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HetNet Radio Network Deployment and Planning

Precise deployment realizes no edge coverage

Elaborate planning fulfills the excellent traffic offload

Inter-operation improves the user's experience

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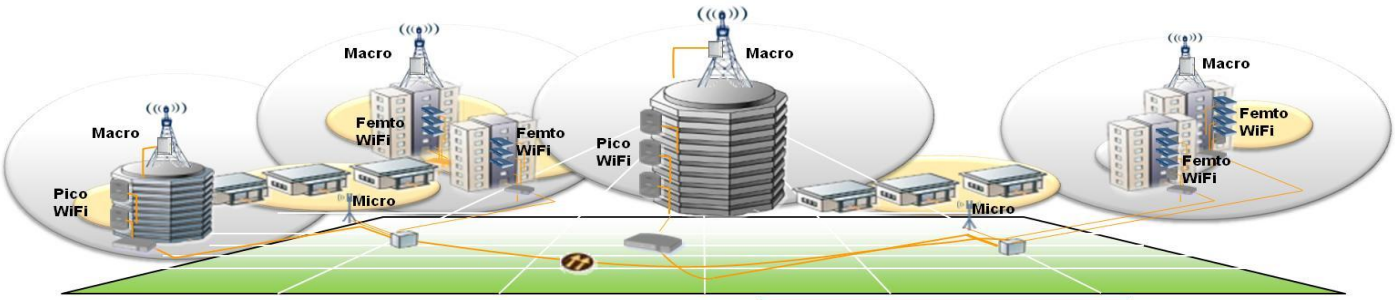
HetNet Solution and Choice Strategy



HetNet:

- Multi-RAT: GSM, UMTS, LTE, WiFi
- Multi-band: 850M, 900M, 1.8G, 1.9G, AWS, 2.1G, 2.6G, AWS…
- Multi-power: Macro, Micro, Pico, Femto Home

Small Cell:

- Micro: <10Watts
- Pico: <1Watts
- Femto Home: <20mW
- WiFi: <500mW

•Customer pain point analysis and opportunity finding

•Blind coverage：to enhance deep indoor coverage, and cover the weak signal area
•Traffic hot spot: to improve the frequency efficiency, capacity
• Macro site unavailable: difficult to acquire the sites for the lacking antenna space or house owner's opposition

• Scenario identification and solution choice strategy

•For the whole network congestion
- Macro sites densification, multi-carriers expansion, multi-band Refarming, multi-sectors solution
•For the hot spot heavy traffic- square, streets and shops, middle and small buildings, campus and stadium
- Deploy the micro sites to fulfill the fast launch and traffic offload
•For the large in-building coverage
- Deploy the DAS with Lampsite Solution.

Note：
•Ubro based Femto products shall be deployed for only the private users.
•Wifi solution is for the fast deployment, low cost and urgent data offload
• Micro site are also applied for highway and rural habitant coverage

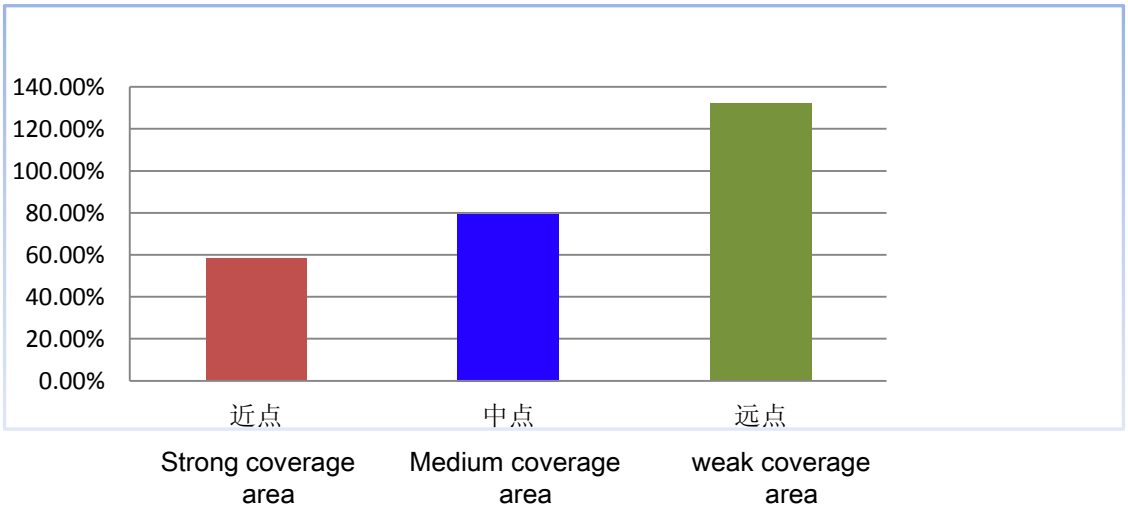
The intra-frequency Coverage Performance

