**Mobile runner**

Initial lookup lists:

* BASE\_YEAR
* END\_YEAR
* TIMESTEP\_INCREMENT
* TIMESTEPS
* POPULATION\_SCENARIOS (high, baseline, low, static)
* THROUGHPUT\_SCENARIOS (high, baseline, low)
* INTERVENTION\_STRATEGIES (minimal, macrocell, macrocell\_700, small\_cell, small\_cell\_and\_spectrum)
* MARKET\_SHARE = 0.3
* ANNUAL\_BUDGET = £2bn across industry \* Market\_share
* SERVICE\_OBLIGATION\_CAPACITY = 10
* NETWORKS\_TO\_INCLUDE = (A, B)

Load in regions:

* Import list of Lads (lads.csv) (id, name)
* Import list of Postcode Sectors (pcd\_sectors.csv) (oslaua, pcd\_sector, population, area\_sq\_km)

Load in scenario data:

* Scenario\_files = {}
* Population\_by\_scenario\_year\_pcd = {}
* For each scenario, filename in scenario\_files.items(),
  + Open
    - For each year, pcd\_sector, population
      * Population\_by\_scenario\_year\_pcd[scenario][year][pcd\_sector] = int(population)
* user\_throughput\_by\_scenario\_year = {}
* Load in throughput by scenario, by year

Load initial system assets:

* SYSTEM\_FILENAME = ‘initial\_system\_with\_4G.csv’.
* Load into initial\_system = []

Import lookup tables:

* CAPACITY\_LOOKUP\_FILENAME = ‘lookup\_table\_long.csv’
* CLUTTER\_GEOTYPE\_FILENAME = ‘lookup\_table\_geotype.csv’

Write methods:

* write\_lad\_results
* write\_pcd\_results
* write\_decisions
* write\_spend
* get\_suffix

Start running the model

* for population\_scenario, throughput\_scenario and interventions:
  + scenario names list
    - initialise initial system assets for each year:
      * update population and throughput at each time step for lower statistical units
      * Specify base\_year:
        + System = ICTManager(…)
      * Import and use decide\_interventions() from interventions.py, and use based on based on annual budget and coverage obligations
      * Decide interventions
      * Accumulate assets
      * Simulate with decisions
      * Calc costs
        + Write

Figure 1 Mobile Model Runner

**Model Run Configuration**

* Timesteps
* Scenarios
* Interventions
* Annual budget

**Load Scenario Data**

* Demographic scenarios
* Per user data demand

**Run Model**

* MobileICTManager()
* decide\_interventions()

**Lookup Tables**

* LAD geography
* Pcd sectors
* Capacity LUT
* Clutter LUT

**Write Results**

postcodes

LADs

Decisions

Spending

**Load Initial System**

* Cells, technologies and frequencies
* Sites

**Fixed runner**

Initial lookup lists:

* premises\_level\_population\_scenarios
* Willingness to pay
* Interventions

Load in regions:

* Lads = []
  + I presume we want these for aggregating the results afterwards? We probably also need a premises to postcode to LAD lookup?
* ~~Pcd\_sectors = [] not sure why we need these here? (for geography?)~~

Load in scenario data:

* Specify Scenario\_files() #for population
* Specify Population\_by\_scenario\_year\_pcd()
* For each scenario file,
  + load in population by pcd\_sector for each year
* specify user\_WTP\_by\_scenario\_year
* Load in WTP by scenario, by year

Load initial system assets:

* Exchanges (imports the exchanges .shp files)
* Cabinets (imports the cabinets .shp files)
* Distributions (imports the distributions .shp files)
* Premises (imports the premises .shp files)

Import lookup tables (can be done at a later date):

* Premises connection type statistics

Write methods:

* write\_lad\_results
* write\_pcd\_results
* write\_decisions
* write\_spend

Start running the model

* for population, throughput\_scenario and interventions:
  + scenario names list
    - initialise initial system assets for each year:
      * update population and throughput at each time step for lower statistical units
      * Decide new interventions based on annual budget and coverage obligations
      * Specify base\_year:
        + System = ICTManager(…)
      * Decide interventions
      * Accumulate assets
      * Simulate with decisions
      * Calc costs
        + Write

Figure 1 Fixed Model Runner

**Model Run Configuration**

* Timesteps
* Scenarios
* Interventions
* Annual budget

**Load Scenario Data**

* People, in households, in premises
* WTP

**Run Model**

* FixedICTManager()
* decide\_interventions()

**Assets**

* Exchanges
* Cabinets
* Distribution points
* Premises

**Lookup Tables**

* LAD geography
* Pcd geography
* Connection capacity

**Write Results**

postcodes

LADs

Decisions

Spending

Mobile Interventions

* INTERVENTIONS (upgrade\_to\_lte(800, 2600),carrier\_700, carrier\_3500, small\_cell)
* AVAILABLE\_STRATEGY\_INTERVENTIONS(minimal, microcell(upgrade\_to\_lte, carrier\_700, carrier\_3500), microcell\_700(upgrade\_to\_lte, carrier\_700), small\_cell(upgrade\_to\_lte, small cell), small\_cell\_and\_spectrum(upgrade\_to\_lte,carrier\_700, carrier\_3500, small\_cell))
* Decide\_interventions method:
  + Meet\_service\_obligation
  + Meet\_demand
  + \_suggest\_interventions
    - Specify logic for suggested interventions in each area
      * Group assets by site
      * Upgrade\_to\_lte
      * Carrier\_700
      * Carrier\_3500
      * Small\_cell
  + Next\_larger\_value
  + \_suggest\_target\_postcodes (sorting using population density)
  + \_area\_satisfied

Figure 2 Mobile interventions

**Interventions**

* Specify all interventions
* Specify available interventions

**Decide interventions**

**Meet coverage obligation**

**Meet demand**

**Suggest target postcodes**

**Suggest interventions**

**Area satisfied?**

Fixed Interventions

* INTERVENTIONS (upgrade\_to\_FTTdp, upgrade\_to\_FTTP)
* AVAILABLE\_STRATEGY\_INTERVENTIONS (upgrade\_to\_FTTdp, upgrade\_to\_FTTP)
* Decide\_interventions method:
  + Meet\_universal\_service\_obligation (USO = 10 Mbit)
  + Meet\_demand
  + \_suggest\_interventions
    - Specify logic for suggested interventions in each area
      * FTTdp
      * FTTP
  + \_suggest\_target\_postcodes (sorting using population density)
  + \_area\_satisfied

Figure XX Fixed interventions

**Interventions**

* Specify all interventions
* Specify available interventions

**Decide interventions**

**Meet universal service obligation**

**Deliver viable investments**

**Suggest target upgrades**

**Suggest interventions**

**Area satisfied?**

CCAM (Mobile\_model)

* ICTManager
  + Lads
  + Postcode\_sectors
* LAD
  + @population
  + @population\_density
  + Add\_pcd\_sector
  + Add\_asset
  + System
  + Capacity
  + Demand
  + Coverage

PostcodeSector

* Calculate\_user\_demand
* Threshold\_demand
* @demand
* @population\_density
* Microcell\_site\_capacity
* Small\_cell\_capacity
* Capacity\_margin

Pairwise

Lookup\_clutter\_geotype

Lookup\_capacity

Interpolate