Inter-Working Signal (IWS) for Femtocell operation

Notice:
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Femto cell operation model

- Femto cell operation model
  - Femto cells can be in any position in the macro cell.
    - Case 1
      - Macro cells and femto cells exist in the same FA.
    - Case 2 and 3
      - Macro cells and femto cells exist in different FAs.
      - Case 2 and 3 requires inter-frequency scanning everywhere within the macro cell for MS to detect fetmo cell

  - This operation model can be linearly extended to the reuse 1 case of macro cells.

Case 1:   freq
        f1=f2

Case 2:   freq
        f1   f2

Case 3:   freq
        f1   f2
   Macro Cell   Femto Cell

Macro Cell
@ f1

Femto Cell
@ f2
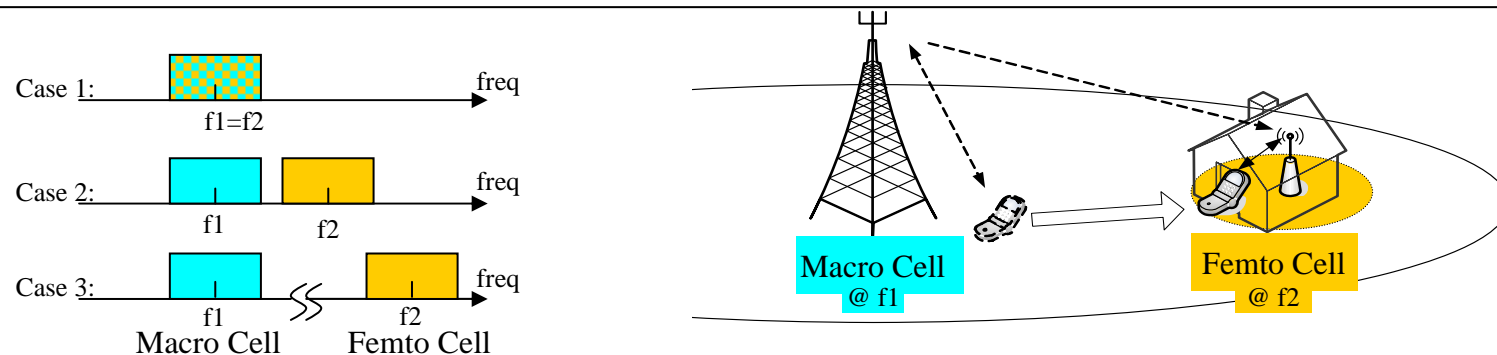
Motivations

- MS needs to detect the existence of femto BS in any FA

  - Hand-in from macro to femto without neighbor list
    - It is prohibitive to provide NBR list for large number of femto BSs
    - MS needs to detect existence of femto to make HO decision
    - Full search even for other FA is huge burden for MS
    - Full search even for other FA will results in interruption of real time services

  - Interference mitigation of femto BS by turning off
    - Femto BS needs to send periodic signal for MS to wake up femto
    - MS needs to detect existence of femto to make wakeup decision
    - Search for other FA will results in interruption of real time services