Microcell intra-frequency Coverage Performance

（Suburban，Macro ISD=1Km, Micro with 5W and edge rate 384Kbps）

Micro Position	Strong coverage area	Medium coverage area	Weak coverage area
Macro RSCP distribution	RSCP>－65dBm	－65dBm～－85dBm	RSCP<－85dBm
3902E coverage range（outdoor）	60m	100m	250m

Average Users Throughput Gain



1. The whole network RSCP improves greatly, especially deployed in the weak coverage area. Micro coverage shrink near Macro due to intra frequency interference from Macro.
2. The influence factors of the Micro coverage range include Cell Average Ioc/Ior, edge throughput, and geography environment, etc.

The intra-frequency Capacity Performance

1. The Macro-Micro capacity gain can reach about 1/2/2.5/3.5 times when a macro cell has 1~4 micro sites.

2. We suggest that half of the micro sites are deployed in the medium and weak coverage area, and the capacity gain is higher for the micro sites in the hot spot.

DL Macro-Micro capacity gain (simulation）					
Scenario	Micro Site Position	1Macro + N Micro	Micro in the strong coverage area	Micro in the medium coverage area	Micro in the weak coverage area
Micro site deployed randomly without fixed hotspot	within the specified area	1＋1	58.13%	79.42%	132.04%
	Random deployment	1＋1	117%		
		1＋2	213%		
		1＋3	287%		
		1＋4	356%		
Micro site deployed In the hot spot	within the specified area	1＋1	105%	114%	142.20%
	within the specified area	1＋2	—	194.60%	257.60%
	Random deployment	1＋4	367.28%		

HetNet Design and deployment, follow 5 steps

5 Step Design, Precise deployment, Elaborate planning

Step 1：Hotspots Finding

•The Hotspots mean the area with heavy traffic, large numbers of users, and lacking of the radio resource. There are mainly three types of hot spots : obvious hotspot (heavy traffic) , implicit hotspot(large number of users) and high value hotspots(with large VIP users)

• data selection consists of cell information based on statistics and geography grid information based on MR traffic map

• Combining the traffic map and cell KPI analysis, we can get the users and traffic distribution and get the hotspots

Step 2: deployment and planning

• evaluate the rationality of operator candidate micro sites
• adding new micro sites based on the macro sites ISD, RSCP, Ec/Io and actual environment
• make simulation of capacity offload
• design the inter-operation between Micro and Macro cells

Step 3：Site Solution

• determine the site solution of antenna, transmission and power.

