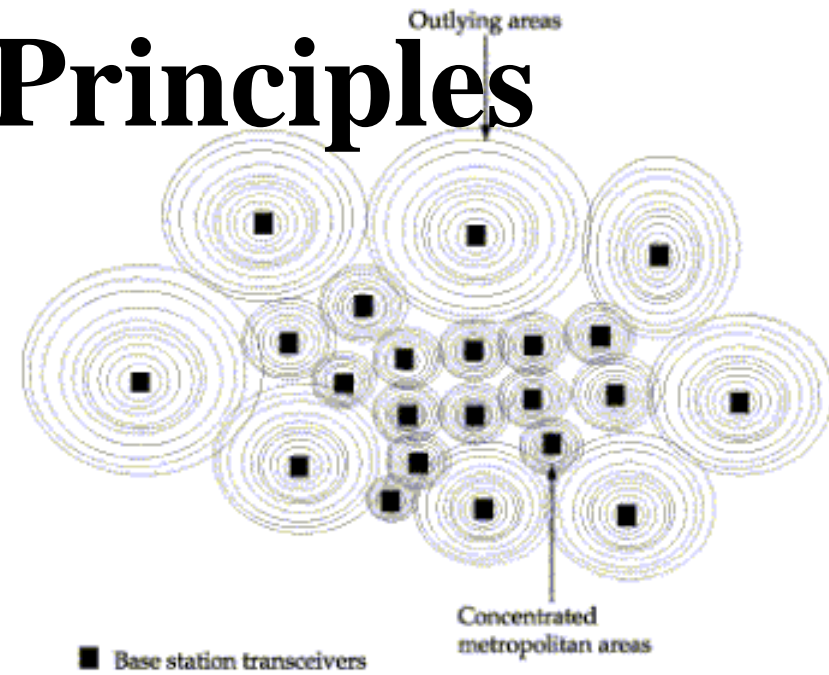


Cellular Principles



AMPS: Advanced Mobile Phone Service ~1980

Wireless and Mobile
Crae Y. Lee

5 Goals of AMPS

How the Goal was met previously

1) Large subscriber capacity

Only if many channels are allocated

2) Efficient use of spectrum

Low reuse

- separation of cells by Earth curvature

- 50% utilization (guardband)

3) Good coverage

High power

4) Provide service to low (portable handset) and high power (automobile mounted handset) users

Low power users had much less range and coverage

5) Build a system adaptive to traffic intensity both in space and time

Insensitive to traffic density

Four Concepts

1. Cells
2. Frequency reuse
3. Cell splitting/Partitioning/Sectorization
4. Handoff

Many low power Tx give same coverage of a single high power Tx

100 cells each with 100w vs. single tower 100kw

BS can communicate with low/high power users

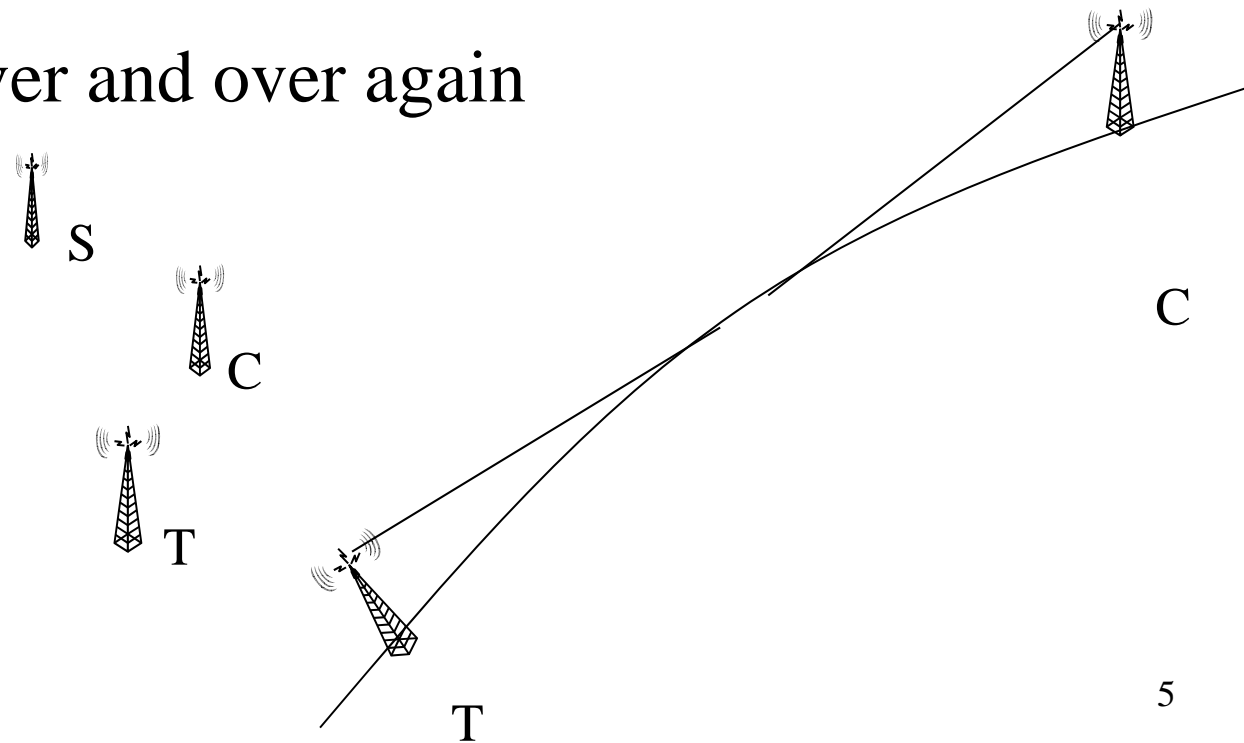
Early Frequency reuse attempts in broadcast system

