

Nokia in Microwave Radios

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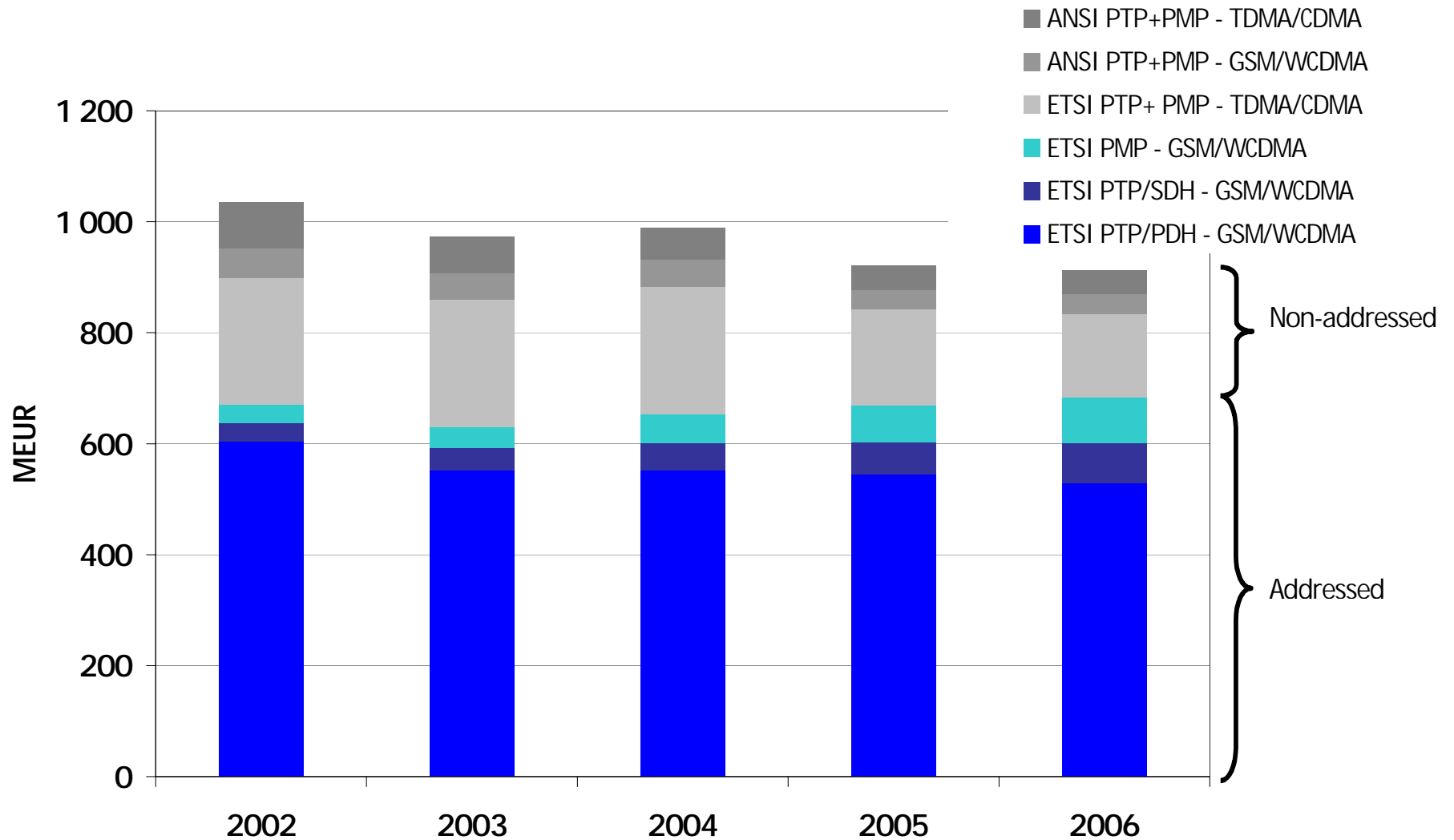




