

Implementation of High Speed Downlink Packet Access to R99 UMTS Networks – A System Level Review

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Background

- Mobile Network Operators Seeking new Sources of Revenue
- Major Investments on PS Services over UMTS
- Numerous Low Cost Competing Technologies Available
 - WLANs, ADSL, etc
- HSDPA enables the Offering of High Data Rate Services over UMTS
 - How to Deploy and With What Cost?



Objectives of the Study

- Assess the changes that the implementation of HSDPA Imposes to a R99 UMTS Network – on a System Level
 - Network Element Dimensioning
 - Interface Dimensioning
 - Air-Interface Dimensioning not Included
 - HW and SW Requirements
- Assess the cost of HSDPA Implementation
 - Dimensioning Effect
 - The HW and SW Effect
 - Workload Effect
- Create a Suitable Model for a Practical HSDPA Capability Deployment
 - Deployment Process and Timetable



Research Method: A Case Study Approach

- Review on UMTS and HSDPA
- Review on HSDPA Deployment Strategies
 - One Strategy Chosen for Further Analysis
- Definition of a Reference R99 UMTS Network
 - Initial Dimensioning for R99 UMTS Traffic
- Re-dimensioning of the Reference Network for HSDPA
 - Based on the Chosen HSDPA Deployment Strategy
- Evaluation of Necessary HW and SW Upgrades
 - Based on the Re-dimensioning Results
- Creation of a Suitable Deployment Process
 - Timetables and Requirements to Each Phase
- Cost Analysis of the Deployment



Basics of HSDPA

- Enhancement to WCDMA PS Services
- 3GPP release 5 Feature
- Max Air-Interface data rate 14.4 Mbps
- No Major Effect to the Core Network
- New in HSDPA
 - New Shared Transport and Physical Channels
 - 16QAM
 - Adaptive Modulation and Coding
 - Multicode Operation
 - Advanced Packet Scheduling
 - etc
- Excluded from HSDPA
 - Soft Handover
 - Fast Power Control
 - etc



HSDPA Deployment Strategy

- When, How and Where HSDPA is Deployed
- Defines General Outlines for Network Planning
- Full Deployment
 - HSDPA Capability to all Existing R99 UMTS Sites
 - Non-Scalable and Expensive
- Hotspot Deployment
 - Deployment Based on Estimated or Measured Traffic (Erl/Mbps)
 - Site/Area Specific
 - Traffic Measurements from GSM or UMTS
 - Scalable and More Cost-Efficient
- Dedicated Carrier or Shared Carrier
 - Dedicated Carrier Simplifies the Air-Interface Dimensioning
 - Shared Carrier More Cost-Efficient in the Initial Phase



Reference R99 UMTS Network

- Defined for the Purpose of this Study
 - A Base on which the HSDPA Capability is Deployed on
- An Independent Part of a Larger Network
 - One RNC
 - 200 BTSs
 - Two Kinds of BTSs with Different Traffic Profiles
- Dimensioned for the R99 Traffic Model
 - CS and PS Traffic
 - Erlang B Based Model for Iub and BTS HW
 - Cumulative Capacity Model for RNC and IuPS



Re-Dimensioning of the Reference Network for HSDPA

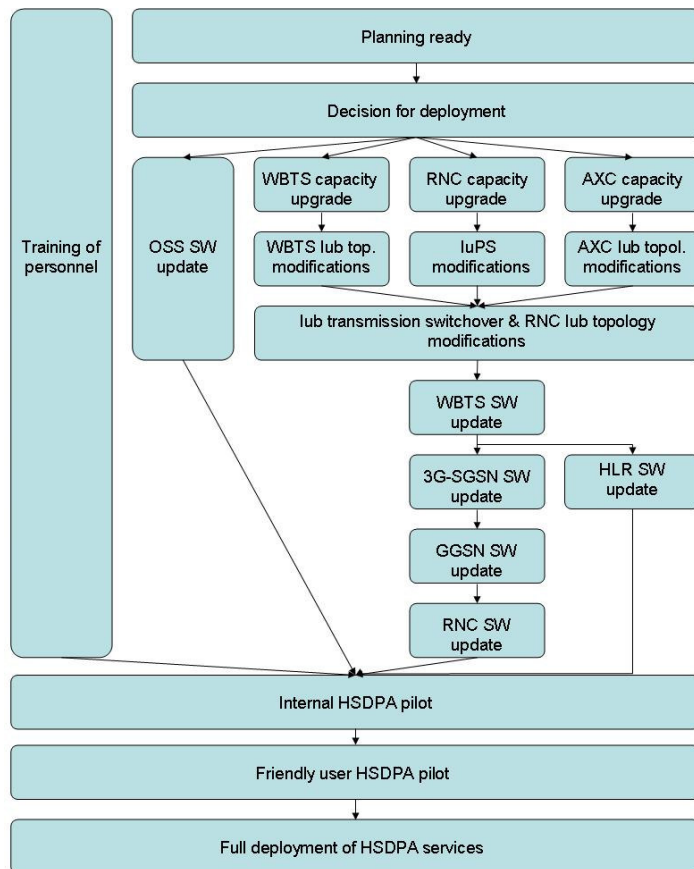
- Hotspot Deployment Strategy
 - HSDPA Deployed to 67 BTSs of 200
 - BTSs Chosen Based on R99 Traffic
- 5 HS-PDSCHs and 16QAM Assumed
 - Max 3,6 Mbps User Data Rate
 - Likely Initial HSDPA Capability of Real Networks
- 3,6 Mbps Dimensioned to be Available From Each Cell
 - Approx. 36% More BTS Processing Capacity Required
 - Upgrade from one E1 to four E1s in Iub
 - Upgrade from one STM1 to four STM1s in IuPS
 - Transmission Topology Modifications
 - RNC Capacity Requirement Doubled