- They motivate for femto BS to send signal in FA of macro BS periodically

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IWS Transmission

- Femto BS is synchronized to macro BS
- Femto BS transmits IWS at macro BS FA in long period
- A MS can detect the existence of femto BS without scanning other FA
- Femto BSs using same FA transmit IWS in the same time/frequency region
  - Femto BSs using different FA → the resource region for IWS transmission is different
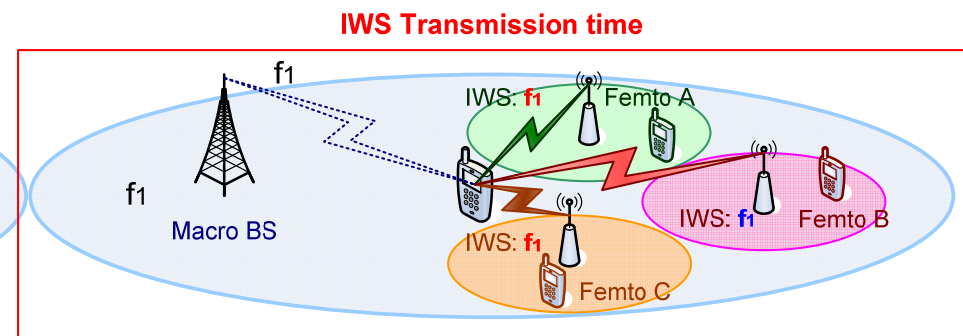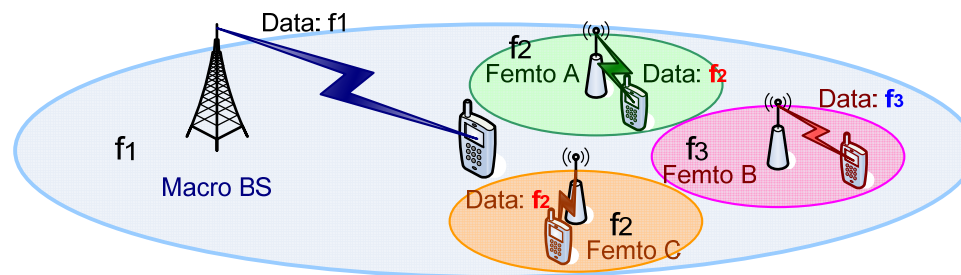
IWS Tx/Rx

- A last OFDMA symbol of a subframe is punctured for IWS
    - Only 6 or 7 symbols subframe is used and becomes 5 or 6 symbols subframe
- During the punctured OFDMA interval, femto BS's Tx IWS
    - Femto BS Tx IWS at macro FA as shown in the example below
- MS receives the IWS of femto BS without scanning other FA

IWS Transmission

- One OFDMA symbol can carry IWSs for several FAs
- All femto BSs operating at the same FA transmit the IWSs at the same resource with different permutation similar to BCH.
  - Allocated resource of IWS tells the FA where the detected IWS belongs to.
- Data protection
  - same as coverage of BCH
- Pilots for demodulation

