Lesson 04
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
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 WS0 and WS3 interfere (collide) in the region near WS1 and WS2
- The collisions of the signals from WS3 with signals from WS0 are not detected by WS0 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 $\text{ch}_1$ signals superimpose on the weak $\text{ch}_0$ signals at $\text{WS}_0$
- $\text{WS}_3$ is the *far terminal* and $\text{WS}_1$ or $\text{WS}_2$ are the *near terminals*
- The radio carriers from both $\text{WS}_3$ and $\text{WS}_1$ will be listened to if the transmission power is raised in $\text{ch}_0$ or decreased in $\text{ch}_1$
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 04
Exposed, Hidden, Near and Far Mobile terminal problems and Power control methods