Step 4：Single Site commissioning and testing

• sites launching and features testing
• KPI monitor and RF parameters tuning

Step 5：Macro-micro Synergy Optimization

• inter-operation parameters optimization
• coverage optimization and interference control
• user experience improvement, and KPI acceptance

HetNet Deployment Strategy and Planning

Micro site audit

- Coverage or capacity issue to solve?
- How about the macro traffic and coverage?
- The ISD design about micro sites，Is there continuous coverage requirement of micro cells?
- Macro multi-carriers strategy and DC/MIMO features?

frequency planning

- For coverage scenario, to share the frequency used by macro Continuous Coverage Layer
- For capacity offload scenario, to adopt the dedicated frequency or share the PS service layer frequency

Coverage planning

For the scenario of macro-micro intra-frequency deploym , micro coverage planning shall consider the hotspot, around Environment and coverage range definition。

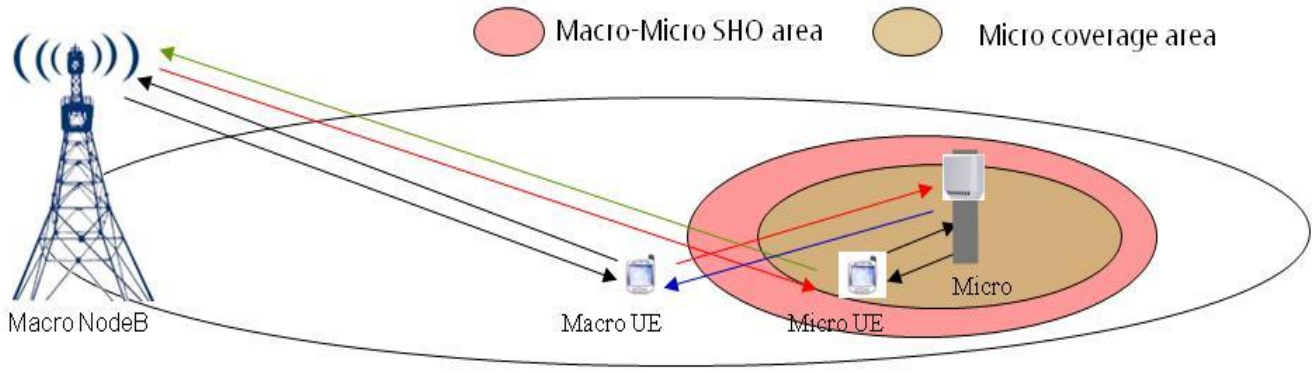
Interference control

- Sites can be deployed sequentially in the medium and
- weak coverage area, finally in the strong coverage area. Make the macro-micro RF optimization and activate features

KPI evaluation

The whole HetNet network KPI can reach the single macro Network performance, but the KPI varies in different area scenarios

Macro-Micro Interference Control



Macro-micro Interference Types：

•Type 1: Uplink interference from Macro UE to Micro cell
Higher interference due to UE closer to Micro when imbalance UL/DL cell edge
•Type 2: Downlink interference from Macro cell to Micro UE
Micro small coverage and high interfered area ratio when close to Macro site

•Type 3: Uplink interference from Micro UE to Macro cell
Similar to Macro-Macro
•Type 4: Downlink interference from Micro cell to Macro UE
Similar to Macro-Macro

Elaborate Planning

• deploy Micro cells in the hotspots , serving more uses.
• Macro-micro edge can be deployed in the area with less users.
• in the area within Macro RSCP< -60dBm ,Micro cells should be careful.
•RF parameters design and tuning

Anti-interference Features

•Anti-Interference Scheduling for HSUPA (RAN13.0)
•Micro Static/Dynamic Desensitization (RAN13.0/RAN15.0)
•Macro UE RRC redirection/IFHO triggered by UL interference (RAN15.0)
•ACIC (RAN16.0)
•UL/DL joint scheduling (RAN16.0)
• Micro multi antenna Joint reception (RAN16.0)

