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Considerations on Further Enhancements and Evolution of UMTS/LTE in R12 and Onwards

China Unicom

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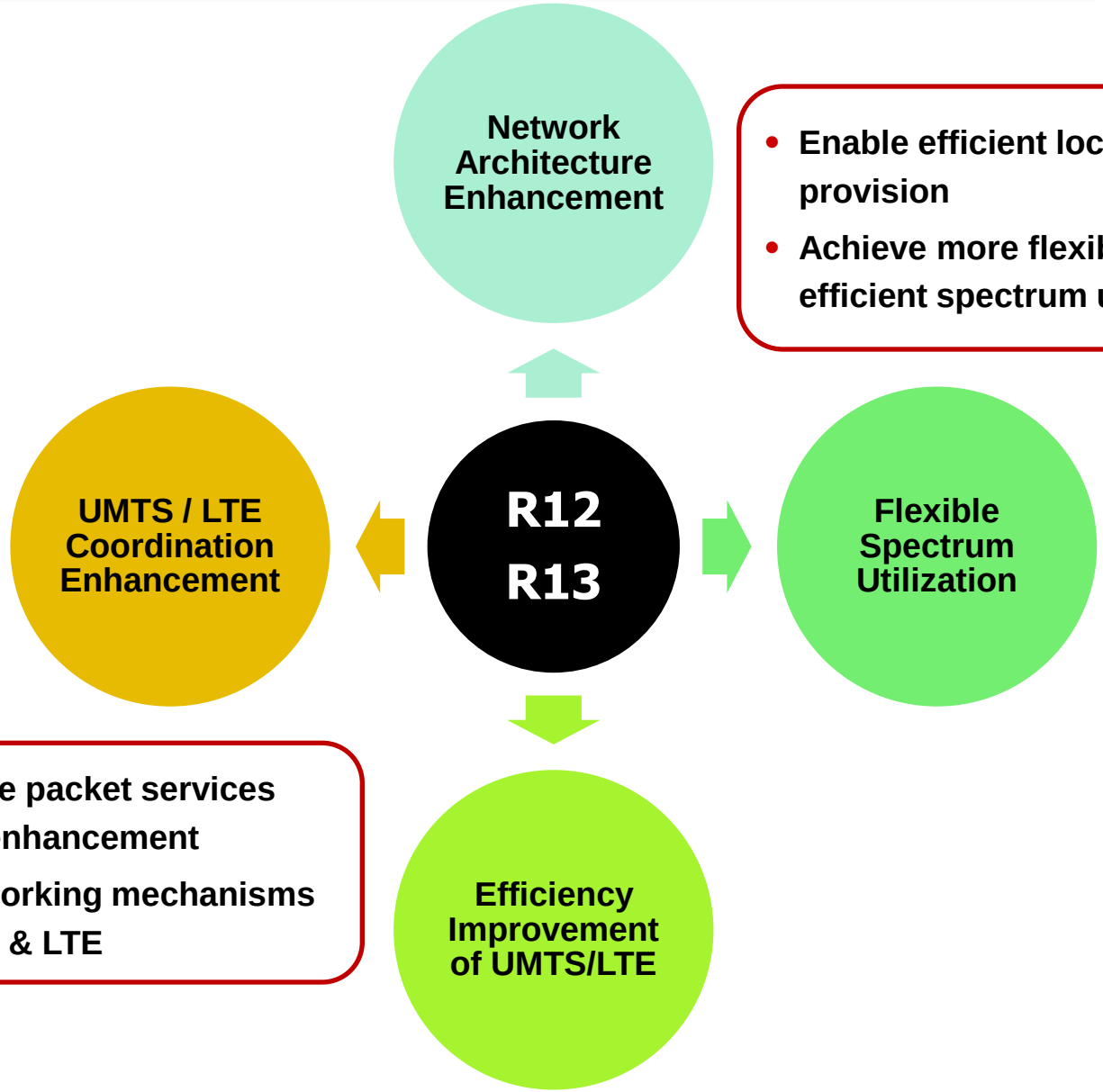
Requirements on R12 and onwards