FM Radio spectrum 87.9 - 107.9 MHz

$20\text{MHz}/200\text{kHz} = 100$ possible radio stations

Total $\approx 11,000$ FM/AM radio stations in USA

Use channel over and over again



Reuse Principle

1. Blast out the power: 50k-100kW in FM
2. Large geographic separation

For issues in Mobile communication radio

Good S/N

Good coverage

Co-channel interference

Adjacent channel interference

Fading

Building Penetration

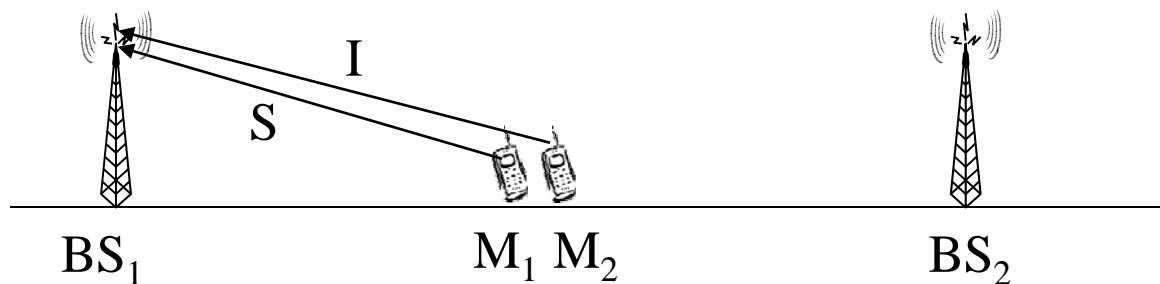
Consistent signal quality

Frequency Reuse

Wireless and Mobile
Chae Y. Lee

Frequency can be reused as far as C/I is satisfied

Ex. M_1 with BS_1 and M_2 with BS_2 , FDD



(at BS_1) $C/I = (d_I/d_S)^4 = 1$ or 0dB