Macro-Micro Inter-operation Strategy

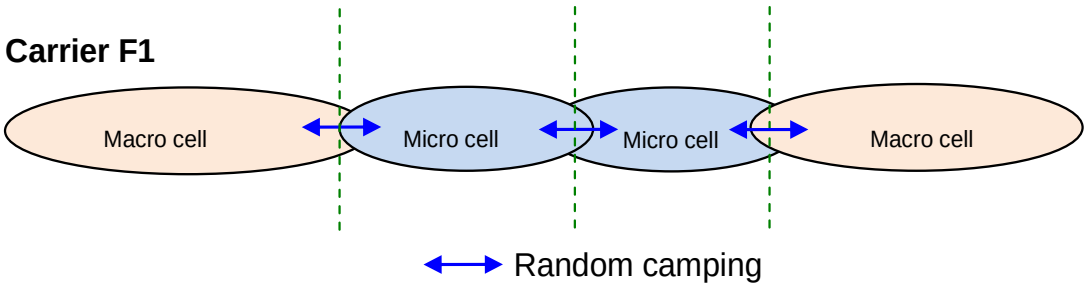
Coverage holes Scenario

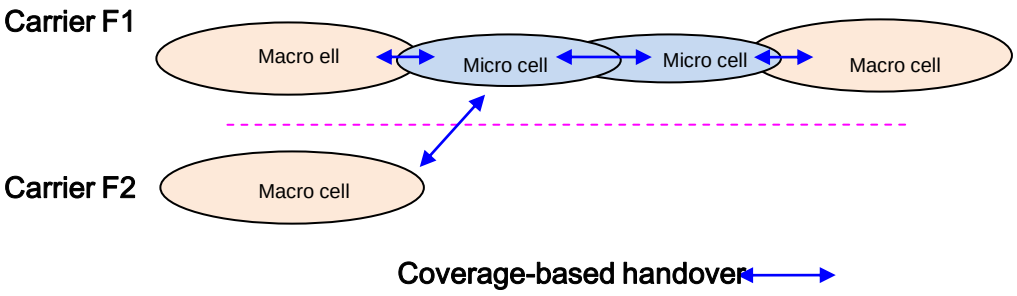
Camping strategy

• In the scenario of coverage holes, random camping is adopted so that UEs can initiate cell reselection and camp on the cell that provides the highest signal quality.

Mobility strategy

•neighboring micro cells or micro and micro cells must support the coverage-based handover.



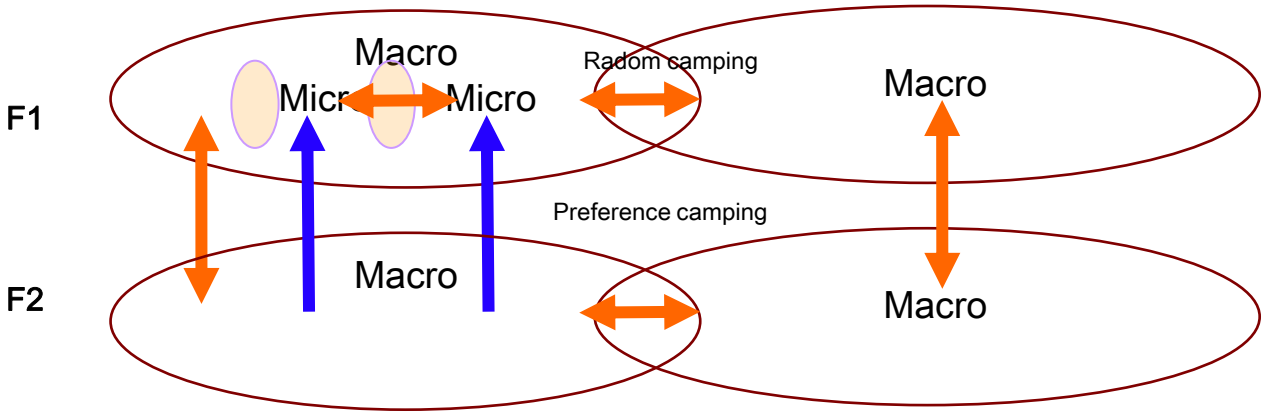


Macro-Micro Inter-operation Strategy

Capacity offloading scenario – with macro multi-carriers and without traffic steering