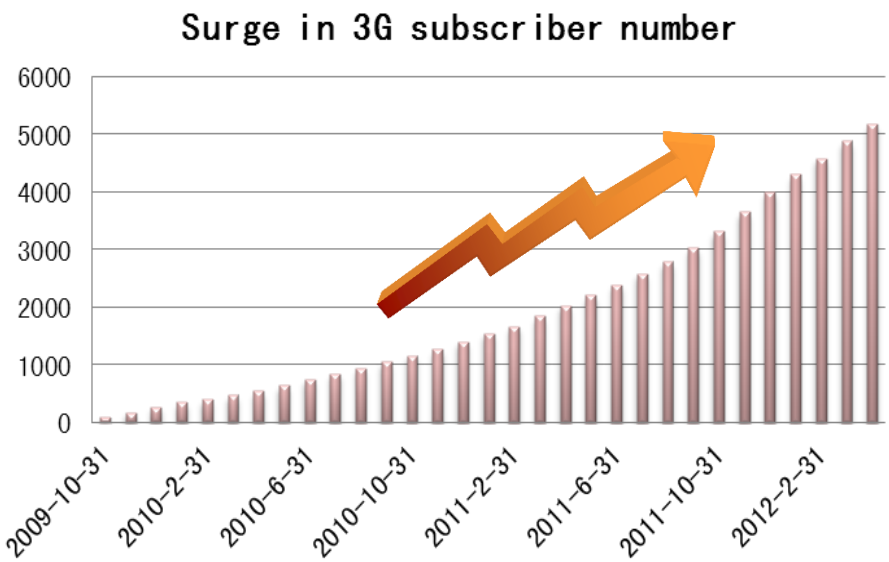
- Enable efficient local service provision
- Achieve more flexible and efficient spectrum utilization

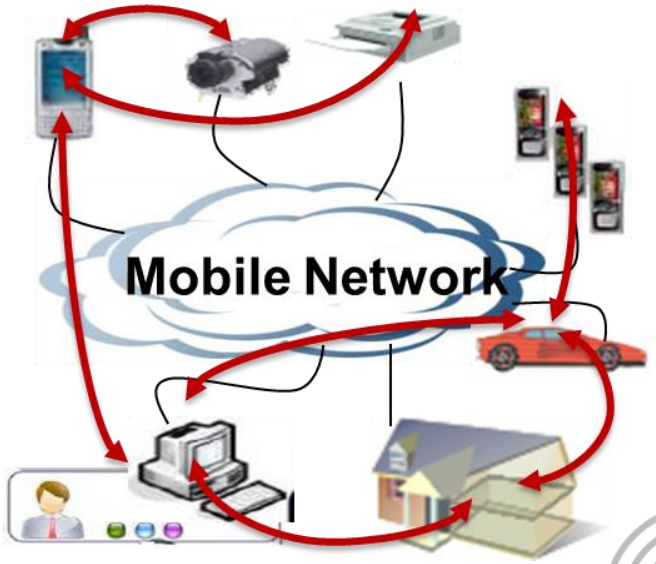
- Support diverse packet services through RRM enhancement
- Improve interworking mechanisms between UMTS & LTE

Traffic Trends in Mobile Internet Era

- **Internet services migrate rapidly from fixed to mobile network**
- **Mobile data traffic keep surging (Data traffic doubles every 6 months in CU network)**
- **Mobile communication becomes more diversified and ubiquitous**