Example of IWS transmission
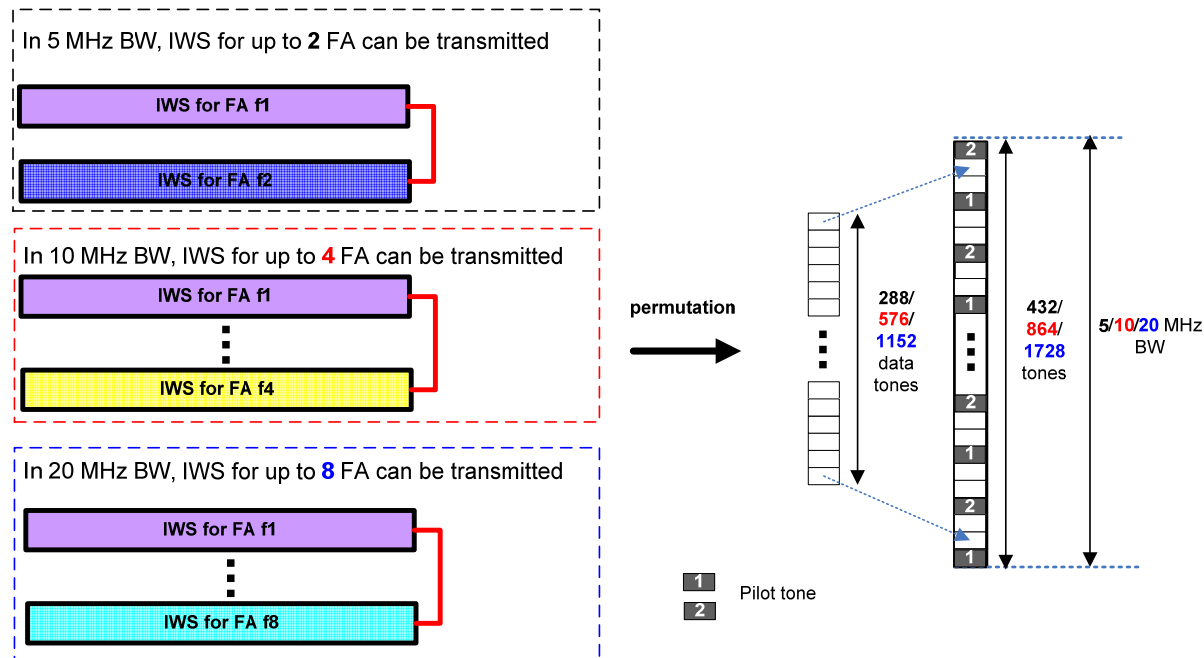
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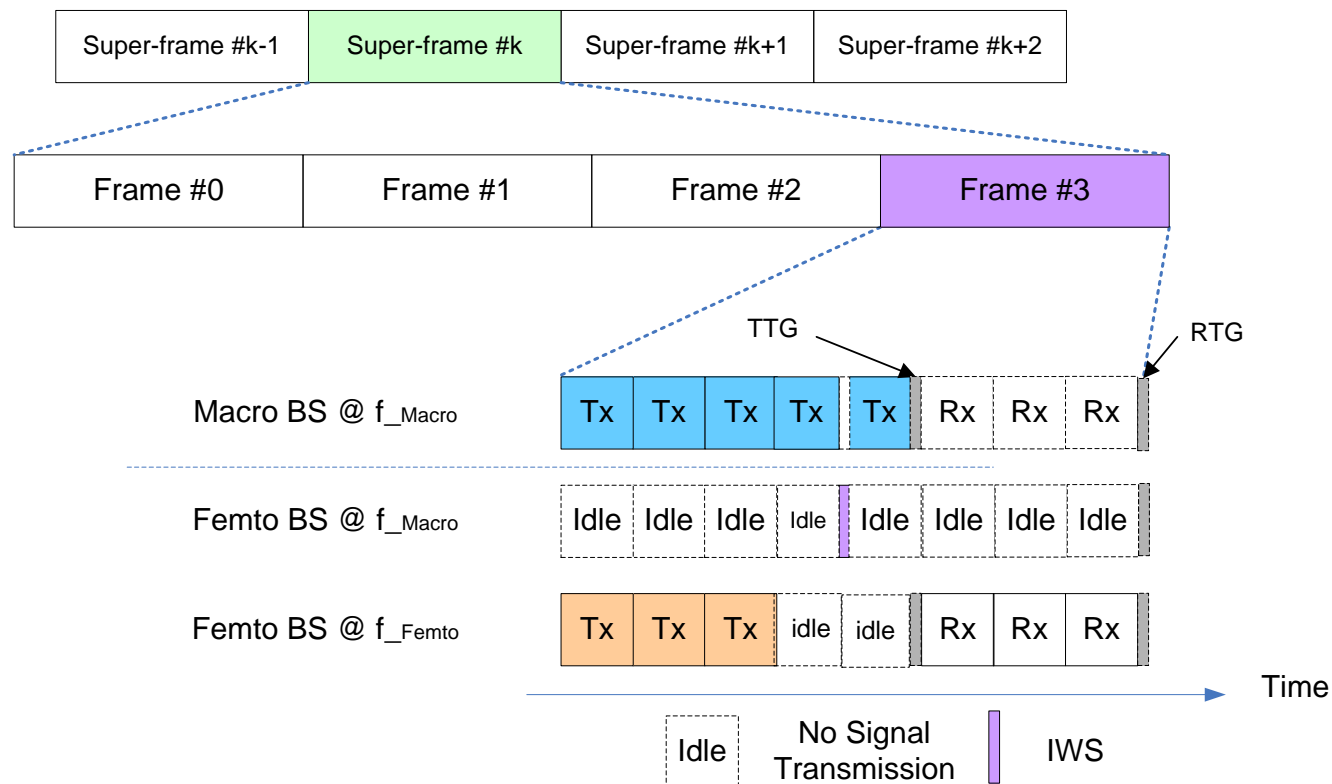- **Operation scenario of hand-in and power saving**

