packet-Switched Abis
- Dimension transmission links based on peak traffic over link
- HW: IP switch card added
- SW: BSS
Thank You!

Expand anywhere.

Ericsson Expander Solutions. Network expansion has no limits.
Wireless Backhaul Technologies
Wireless Backhaul Today

GSM Network Characteristics

- Large number of geographically-dispersed cell sites
- One or more E1/T1s per cell site — inefficiently utilized
- New technology deployments require additional, separate, E1/T1 facilities
Early Backhaul Optimization

- TDM groomers save unused DS0s
  - Simple approach
  - No statistical multiplexing
  - No help for Abis inefficiencies
3G Backhaul — The Vision

- 2G & 3G traffic combined on ATM backhaul
  - Statistical multiplexing gain; may avoid stranded DS0s
  - No help with Abis inefficiencies; Adds ATM cell tax
  - Will be superceded by IP backhaul, eventually
### Typical GSM A.bis on E1

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- **16 kbps TRAU channels, occupied even during silence**
- **Unused DSOs**
- **Multiple lightly loaded signaling channels**
GSM 2G
Before Optimization

BTS
13 TRX

2 T1/E1s
A.bis

BTS
22 TRX

3 T1/E1s
A.bis

BSC
Central Office

MW/Fiber

5 T1/E1s
Total
Backhaul Optimizations

- Eliminate traffic from
  - Call inactivity
  - Voice silence periods
  - Other TRAU idle frames
  - GPRS & EDGE idle PCU frames
- Multiplex signaling channels
- Recover stranded timeslots (TDM grooming)
- Handle other cell site traffic
  - Location measurement unit
  - IP links for other remote third-party equipment
...With Optimization

**BTS**

- 13 TRX
- 2 T1/E1s A.bis

Eliminated

**BTS**

- 22 TRX
- 2 T1/E1s

- 3 T1/E1s A.bis

**Central Office**

- 2:1 Savings
- 3:2 Savings
Stringent Requirements

- **Radio vendor inter-op certification**
  - Vendor-specific interface issues are time consuming, but critical for successful deployment
- **Minimum added end-to-end latency**
  - 10 ms or more added delay has unacceptable impact on voice quality
- **Automatic payload analysis**
  - Critical to avoid manual provisioning of timeslot assignments
- **Minimum footprint**
  - Typically must fit within existing BTS cabinet
EDGE & Expansion...

- EDGE is introduced into the network
- Overall GSM traffic increase

**BTS 13 TRX**

**BTS 22 TRX**

**Central Office**

**BTS**

**Note:** The TRX numbers are calculated for T1s
UMTS Support

- Remove non-active cells from the ATM
- Pool/multiplex UMTS traffic over the common backhaul
  - Avoid inefficient ATM circuit emulation
  - More efficient than any ATM over fractional E1
Evolution to IP Backhaul

- 2G & 2.5G optimizations are still required

* ROP – RAN Optimized Protocol
** HC – IP Header Compression
Backhaul Optimization
Save Money — Support New Services

- Reduce operating expenses
  - Backhaul can be 30% of OpEx
- Provide new services and/or new capacity with limited or existing backhaul capacity
Wireless Backhaul Technologies

Q & A
For more information....

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THANK YOU!