Mobile traffic trends: Socialization, Localization, Personalization

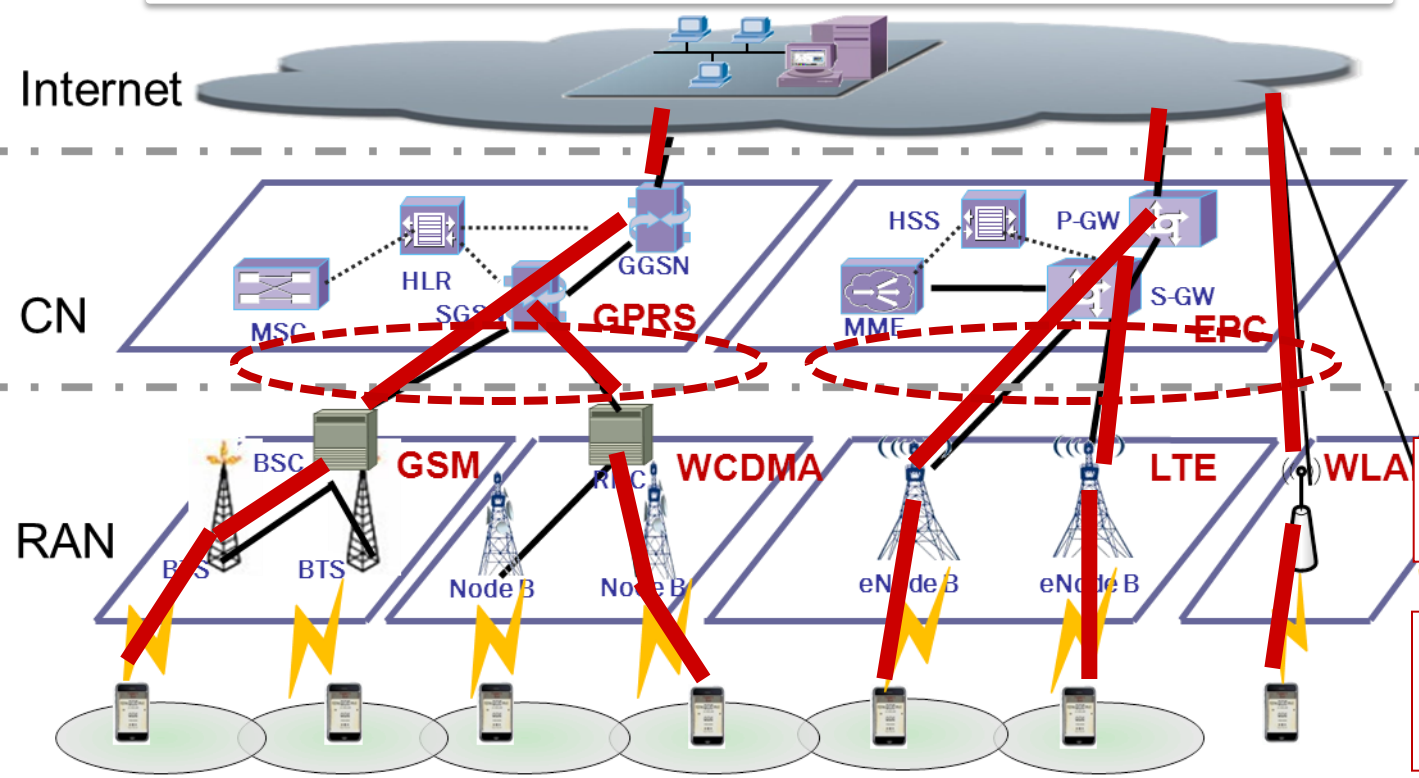




Ubiquitous Mobile Communication

Network Challenges in Mobile Internet Era

Traditional centralized, "vertical shaft" like architecture



Boosting backhaul capacity requirement

Continual CN capacity escalation

Further RAN infra-structure investment

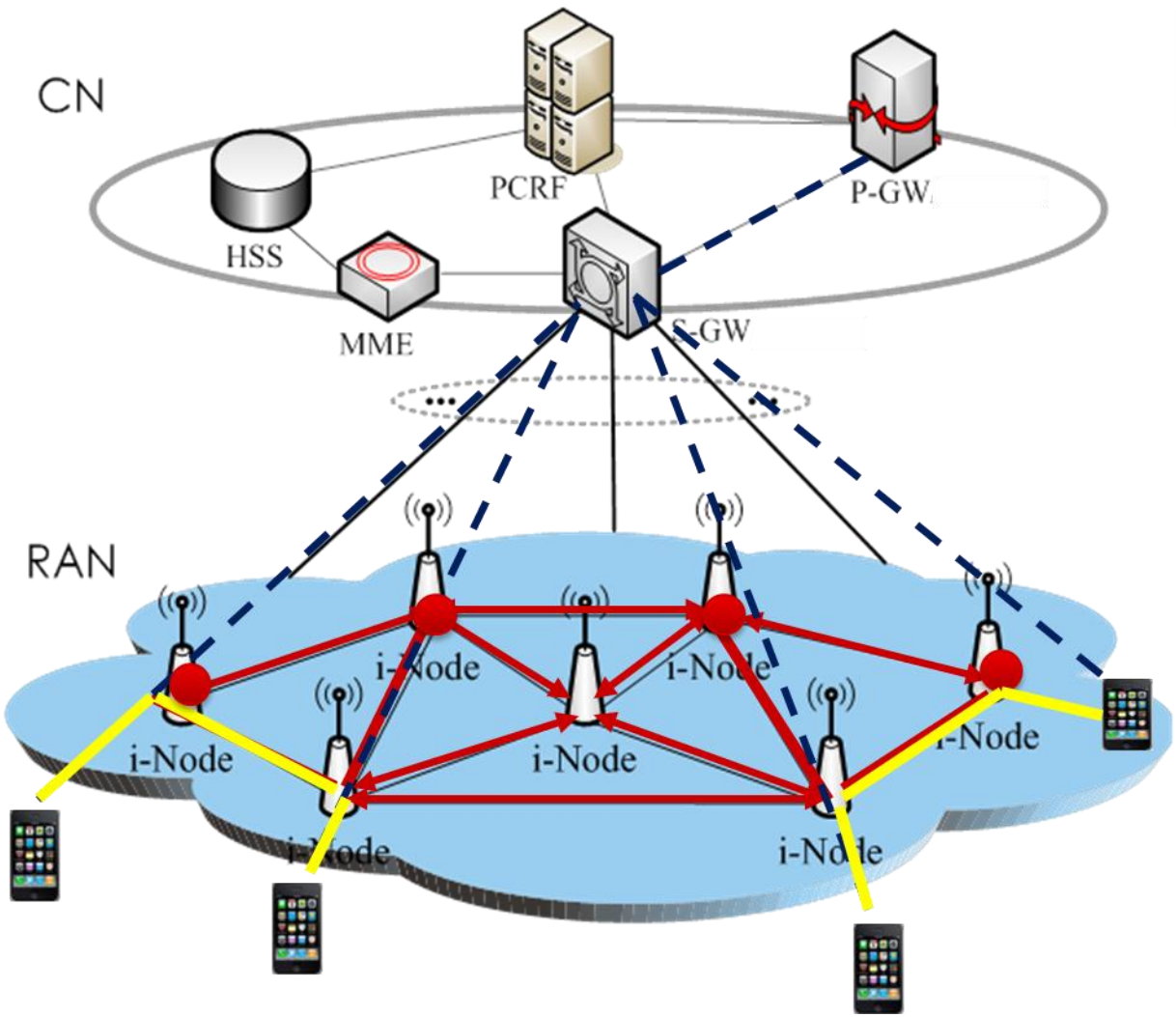
Surging data traffic from mobile internet services