$BS_1 \xrightarrow{f_1} M_1$

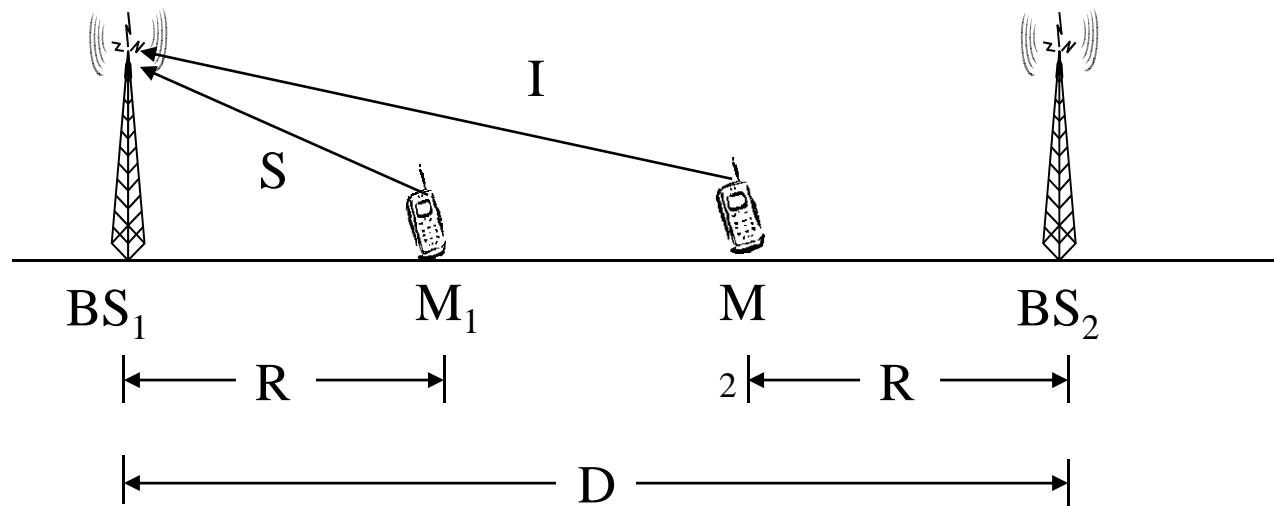
$BS_2 \xrightarrow{f_1} M_2$

$BS_1 \xleftarrow{f_2} M_1$

$BS_2 \xleftarrow{f_2} M_2$

Frequency Reuse

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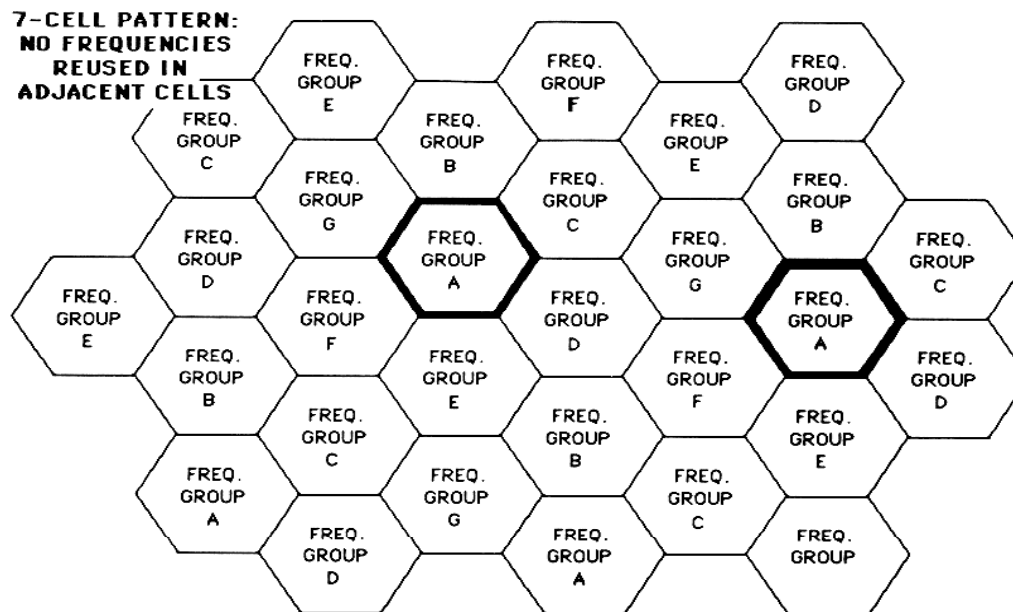
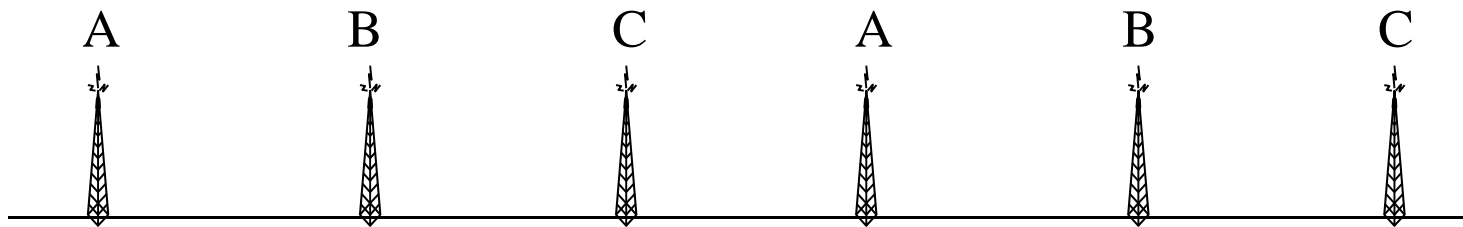
(at BS_1) $C/I = \{(D-R)/R\}^4$, typical value: 10-20dB

As making R small enough $C/I \rightarrow \infty$

Make R small enough relative to the spacing D
of co-channel cell sites

Frequency Reuse

23 channels with Group A, B, C each with 7 channels



7-cell pattern:

No frequencies reused
in adjacent cells

Adaptive to traffic density over time/space

