ITU / BDT- COE workshop

Nairobi, Kenya,

7 – 11 October 2002

Network Planning

Lecture NP-3.2

Service and traffic forecasting

Service forecasting:

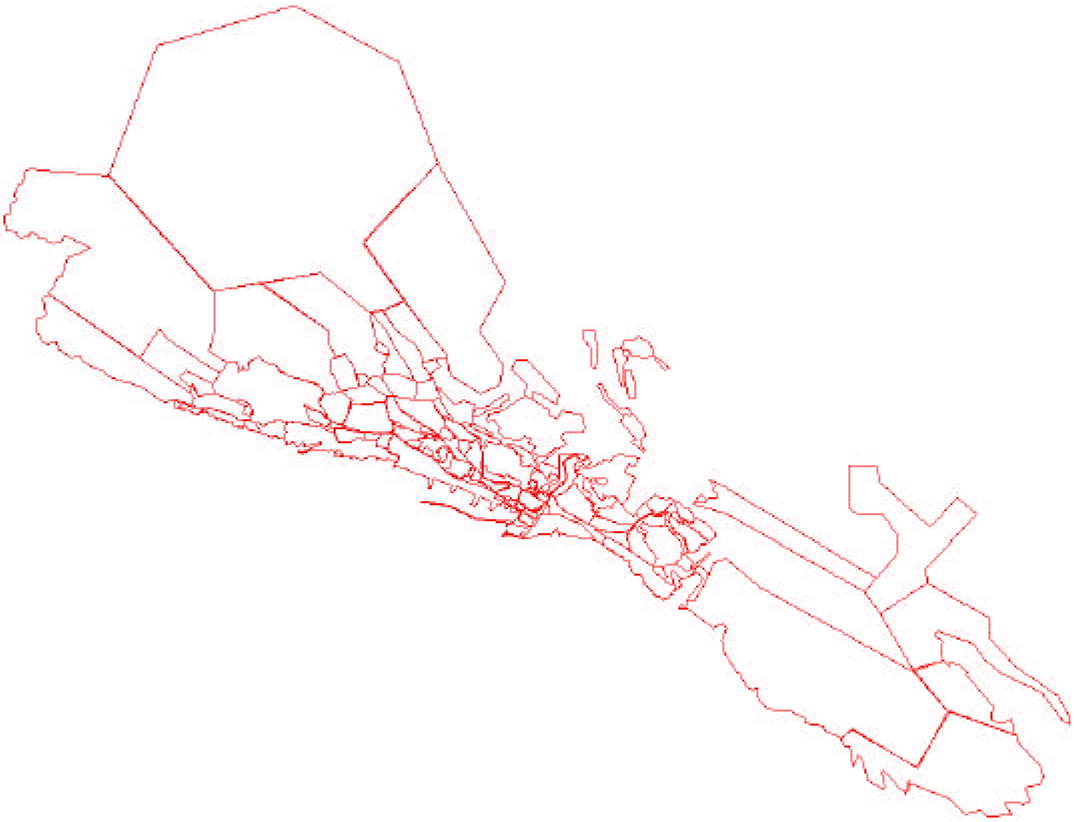
Models for subscribers

Subscriber zones –

group of subscribers, homogeneously distributed in a geographical area (group of buildings, houses, etc.).

They can be from several to several hundreds.

Example:



Typical model for subscribers in metropolitan areas.

In a city usually in the suburbs the subscriber zones are quite big areas (e.g. diameter of one km), in the centre they are much smaller (e.g. one administrative building).

Subscriber categories –

subscribers with approximately similar habits of using the telecom network.

Generally used categories are:

Residential (RES) and Business (BUS).

Further, the BUS subscribers could be divided to:

- Direct business lines (B),
- PBX lines(PBX),
- Coin box telephones (CB), etc.