Mobile Network Problems

- **Core network faces intense pressure from surging data traffic**
- **Transmission network suffer great resource wastage when delivering local service**

I-Net : Potential Solution to Mobile Internet

I-Net: "I"-centric mobile network design philosophy



Internet-oriented

- More adaptive to internet traffic pattern

Inter-connected

- Direct communication capability between eNBs

Intelligent

- Smart local resource management:
  - Enhanced capacity
  - Improved user experience
  - Flexible deployment

I-Net : Benefits and Use Cases

Cost reduction and capacity enhancement
--through backhaul requirement reduction

a. VoIP
b. Mobile enterprise network
c. Video communication (Internet video calling, video instant messaging, video monitoring, video game**) …**

User experience improvement
--lower latency, bring content closer to end user

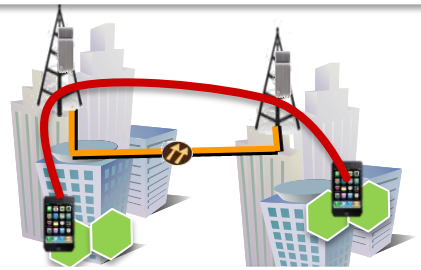
a. Social network (e.g., proximity-based service…)
b. RAN side content cache/CDN (e.g., local show, local advertisement) …

Flexible deployment
--coverage for local communication concentrated area

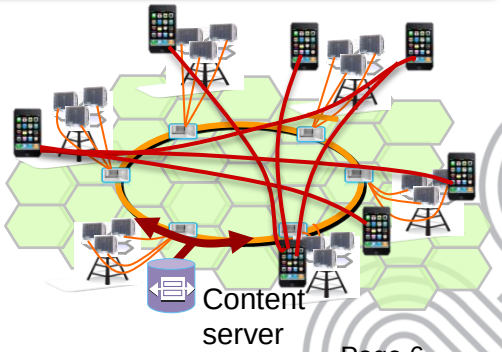
a. Emergency and Public safety communication
b. Far Rural area, Campus, Island, Mine, High speed Train, Ocean Ship …

Mode 1: Intra-eNB

Mode 2:Inter-eNB



Mode 3: Multicast



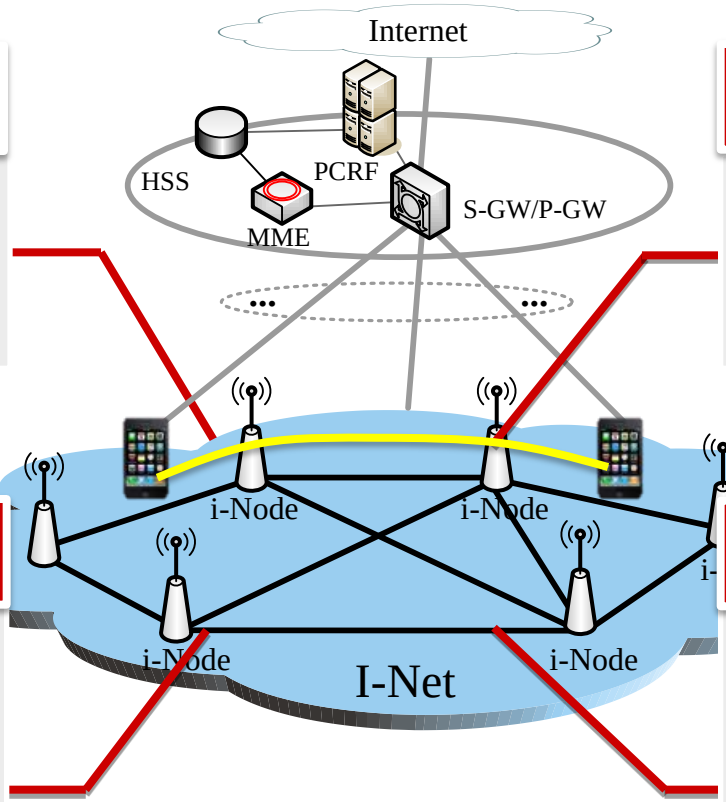
I-Net : Key Techniques

Service Localization Decision

Determine whether to establish/release direct communication via eNBs

Direct Communication Bearer Control

Provide session control and QoS management for direct communication via eNBs



Mobility Management

Maintain service continuity for local direct communication

Security and Control

Ensure security, lawful interception, charging for direct communication

- **RAN enhancement to support efficient local service provision with telecom-level control and management capability**