Nokia in MicroWave Radios

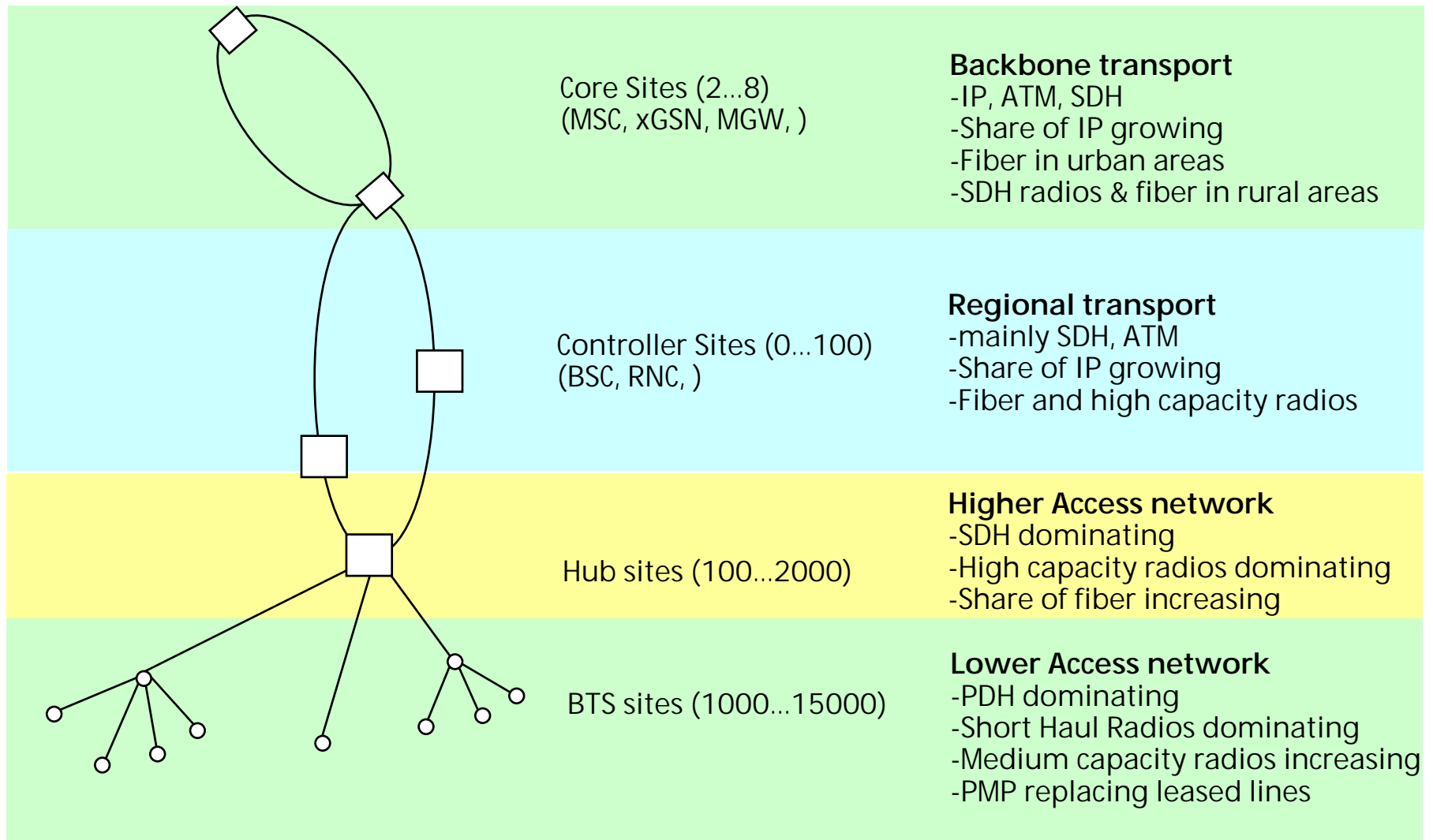
- Business operations started in 1960's
- Position as acknowledged party achieved via GSM challenger market growth in 1990's
- In year 2003 Nokia will produce 30.000+ PDH-radios
- In year 2003 we have achieved 30% yoy growth in volumes
- We regard ourselves
 - No. 2 in cellular transmission
 - Among 3 top players in global PDH-radio market
- R&D site in Karaportti Espoo, main technology partners EndWave (US), Teledyne (US), Filtronic (UK) and EADS (Germany)
- Production in Espoo Plant
- Portfoliopartners NERA (Norway) in SDH and HNS (US) in PmP