HW and SW Requirements

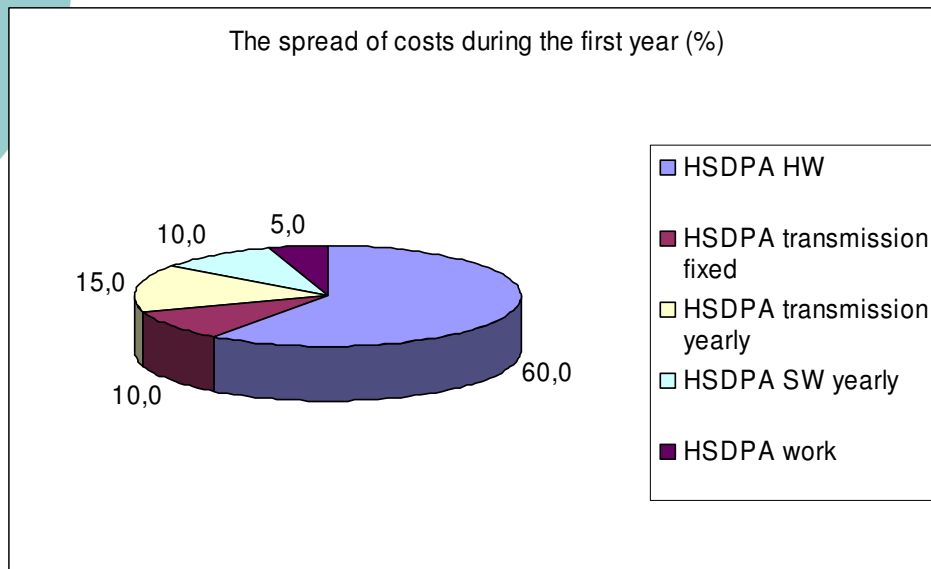
- A Reference Vendor Assumed
 - Based on Information of Likely Requirements
- SW Upgrades Necessary to all RAN Elements and to Almost all PS Core Elements
 - R99 QoS Profiles Support only 2048 kbps
- HW Upgrades Necessary for BTSs, RNC and Transmission Elements
 - No HW Requirements for Core

HSDPA Deployment Process



- Capacity Upgrades Before SW Updates
 - SW Related Problems Easier to Detect
- Sufficient Guard Period Between Phases
 - For Monitoring Purposes
- Personnel Training Completed Before Piloting
 - Personnel Qualified to Handle the new Tasks
- Piloting Periods Before a Full Service Deployment
 - Internal and Friendly User
 - Field Testing to Verify the Capacity and Functionality
- 7 Calendar Months and Over 3000 Work Hours From the Deployment Decision

Cost Analysis



- Four Cost Categories:
 - Hardware
 - Software
 - Transmission
 - Workdays
- The SW and HW Pricing is Vendor and Operator Specific
- Transmission Prices Somewhat Regulated
- HW Dominates the Costs for the First Year
- Transmission Leases Dominate the Following Years



Conclusion

- Detailed System Dimensioning Models Unavailable for HSDPA
 - More or Less a Worst Case Dimensioning was Used
 - Development of more Applicable Dimensioning Models for HSDPA?
- Reconfiguration of the RAN Network Topology Necessary
 - No Major Effect to the Core Network
- The Use of PDH Transmission for Iub far From Cost-Efficient
 - Emphasized in the Future Releases of HSDPA
 - Alternative Transmission Solutions?
- The Deployment of HSDPA Causes Major Investments Especially to the HW and Transmission Capacity
 - High Cost per bit
 - Feasibility of the HSDPA business case?
- 6-12 Months Deployment Time Likely for Large Networks