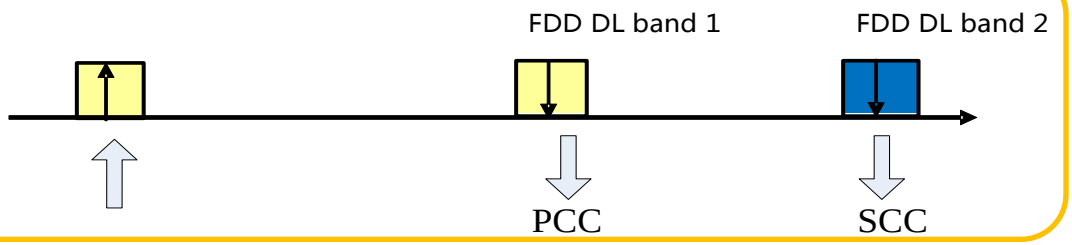
Flexible Spectrum Utilization

Flexible Spectrum Utilization

Considering there is one single band which could be used for FDD DL

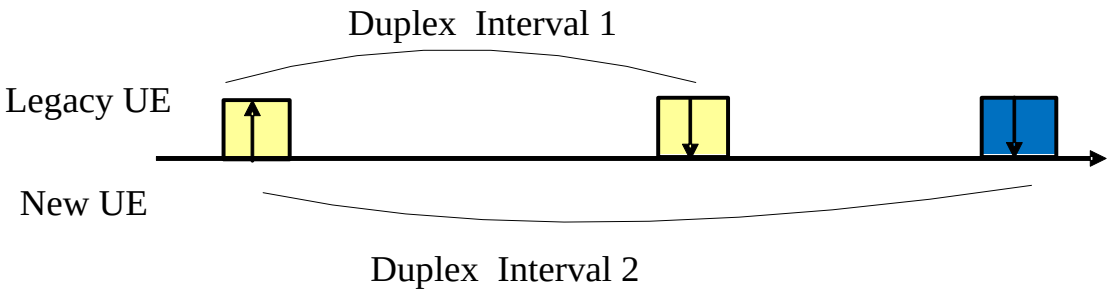
Study on different duplex-interval FDD-LTE with same uplink band

- WI “LTE_DL_FDD700” proposed to use the single DL band for CA SCC
- A CA capable UE can use the single DL band to achieve high speed DL



Another scheme to use the single DL band is proposed as below:

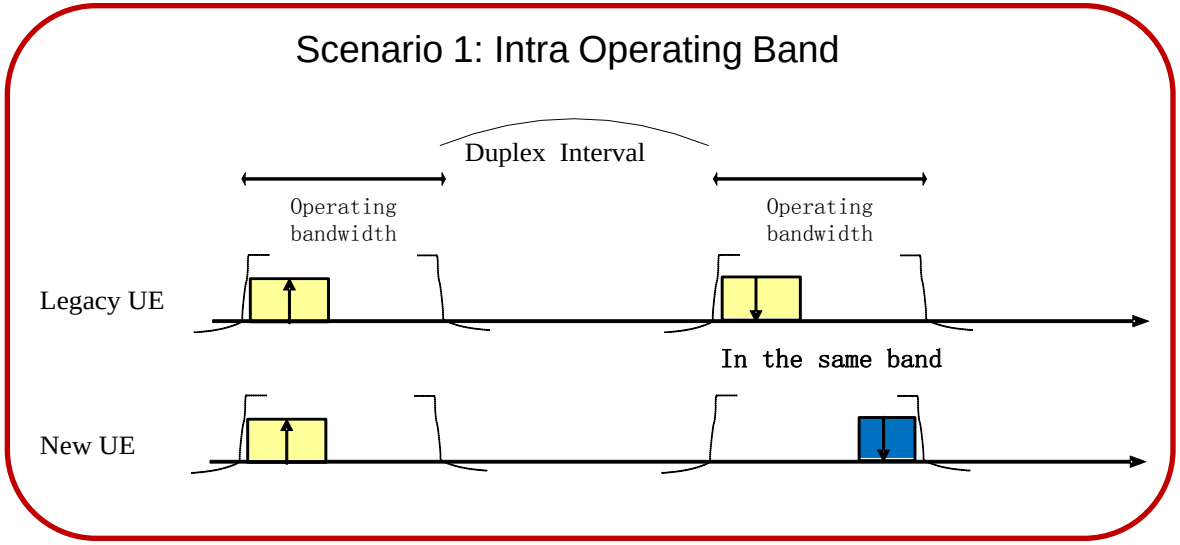
- A FDD LTE system supporting different duplex-interval UEs with the same UL band
- Low complexity of UE
- Another choice for operators except CA