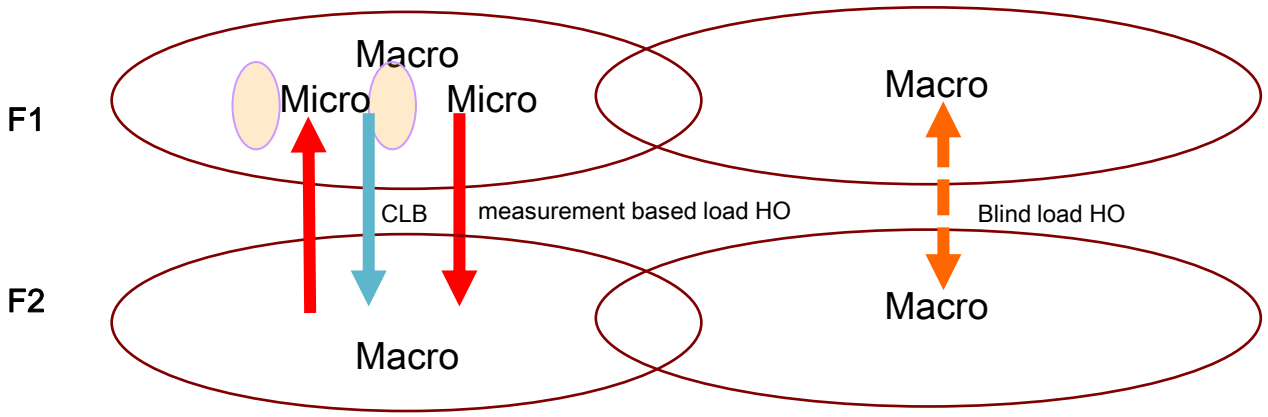
Camping strategy

• preference camping on micro cells is adopted, if traffic steering policy is not used. In this way, the micro cell can offload higher traffic from the macro cells。



Load Balancing

•load reshuffling (LDR) and cell load balancing (CLB) can be used together to achieve load balancing among macro and micro cells.
•And Blind load handover is adopted between macro cells.

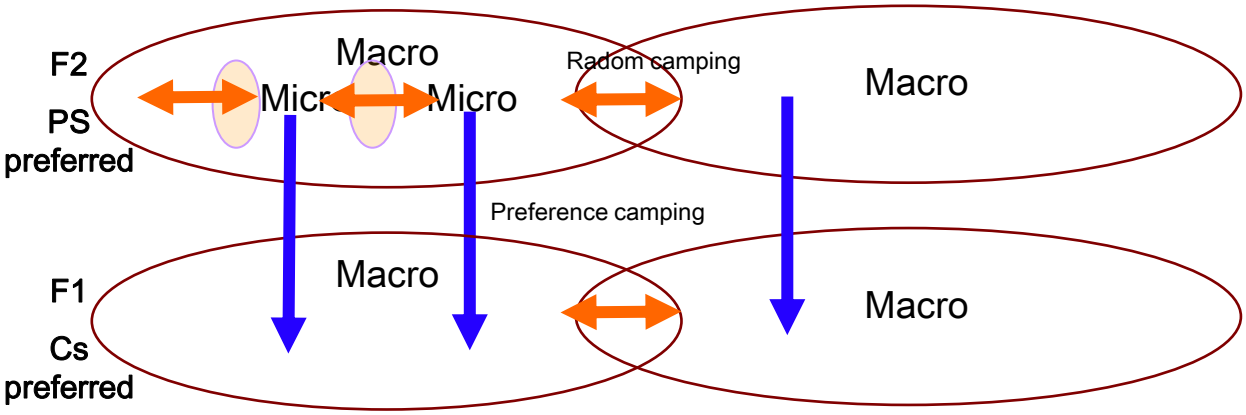


Macro-Micro Inter-operation Strategy

Capacity offloading scenario – with macro multi-carriers and with traffic steering

