Cellular Network: Base Station Recovery

Po-Kai Tseng
Adviser: Wei-Ho Chung
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Base Station Recovery

• BS recovery: an alternative is overlaying architecture by adjusting transmission power of all available base stations.

BS 3 failure:
Problem Formulation

• Formulation:

Max Survivability

subject to

(1) demand constraints
(2) (BS, user) assignment
(3) power constraints
Problem Formulation

Max \sum_{s \in S} \sum_{b \in B} \sum_{u \in U} x^s_{bu}

Subject to

(1) \quad x^s_{bu} d_u \leq W \log_2 (1 + \frac{p^s_b g_{bu}}{\sum_{k \in B \setminus B_s} p^s_k g_{ku} + N_0 W}), \quad \forall s \in S, b \in B, u \in U

(2) \quad \sum_{b \in B} x^s_{bu} \leq 1, \quad \forall s \in S, u \in U

(3) \quad x^s_{bu} = 0 \text{ or } 1, \quad \forall s \in S, b \in B, u \in U

(4) \quad 0 \leq p^s_b \leq P_{\text{max}}, \quad \forall s \in S, b \in B \setminus \{B_s\}

(5) \quad p^s_b = 0, \quad \forall s \in S, b \in B_s

(6) \quad x^s_{bu} = 0, \quad \forall s \in S, b \in B_s, u \in U

Notations:

- B: set of base stations.
- U: set of users.
- S: set of potential failed states.
- B_s: set of failed base stations at state s.
- d_u: demand of user u.
- p_{\text{max}}: maximum transmission power.
- W: channel bandwidth.
- N_0: ambient Gaussian noise density.

Decision variables:

- x^s_{bu}: =1, if the base station b is determined to serve user u at state s; =0, otherwise.
- p^s_b: the transmission power of base station b at state s.
Problem Decomposition

For each given state $s$:

$$\text{Max } \sum_{b \in B} \sum_{u \in U} x_{bu}^s$$

Subject to

(1) \[ x_{bu}^s d_u \leq W \log_2 (1 + \frac{p_b^s g_{bu}}{\sum_{k \in B, k \neq b} P_k^s g_{ku} + N_0 W}), \quad \forall b \in B, u \in U \]

(2) \[ \sum_{b \in B} x_{bu}^s \leq 1, \quad \forall u \in U \]

(3) \[ x_{bu}^s = 0 \text{ or } 1, \quad \forall b \in B, u \in U \]

(4) \[ 0 \leq p_b^s \leq P_{\text{max}}, \quad \forall b \in B \setminus \{B_s\} \]

(5) \[ p_b^s = 0, \quad \forall b \in B_s \]

(6) \[ x_{bu}^s = 0, \quad \forall b \in B_s, u \in U \]
Solution Procedure: B1 fails

Search available BSs

Miss comm. users

Served by the BS with min distance

interference and demand

Channel and power allocation
If BSC failure (distributed algorithm)

1. Search available BSs
2. Response received signal strength
3. Response a random number
4. Determine BS by the best signal or largest number

interference and demand
Channel and power allocation
Thank You!