Flexible Spectrum Utilization

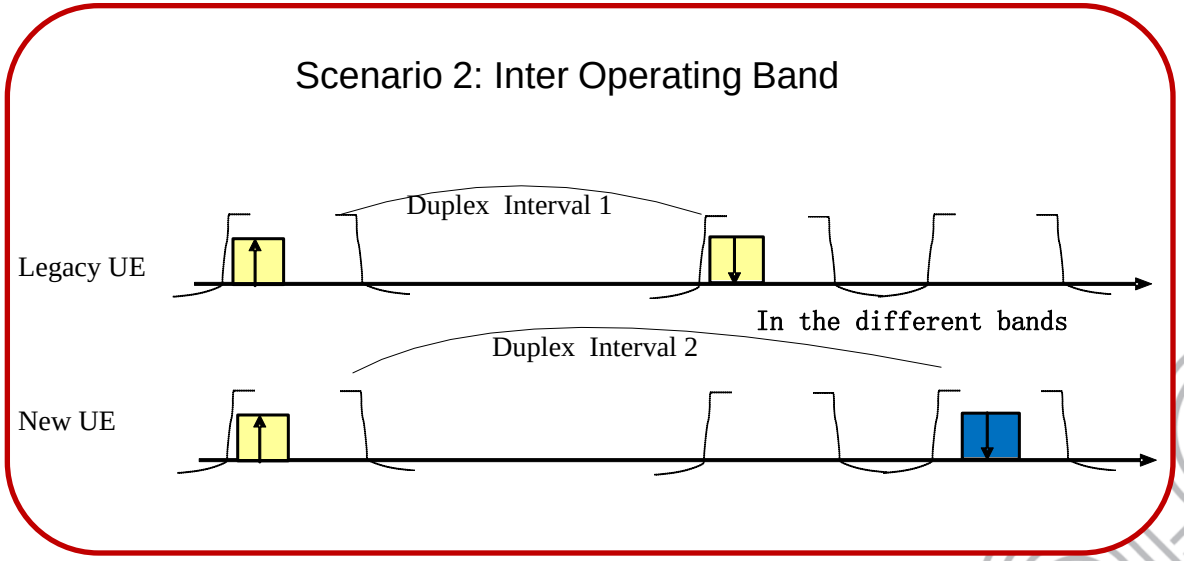
Scenario 1

- Duplex interval is unchanged
- No impact on UE side
- Small impacts on BS side
- BS need to schedule UL resources on the same carrier



Scenario 2

- Legacy UE use traditional duplex interval
- New UE can use new duplex interval or support both
- BS should support both duplex interval and schedule UL resources on the same carrier



Efficiency : HSPA RRM enhancement

- **Requirements on HSPA network enhancement**
  - HSPA network is supposed to serve most part of mobile devices still for long time
  - The networks have to serve increasingly **various types of services with disparate QoS guarantees**
  - HSPA networks have to be optimized to fit for the requirements of new traffic types
    - **Network, especially RAN, knows limit UE information, including their demands and status**
- **Possible enhancements**
  - **Aims: both user experience and network efficiency are our concerns**
    - Better supports of various PS services and low UE battery usage
    - High network resource utilization efficiency with low control signaling overhead
  - Possible ways to go
    - **Consider possible UE assistant information** to help the network know more about UE, and make more accurate RRM decision
    - **Define unified UE experience measurement and evaluation** to help network adjust the resource management more quickly
    - **Improve of RRM mechanisms**, including RRC, with UE assistant information to improve user experience

Efficiency : Paging Optimization

Scenario 1: Macro Cell

With the diverse applications in the smart phones, more and more users would like to access the Internet by using smart phone

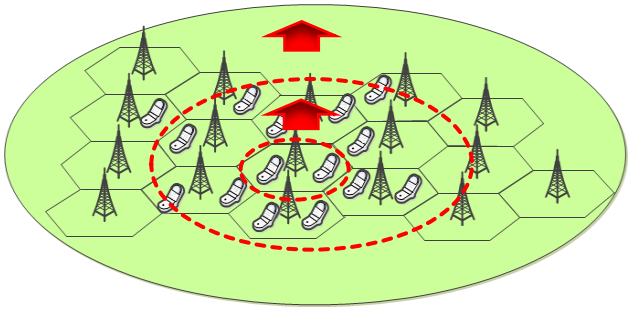
Scenario 2: MTC

MTC type services are increasing dramatically and lots of MTC UEs emerging in mobile network

- **Paging happens more frequently, especially in the hotspots**
- **Study on paging mechanism is expected**