Camping strategy

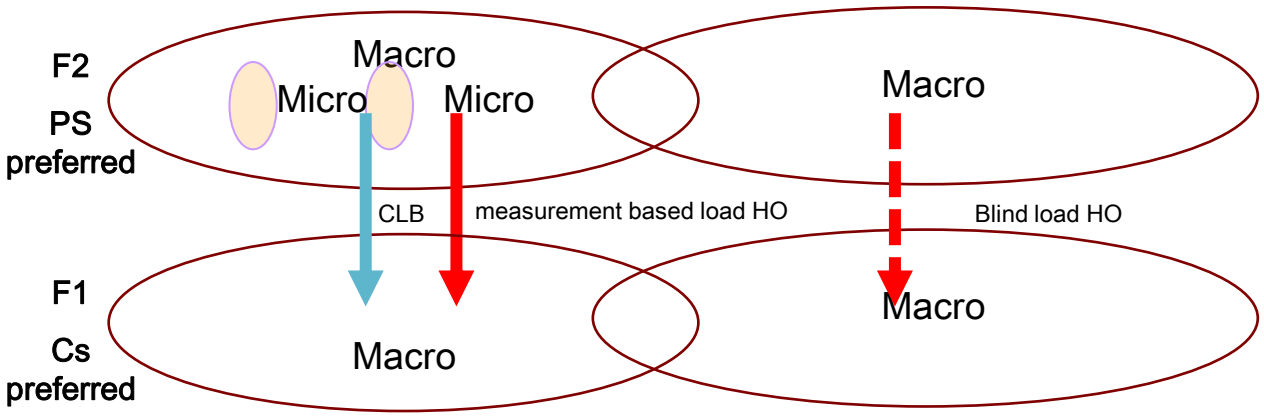
• If traffic steering is used, UEs preferentially camp on CS-preferred inter-frequency macro cell.



Load Balancing

•Access mode: It can be implemented through traffic steering based RRC redirection or traffic steering-based RAB DRD.

• connected mode: the measurement-based load handover and measurement-based CLB from the micro frequency 1 to macro f2