Operation scenarios

- Scenario1
  - IWS consists of

Preamble information (Pbits)	Turn on/off indicator (1bits)	CRC (8bits)
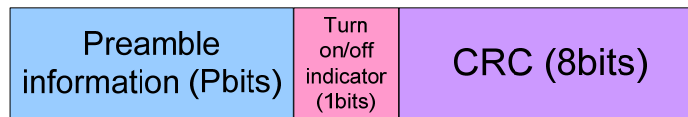
  - Preamble ID of femto BS or part of preamble ID information
    - It will reduce the burden of scanning and searching of femto BS

  - Turn-off indicator
    - '0': the femto BS wakes up and operates normally
      - The femto BS transmits 16m superframe in every time slot
    - '1': the femto BS is in turn-off mode to reduce interference
      - the femto BS transmits 16m superframe in a predetermined time slot
      - During the active superframe time slot, MS can try ranging to wake up femto BS

- MS needs L2 information from femto BS before decision to initiate HO or wakeup the femto BS

Scenario 1: Hand-in

MS

Macro BS

Femto BS Operating @ FA2

FA1   FA2   FA1   FA2   FA1   FA2

IWS configuration information

Periodic Broadcast Information
(Configuration of IWS,)

Periodic IWS (Preamble info., Power saving mode, FA)

Select target femto to scan @
FA2 & get preamble and FA info.

Scan request to the target FA

Scan response (Allocate scan interval)

Scan the target BS @ FA2
(with help of preamble info.) &
Get BSID from BCH

Decision to initiate HO to the
target BS with BSID

Handover request (BSID)

HO procedure between BSs

Handover response

Handover Indication

Network entry for handover

- IWS configuration includes how to access IWS of femfo BSs in a specific FA. MS can know FA associated with a IWS.

Scenario 1: Autonomous turn off/on

MS   **Macro BS**   **Femto BS Operating @ FA2**

FA1   FA2   FA1   FA2   FA1   FA2

IWS configuration information

Periodic Broadcast Information
(Configuration of IWS, Turn-off info.)

Periodic IWS (Preamble info., , Turn off info., FA)

Select target femto to scan @ FA2 &
get preamble, turn off and FA info.

Scan request to the target FA

Scan response (Allocate scan interval)

Superframe @ predetermined time slot

Scan the target BS @ FA2
Get system infro (BSID) from BCH

Decision to wakeup the target BS

Scan request to the target FA

Scan response (Allocate scan interval)

Ranging at UL subframe @ the predetermined superframe time slot

Wake up in response to the ranging

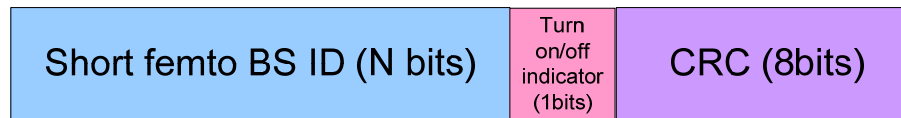Superframe @ every superframe time slot

- Instead of ranging, MS can ask macro BS to wakeup femto BS with a specific BSID through backhaul from macro to femto

Operation scenarios

- Scenario2
  - IWS consists of

Short femto BS ID (N bits)	Turn on/off indicator (1bits)	CRC (8bits)