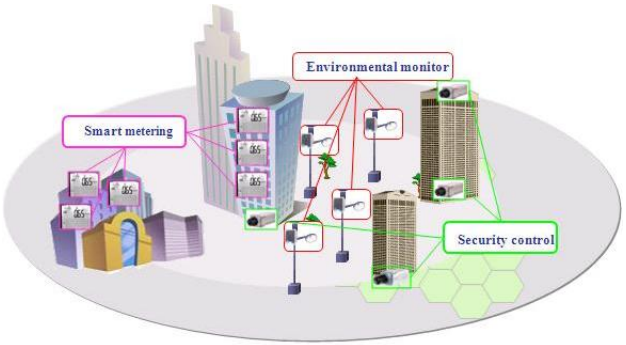
Efficiency : Paging Optimization

Scenario 1: Macro Cell



Diverse internet applications make the network has more opportunities to know the locations of users

Scenario 2: MTC

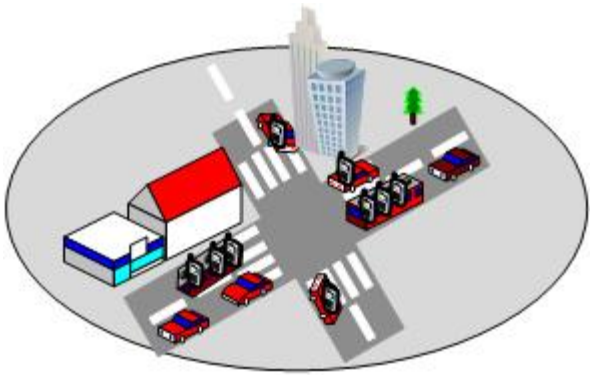


In R10 low mobility MTC applications, solution proposed is premature

- **For UMTS macro cell scenario, one possible solution is to enlarge paging area gradually in order to control the number of paging**
- **Consider different solutions for MTC case, one possible solution is to page low mobility MTC terminals in specific cell**

Efficiency : Small data services in high mobility

Smart Phone



Consumers more and more prefer to use smart phones in high mobility scenario

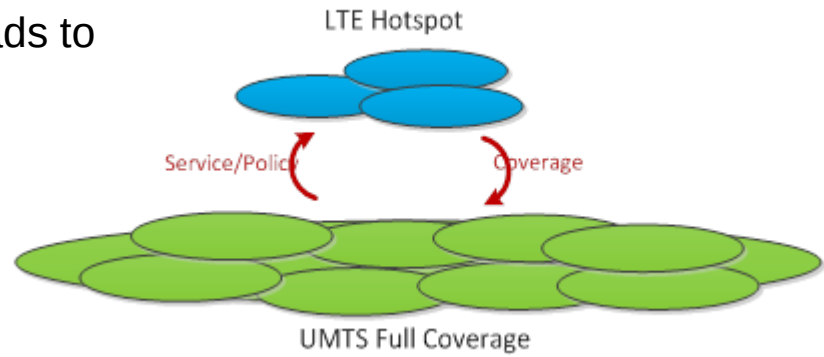
MTC

High mobility MTC use case becomes much more popular (e.g. car monitoring)

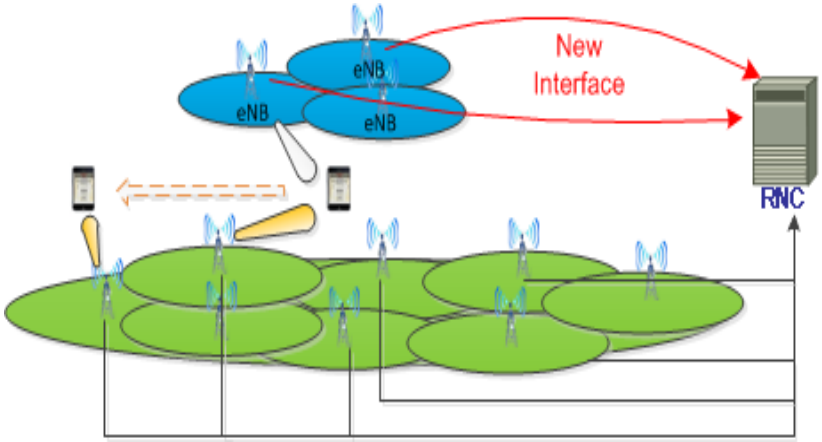
- **High mobility scenario is necessary. R11 E-DDA mainly focuses on low mobility. The solution is not adapt to the high mobility case**
- **Study on small data transmission optimization for high mobility scenario is needed**
- **One possible solution is to optimize the existing signaling mechanism, such as handover, state transfer and so on**

Coordination : HSPA/LTE e-interworking

- **GSM/HSPA/LTE will coexist for a long time**
  - Frequent and inefficient inter-RAT handover leads to heavy network burden and poor QoE
- **Enhance network coordination to**
  - Facilitate multiple networks maintenance and interworking
  - Maximize the benefits of multi-RAT deployment