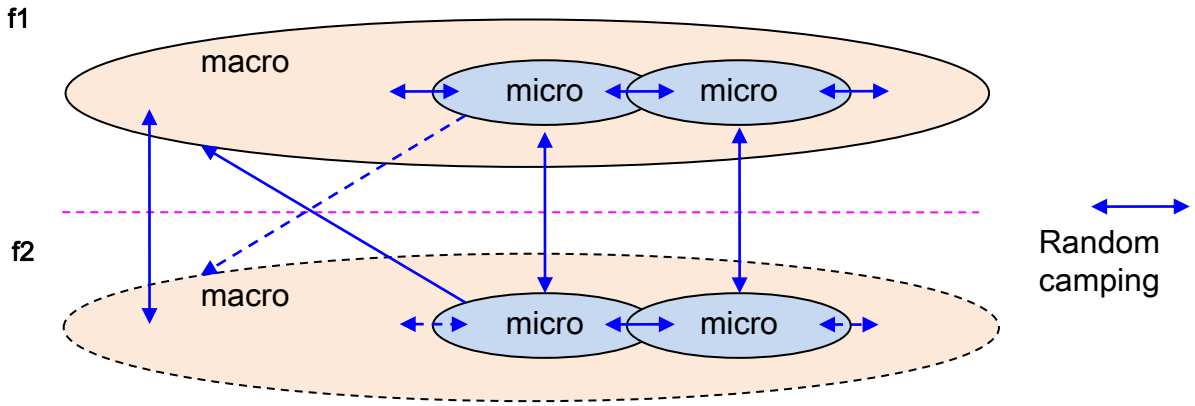
Macro-Micro Inter-operation Strategy

Capacity offloading scenario – with macro&micro multi-carriers

Camping strategy

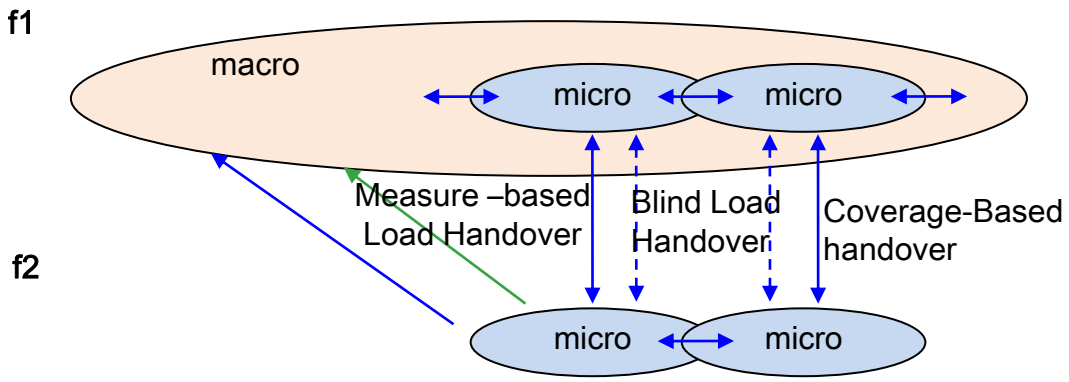
•Random camping is adopted between macro and micro cells. Inter-frequency macro-micro should be uni-direction adjacent cells.

• dashed indicates maybe no existance.



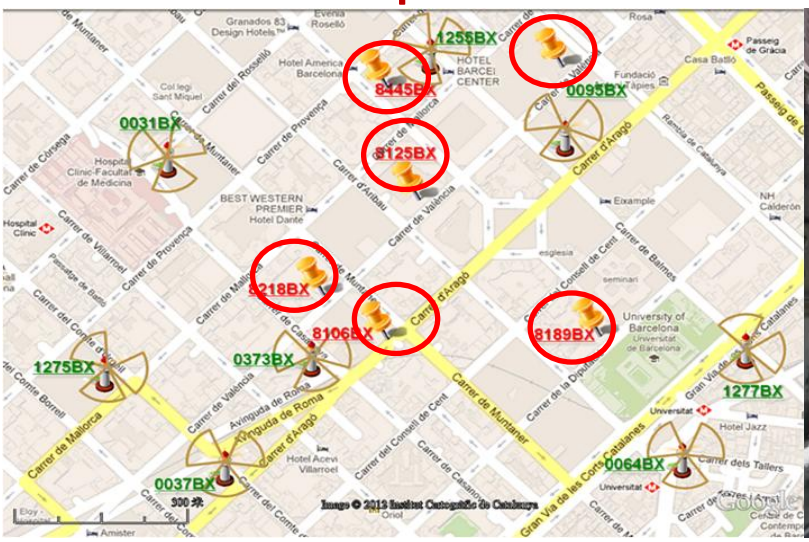
Load Handover

•the measurement-based load handover, blind load handover and the Coverage-Based handover are supported between micro and macro



HetNet TOP Projects Experience Sharing

Spain Vodafone Trial Case



- Background: intra-frequency deployment with 4 Macro and 6 Micro cells，improve the street coverage and offload capacity

Total Capacity improvement：CS/PS total users increase 15%, HSDPA traffic increase 33%，HSUPA increase24%

Micro offloading excellent: Micro can effectively capture 20% traffic and 16% users in the Macro coverage

User experience gets better：based on the drive test, the average throughput improve greatly with HSDPA about 30%,and HSUPA 133%

KPI performance : Even co-channel deployment of Microcell, the network KPI were still be improved, e.g. CDR decrease 0.2%（CS）~1%(PS)

HetNet TOP Projects Experience Sharing

Mexico Iusacell Commercial Case

- 400Micro，intra-frequency deployment, macro network has 850M/1900M UMTS dual band cells, Average macro RSCP is about-72 dBm, the micro sites are deployed in the coverage area with RSCP - 60 ~ - 85dBm

