Optimized UTRAN Topology Planning Including Point-to-Multipoint Equipment

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Network elements and logical topology in UTRAN

UMTS radio access network (UTRAN)

MSC = Mobile Switching Center (circuit oriented)

SGSN = Serving GPRS Support Node (packet oriented)

RNC = Radio Network Controller

PMP entity = Point to Multipoint Entity, consisting of:
  PMP Master Station, Peripheral Stations and connected Node Bs
Point to Multipoint Entity

- Leased Line or Point to Point microwave link
- PMP sector

PMP Entity: 4 sectors
Goal

- Introduce PMP Equipment into UTRAN in order to reduce network costs

Algorithm Input

- UTRAN solution with pure leased lines and/or point-to-point microwave topology
- Set of optional PMP master station locations
- Costs (CAPEX and OPEX)
- Constraints (capacity, range, connectivity)
Step 1: determine feasible PMP locations

**Result:** Subset of PMP locations that:

- **satisfy constraints**
- **yield profit compared to point-to-point microwave and leased lines**
- **are partitioned into four sectors (not on the picture)**
Step 2: Solve Weighted Independent Set Problem

Result: maximum non-overlapping collection of PMP entities
The Algorithm 4/4

- **Step 3: build initial tree**
  - Connect PMP master stations to RNC
  - Connect peripheral stations to PMP master stations

- **Step 4: add Node B to initial tree**
  - Sort Node B by their distance to initial tree
  - Repeatedly add Node B with minimal distance
  - Improve solution by rearranging sub trees

- **Output**
  - UTRAN topology with PMP equipment
  - Detailed description of introduced PMP entities
MMP&PGTS04: Optimized UTRAN Topology Planning Including PMP antenna diameter 60 cm

Horizontal range

antenna diameter 30 cm

Vertical range

Node B with Peripheral Station

antenna diameter 60 cm

RNC

PMP master

Link to NB_13_PMP

Link traffic circuit 2000

Link traffic packet 2000

Link range 2161.27
Example: UTRAN Network with 359 Node B

- NodeB
- RNC positions
- MSC pos.
- SGSN pos.
Solution using Leased Lines

Different colors indicate different RNC clusters
Solution including PMP Equipment

For four RNC clusters placing PMP entities reduces costs.

Profit in four years for the red cluster is nearly 10%.
Conclusion

- The profit of PMP solutions increases with amortization period and traffic (high investment costs but low monthly costs, one PMP master station can serve a large number of Node B)

- An algorithmic approach for introducing PMP into UTRAN topology design has been presented

- Often the results of automatic optimization are different from the expectations based on viewing locations and density of Node B's.

- The PMP solutions generated by our tool can be used as a valuable decision support for network planners.