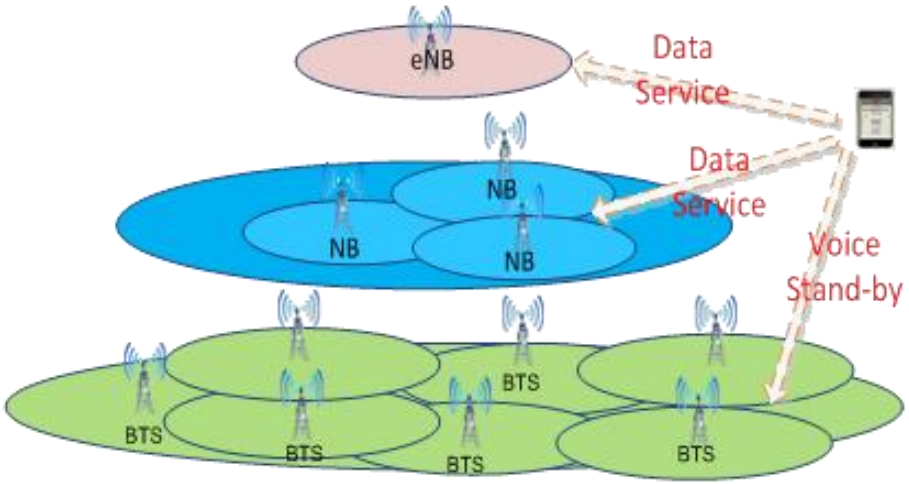


- **Possible architecture enhancement for UMTS/LTE mobility improvement and resource aggregation:**
  - Optimize interworking procedure
  - HSPA/LTE aggregation
    - Provide well CS Voice continuity
    - Eliminate frequent inter-RAT handover;
    - Easy for LTE initial implementation



Coordination : Multi-mode UE

- **RAN enhancement for multi-mode multi-standby/pass UEs**



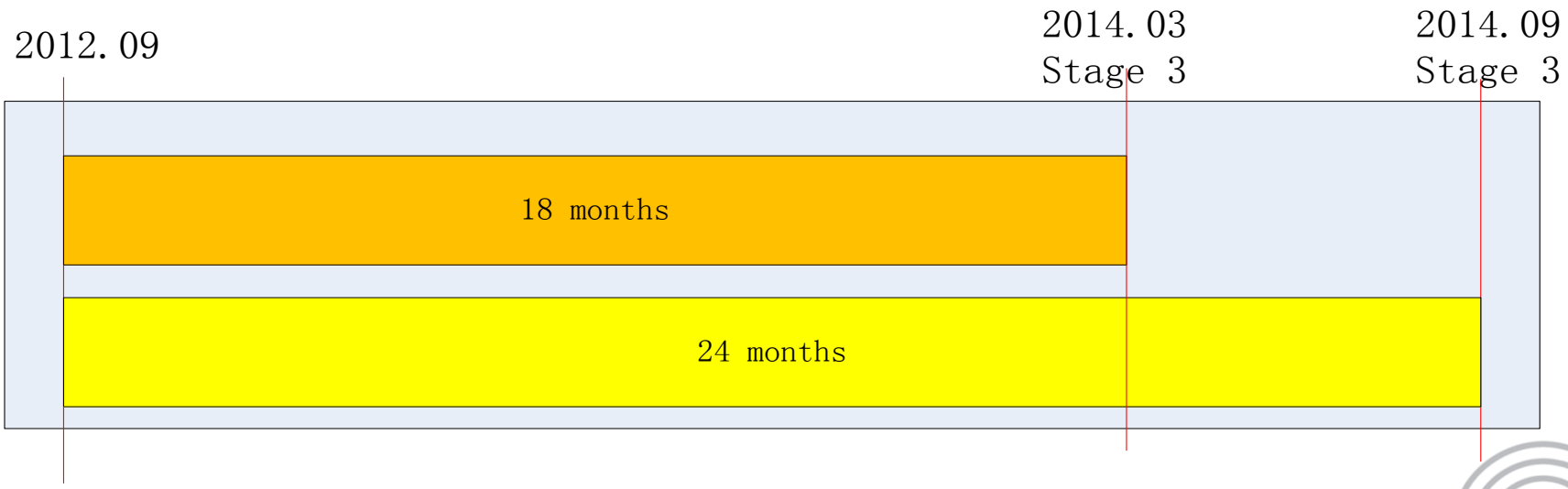
- Multi-mode terminal will play an important role to help network convergence
- Multi-mode multi-standby/pass UE has become popular in China and Indian market
- Network has not fully utilized its multi-RAT capability and coordinated with UE side for better efficiency

- Network enhancement for closer coordination among different RAT for higher network efficiency and lower UE complexity.
- Network-assistant mechanisms to facilitate the application of multi-mode multi-standby UE

Other important topics and R12 Timeline

- HSPA / LTE HetNet
- Multi-flow / CoMP
- Intra/Inter-RAT CA
- Enhanced UL coverage
- MDT
- E-DDA
- SON
- Relay
- AAS / 3D MIMO
- MB-MSR

R12 should last at least 18 months to guarantee time for WI/SIs including UMTS and LTE



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