

Wireless and Mobile Network Architecture

Chapter 10: Heterogeneous PCS

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Outline

- Introduction
- Three types of PCS integration
- Tier handoff mechanism
- Registration mechanism
- Cell delivery mechanism
- User identities
- Summary





Introduction

- Heterogeneous PCS
 - Integration of different PCS system
- Multi-tier system
 - Different radio technology, different network technology
- Multi-service
 - Different radio technology, same network technology





Why HPCS

- Service areas do not overlap
 - Extend the coverage service areas
- Service areas do overlap
 - Increase the capacity
 - Number of circuits
- A basic requirement
 - Downward-compatibility
- Three types of HPCS (Table 20.1)
 - Depending on the **network** and **radio** technologies





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Table 20.1 Integration of Cellular andLow-Tier PCS Technologies

TECHNOLOGY	ADVANTAGES	EXAMPLES
Cellular/Cellular (Overlapping)	Increasing capacity	PCS 1900/GSM-900
Cellular/Low-tier PCS Low-tier PCS/Low-tier PCS (Overlapping)	Increasing capacity Improving circuit quality Increasing the user mobility	DECT/GSM-900 PACS/AMPS, unlicensed PHS, licensed PACS
Cellular/Cellular Cellular/Low-tier PCS Low-tier PCS/Low-tier PCS (Non-overlapping)	Extending Coverage	All examples listed Above and IS-136/AMPS IS-95/AMPS IS-95/AMPS, unlicensed PHS, and licensed PACS



Three types of PCS integration

- Similar Radio technologies, Same Network technologies (SRSN)
 - GSM900/GSM1800
- Different Radio technologies, Same Network technologies (DRSN)
 - IS-95/AMPS
- Different Radio technologies, Different Network technologies (DRDN)
 - GSM/PHS





Similar radio technologies, same network technologies (SRSN)

- The individual system use the same
 - Network management technology
 - Roaming, call control
 - Radio technology
- SRSN with different power levels
 - Macrocells
 - Microcells
- SRSN with different frequency bands
 - Multi-band system



Different radio technologies, same network technologies (DRSN)

DRSN

- IS-136/AMPS
 - IS-136 based on TDMA
 - AMPS based on FDMA
- IS-95/AMPS
 - IS-95 based on CDMA
 - AMPS based on FDMA
- All share the same network protocol
 - IS-41



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Different radio technologies, Different network technologies (DRDN)

- Integrates cellular systems (high-tier) with low-tier PCS
- High-tier PCS
 - High mobility
- Low-tier PCS
 - Lower call delivery cost
 - Better circuit quality
- GSM PHS





Tier handoff mechanism

- Tier handoff is a issues for HPCS
- Hard handoff
 - FDMA, TDMA
- Soft handoff
 - CDMA
- For SRSN, tier handoff is the same as the normal handoff





Cont.

- For DRSN, it needs modify the tier-handoff to compatible
 - Soft handoff (IS-95)/hard handoff (AMPS)
 - MAHO/TDMA (IS-136)/MCHO/FDMA (AMPS)
- For DRDN, tier handoff is almost impossible
 - Different handoff approach
 - Significantly modified
 - Different implementation
 - Automatically redial, reconnect





Registration mechanism

- For SRSN
 - The heterogeneous BSs can be controlled by the same VLR (Visitor Location Register)
- For DRSN
 - The HLRs can be merged into one HLR, and VLRs form different system talk to the single HLR





DRDN registration mechanism

- For DRDN
 - Modify all protocol
- Different system
 - Different registration
 - Different authentication
 - Different information stored





Multi-tier HLR

- To minimize the cost of DRDN
- To merge the HLRs of DRDN into a single HLR is difficult
 - Formats
 - Operations
- To build a tier manger that communicates with the different HLRs (Fig. 20.1)
 - Single registration
 - Multiple registration





Fig. 20.1 Multi-tier HLR







Single registration

- The MS is allowed to register with MHLR on only one tier at any time
- Figure 20.2 shows how SR works









Multiple registration

- The MS is allowed to register with MHLR on multiple tiers at any time
- Figure 20.3 shows how MR works









Cell delivery mechanism

- The SR call delivery procedure follows a standard, IS-41 (Figure 20.4)
 Step1. Query the MHLR to find the location of p1
 Step2. VLR returns the routable address of the MSC
 Step3. Sets up the trunk to the MSC
- The MR call delivery procedure is complex





Figure 20.4 SR procedure **MHLR** Step1. Step1 **VLR** 1 D L1 Step2 Step2 EO MSC1 Step3 Originating switch (EO: End office) VLR H1 MSC2 WMI

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MR call delivery procedure

- MHLR does not know the current tier where p1 reside
- Try and error
 - Figure 20.5 and Figure 20.6
- To reduce penalty
- Use Paging approach (Figure 20.7)





Figure 20.5 MR call delivery procedure (part 1)





Figure 20.6 MR call delivery procedure (part 2)



Figure 20.7 MR call delivery procedure (paging before returning the routable address)





User Identities

- HPCS user may have a single or multiple identities
 - SRSN only one
 - DRSN and DRDN may carry multimode MS
- Typically, select the tier by user
- Or Intelligent select by MS
 - In SR (Figure 20.8)
 - In MR (Figure 20.9)









Summary

- HPCS development has been motivated by business needs
- One of the most important technical issues
 - To minimize the extra signaling traffic
- Performance modeling of HPCS is at early stage
- No conclusion regarding billing platform