Total Cellular Transmission Market



Wireless Transmission Role in Cellular Backhaul

Typical medium size Operator network



Cellular Backhaul developments

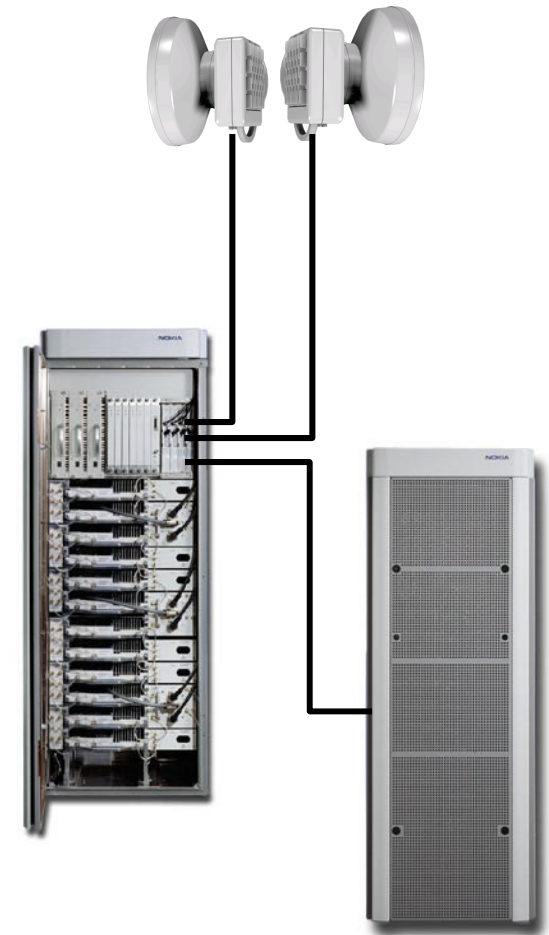
- 2G networks mostly built during 90´s in developed countries
=>high PDH radio demand and volumes
 - Design focus was in features, short development cycles and delivery capability
- Today heavy 2G networks rollouts in developing countries and some greenfield 3G builds in developed countries
 - Design focus in quality, cost efficiency and delivery capability
- Larger 3G rollouts starting 2004-2005 onwards from urban and dense urban areas
 - Design focus in better bandwidth efficiency, higher capacities, flexible platforms but still with low cost and high quality
- 3G rollouts to rural areas possibly later and network density increasing
 - Design focus moving to medium and high capacity IP capable transport networks

Cellular Transmission Technologies

- **Microwave radio** share of all Cellular backhaul has been approximately 60% => no big change by 2007 => share of radios slightly decreasing by 2012
- During 2002 **PMP** share of Wireless Cellular Backhaul was approximately 5% => 10% in 2007 => will be saturating after that to 10-15% level
- During 2002 **SDH** share of Wireless CT was appr. 5% => 12% in 2007 => share of high capacity links will further increase
- **Ultra Short Haul Radios** (<1km) share increasing due to lack of frequencies in dense networks => 58GHz share of CT increasing
- **FSO** share of CT is very small => <10% by 2012
- **Leased line** (fiber, copper) share increasing slightly
 - rental price erosion 10 – 13%/year
 - rental price heavily dependent on country, line capacity and distance
 - Competitive, when short distance, low capacity => dense urban => PMP & Ultra Short Haul radios will be competing here heavily

Design Perspective - Cost

- Price erosion will be high, up to 10%/year (Skylight Research expects 2-5% price erosion)
 - Pressure from operators business case, which is currently cost driven
 - Pressure from leased lines rental prices
- Radio Site first year cost structure approximately
 - 70% Microwave Radio & antennas, 6% installation cost, 10% spare parts, 14% Operating costs
 - Big cost savings possible also from other areas than direct product cost
- Dominating part in Microwave Radio cost is RF & Microwave section
 - Cost of GaAs needs to be lower than today
 - Higher MMIC volumes by generic commercially available chipsets => lower cost, improved quality
- Other factors contributing to Cellular base station site cost
 - Optimized delivery logistics, site planning, installation
 - Integrated transmission & cross connection nodes; less cabling
 - Base station integrated transmission nodes; less cabinet space



Design Perspective - Flexibility

- Flexible radio platforms further improves cost efficiency and delivery capability
 - Many common parts and late variation to create needed frequency variants
 - SW selectable features (capacity, modulation modes, power levels, other features) enables customers to optimize investment cost in network build.
 - New features and enhanced performance can be purchased later on need basis.

Design Perspective – Delivery capability & Quality

- Design for volume production principles are very important to apply
- Designed in quality and thorough reliability verification essential

Summary

- Wireless Transmission business in Cellular Backhaul will grow in coming years, but only moderately
- Price erosion will be high
- Short Haul PtP PDH radios are and will be dominant media for Cellular Backhaul
- Current SDH radiotechnology is too expensive, new innovative low cost high capacity radios has to be developed



References, Abbreviations

- References
 - Skylight Research analysis 2003
- Abbreviations
 - PDH Plesiochronous Digital Hierarchy
 - SDH Synchronous Digital Hierarchy
 - FSO Free Space Optics
 - IP Internet Protocol
 - ATM Asynchronous Transfer Mode
 - MSC Mobile Switch
 - MGW Multimedia GateWay
 - xGSN GPRS support nodes (Gateway, Serving, ...)
 - BSC Base Station Controller
 - RNC Radio Network Controller
 - BTS Base Station
 - 2G, 3G 2nd Generation, 3rd Generation
 - PtP Point to Point
 - PMP Point to MultiPoint
 - SW SoftWare
 - MMIC Microwave Monolithic Integrated Circuit
 - RF Radio Frequency
 - GaAs Gallium Arsenide
 - DWDM Dense Wavelength Division Multiplexing