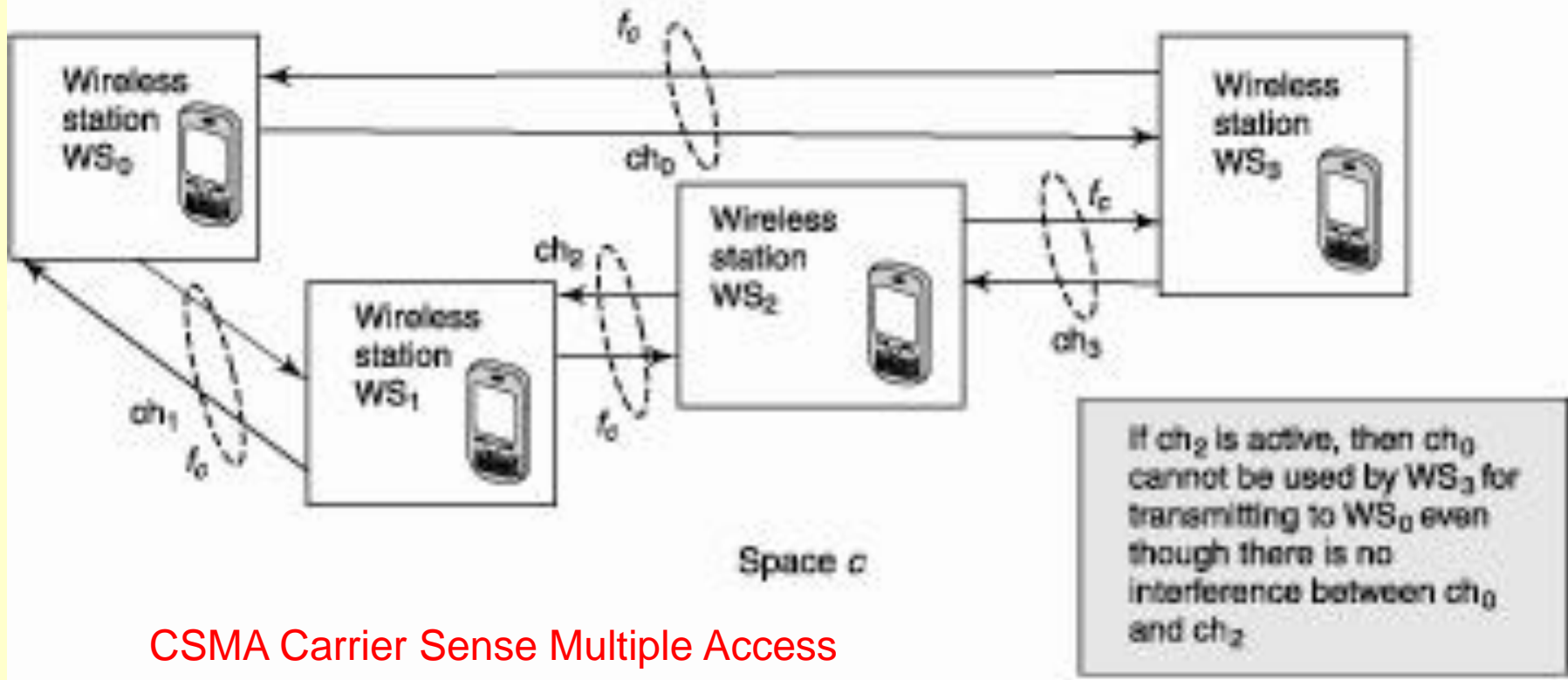


WIRELESS MEDIUM ACCESS CONTROL AND CDMA, 3G AND 4G COMMUNICATION

Lesson 03

**Exposed, Hidden, Near and Far Mobile
terminal problems and Power control
methods**

A CELL C WITH FOUR RADIO-CARRIERS USING THE SAME RADIO CARRIER FREQUENCY f_c IN THE SAME TIME-SLOT AND CSMA



CSMA Carrier Sense Multiple Access

MULTIPLE ACCESS CONTROL FOR EXPOSED TERMINALS IN CSMA

- When ch2 is active, then ch0 cannot be used by WS3 for transmitting to WS0 even though there is no interference between ch0 and ch2
- WS3 senses that the radio carrier f_c being used by WS2 and backs off
- WS3 thus *exposed* to the WS2 carrier

HIDDEN TERMINAL PROBLEM IN CSMA

- WS_0 cannot sense the ch_0 signals from WS_0 because the signal strength decreases as the inverse of the square of the distance between the two terminals
- When WS_0 transmits to WS_1 or WS_2 , since WS_3 does not sense that the radio carrier f_c is being used by WS_0
- WS_3 also starts transmission to WS_1 or WS_2

HIDDEN TERMINAL PROBLEM IN CSMA

- The radio carriers from WS_0 and WS_3 interfere (collide) in the region near WS_1 and WS_2
- The collisions of the signals from WS_3 with signals from WS_0 are not detected by WS_0 in CSMA (but they can be detected in CSMA/CD)
- This is because WS_0 is hidden to the WS_3 carrier

MULTIPLE ACCESS CONTROL FROM NEAR AND FAR TERMINALS

- Each WS transmits with a set of frequencies coded with a distinct code
- WS_3 sends signals via ch_0 for WS_0
- The signal strength is weak along the ch_0 region near WS_0
- Signal strength decreases as inverse of the square of the distance between the two terminals