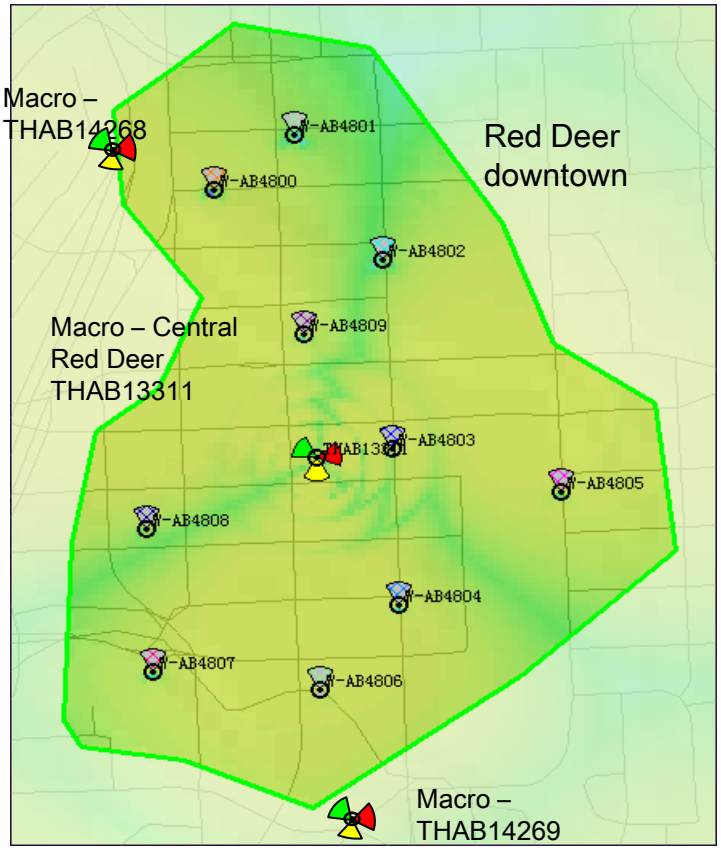
Micro capacity offloading： Micro users occupy the 25% of the macro users, and PS traffic more offloading percentage for the higher user throughput in the micro coverage area.

User experience：The deployment of Microcell (co-channel) significantly improves the user experience in the indoor/outdoor weak Macro coverage area.

Radio resource utilization：The deployment of Microcell (co-channel or adjacent channel) can improve the efficiency of Macro radio resource utilization, reducing downlink TCP per unit amount traffic

HetNet TOP Projects Experience Sharing

Canada Telus Commercial Case



- Macro/ Micro inter-frequency deployment in Red Deer, Alberta district.
- Micro cluster design：9* cells with 1 carrier per Micro, 5W, Omni antenna
- Macro cluster design：36 cells under 3 sites ,3*4 carrier configuration per Site

Capacity offloading outstanding：9 Micro cell took over 40% CS traffic and 50% PS traffic，compare to 3*4 Carrier Macros

Overall KPIs Keeps Same and Even Better：Whole cluster's IFHO has been greatly improved after micro cells activation (from ~95% to 99%)，HSDPA Throughput has been improved, that enhanced user experience

E2E solution and design：Cost effectively & integrated site solution support *fast deployment* ,Effectively *offload hotspot traffic.* Quick deployment to *solve coverage issue*

Key Documents Recommendation

HETNET Solution and planning documents

(1) Huawei_HetNet_Overview_V2.1

http://3ms.huawei.com/mm/docMaintain/mmMaintain.do?method=showMMDetail&f_id=UF201108160054

(2) UMTS Micro BTS deployment and planning Strategy-V1.0(20120313)

http://3ms.huawei.com/mm/docMaintain/mmMaintain.do?method=showMMDetail&f_id=RS12111404520065

(3)AtomCell8.0 Raido Networking Solution White PaperV1.0

http://3ms.huawei.com/mm/docMaintain/mmMaintain.do?method=showMMDetail&f_id=RS13010548310079

(4)UMTS Microcell Deployment Strategy（Canada Telus case)

http://3ms.huawei.com/mm/docMaintain/mmMaintain.do?method=showMMDetail&f_id=SC12101053310104

The following two documents and slides are not open at present, if you need them, please contact zhaoyinghe@huawei.com

(5)Vodafone Barcelona UMTS HetNet Trial Report_Phase I v1.2

(6) Huawei UMTS HetNet Interference Management v1.0

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