  - Short femto BS ID
    - Enough to get the original network ID of a femto BS

  - Turn-off indicator
    - '0': the femto BS wakes up and operates normally.
      - The femto BS transmits 16m superframe in every time slot.
    - '1': the femto BS is in turn-off mode to reduce interference
      - The femto BS transmits 16m superframe in a predetermined time slot.
      - During the active superframe time slot, MS can try ranging to wake up femto BS.
  - MS does not need L2 information from femto BS before decision to initiate HO or wake-up the femto BS.
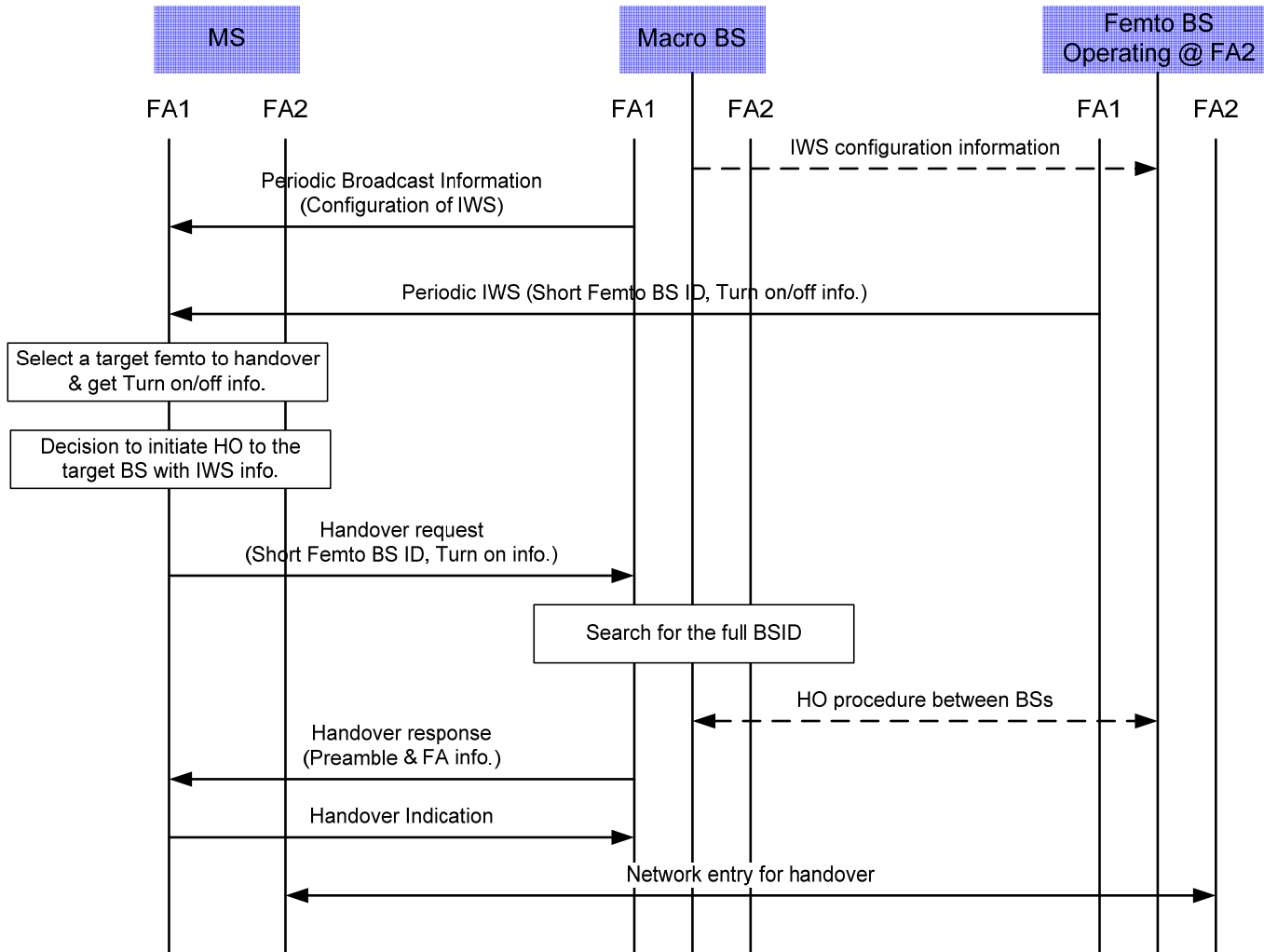
Scenario2: Autonomous turn off/on
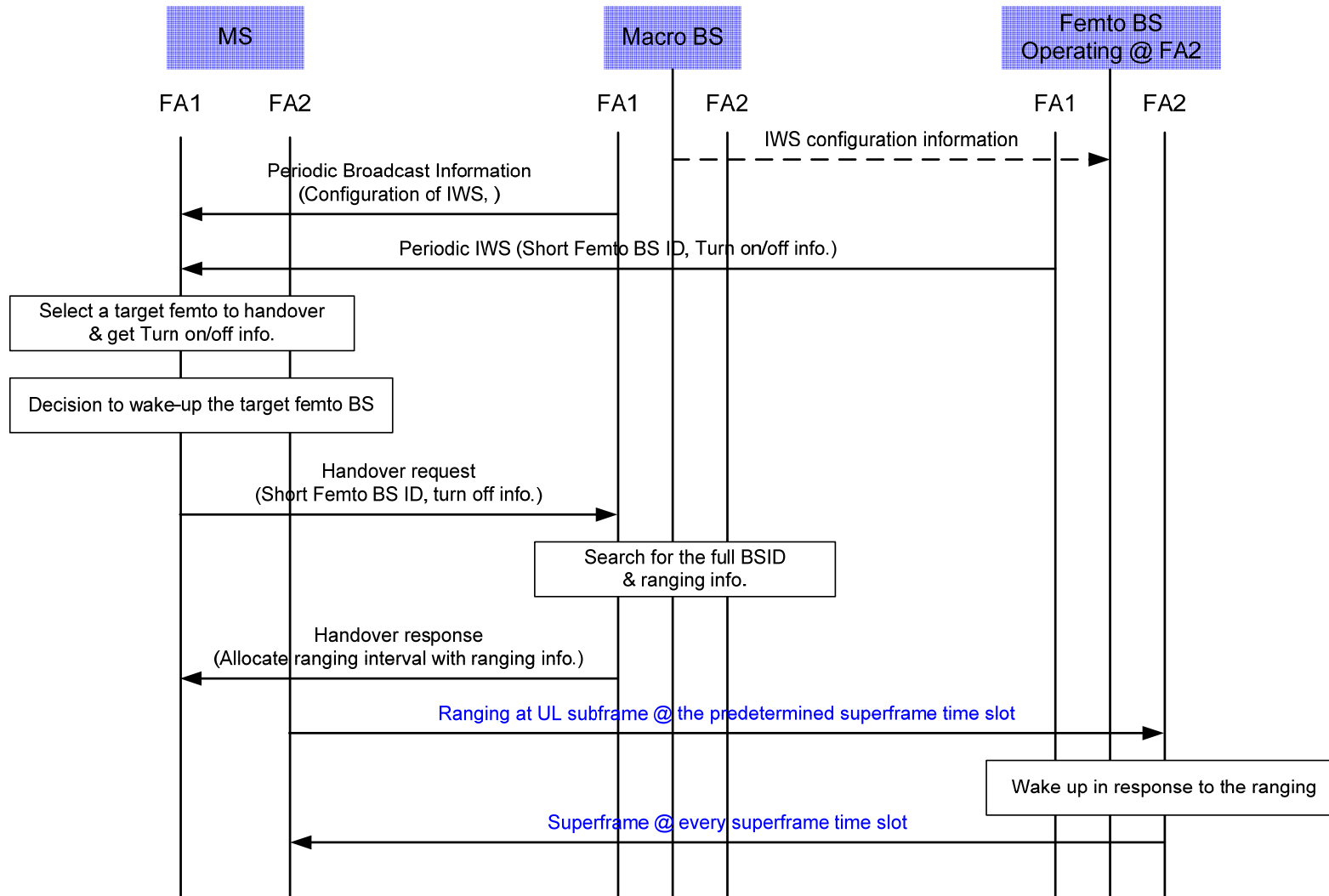
- Instead of ranging, MS can ask macro BS to wake-up femto BS with a specific BSID through backhaul from macro to femto.

SDD text

- ## 17.x Cell detection
  - Femto BS can transmit control signal in the macro BS's FA regardless of femto BS's FA: whether it uses the same FA or different FA as the macro BS. If an MS that is in communication with the macro BS receives the control signal from the femto BS, it identifies the existence of the femto BS. The control signal contains the information necessary for the MS to perform HO operation as well as the on/off state of the femto BS. The MS can then wakeup the femto BS or initiate HO to the femto BS.