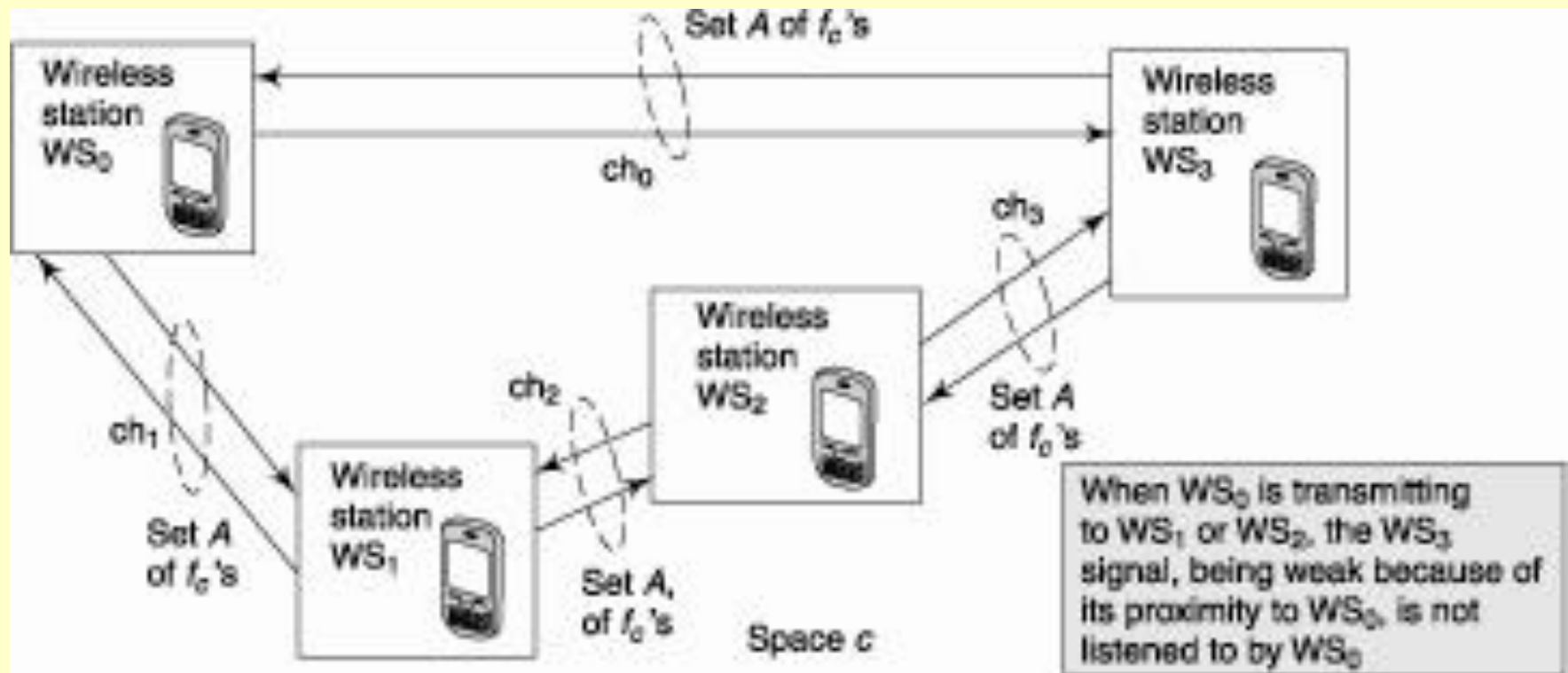
MULTIPLE ACCESS CONTROL FROM NEAR AND FAR TERMINALS

- When WS_0 is transmitting to WS_1 or WS_2 , the WS_3 signal, being weak in proximity to WS_0 , is not listened to by WS_0
- The ch_1 signal strengths are higher near WS_0 as compared to the ch_0 signal strengths

MULTIPLE ACCESS CONTROL FROM NEAR AND FAR TERMINALS

- The strong ch_1 signals superimpose on the weak ch_0 signals at WS_0
- WS_3 is the *far terminal* and WS_1 or WS_2 are the *near terminals*
- The radio carriers from both WS_3 and WS_1 will be listened to if the transmission power is raised in ch_0 or decreased in ch_1

A CELL C WITH NEAR AND FAR TERMINALS USING FOUR RADIO-CARRIERS



POWER CONTROL

- Required for the far and near terminals to avoid drowning of the far terminal signals in presence of signals from the near terminals

GSM SYSTEM BTS TRANSMISSION

- To an MS during CCH data bursts, the required power transmission level from that MS is decided by measurements of the signal strengths from the MS
- The RRM layer performs the signal measurement and power control tasks
- GSM defines five levels of power transmission

CDPD TRANSCEIVERS

- Transmit the power-received level during the CSI (channel stream identification) data bursts for an MS by measurements of the signal strengths at the RRM

GSM SYSTEMS CLOSED LOOP POWER CONTROL

- The MS and BTS measures the signal strength
- MS transmits information regarding the signal quality to the BTS
- MS adjusts its power level to minimize the transmitted power and still maintain an acceptable quality of signals
- Both ways transmission of measured power and receiving end adjusts its power accordingly

GSM SYSTEMS CLOSED LOOP POWER CONTROL

- MS adjusts its power level to minimize the transmitted power and still maintain an acceptable quality of signals
- Closed loop— Both ways transmission of measured power and receiving end adjusts its power gain accordingly

CDMA IS-95 OPEN LOOP POWER CONTROL

- Mechanism for near and far terminals
- Open loop— One way transmission of measured power and receiver end adjusts its power gain accordingly

SUMMARY

- Wireless exposed and hidden terminal problem
- Wireless near and far terminal problem
- Closed loop power control in GSM
- Open loop in CDMA

End of Lesson 03

**Exposed, Hidden, Near and Far Mobile
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