Subscriber nodes –

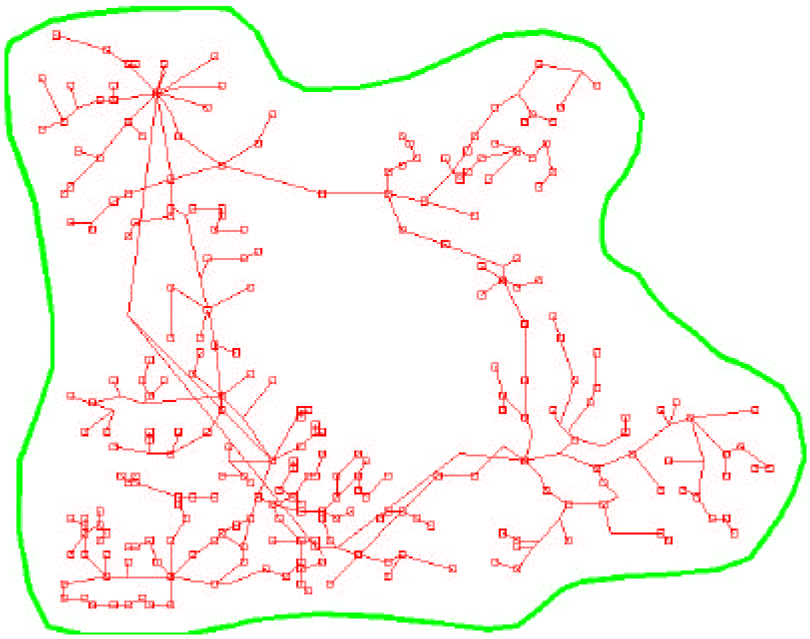
based on the network model for subscribers in a rural area

Graph model with subscribers in the nodes of the graph.

E.g. - one node is one town, village, group of houses, business centre, etc.

Typical model for subscribers in rural areas.

Example:



Subscriber categories –

Could be also Residential, Business, etc.

Or could be categories based on the categorization of the populated places.

Usually the parameter for describing a category is the size of the populated place (in inhabitants).

Example:

Category	Population
0	> 50 000
1	10000 - 50000
2	1000 - 10000
3	500 - 1000
4	100 - 500
5	0 - 100

Metods for forecasting of subscribers

- **time trend** forecasting methods - it is assumed that development will follow a curve which has been fitted to existing historical data

- **explicit relationships** between demand and various determining factors - these will remain the same in the future

- **Comparing** various steps of telecommunication development - it is assumed that the less-developed country (or area) will develop to the level of the more developed one

- personal (subjective) **judgment** in the forecast - the future will resemble the person's previous knowledge and experience of past developments.

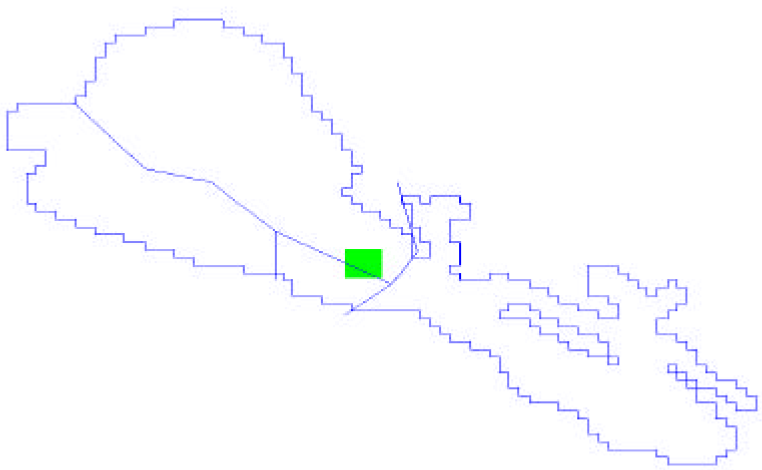
Traffic forecasting:

TTE Handbook, ITU Recommendations

Models for traffic

Scope of teletraffic engineering

Traffic zones - groups of subscribers with similar habits, homogeneously distributed in a geographical area (e.g. the center of the city, the industrial zone, the residential area.).



Calling rates - traffic per subscriber (per subscriber category, from certain traffic zone).

Traffic interest - of subscriber, between traffic zones

Forecasting – based on subscribers forecasting and calling rates

Annex: **Logistic model**

General forecasting model for development with exponential logistic curve, which means that the development is supposed to follow a curve which first accelerates, then passes a point of inflection, and finally the development slows down and approaches an asymptote, the “saturation level”, or “the maximum density”.

The exponential logistic model

$$D_V = Y_V \cdot DMAX_V$$

$$Y_V = \frac{1}{\left(1+e^{-C_V(T-T_0)}\right)^{1/M_V}}$$

General subscriber forecast expression

In our case (T = 0)

1. $Y_V(-5) = \frac{N_V(-5)+L_V(-5)}{P_V(-5)} / DMAX_V$

$Y_V(0) = \frac{N_V(0)+L_V(0)}{P_V(0)} / DMAX_V$

2. $T = 0, \quad Y = Y_V(0)$ $\qquad M_V : M_V = -\frac{\ln 2}{\ln Y_V(0)}$

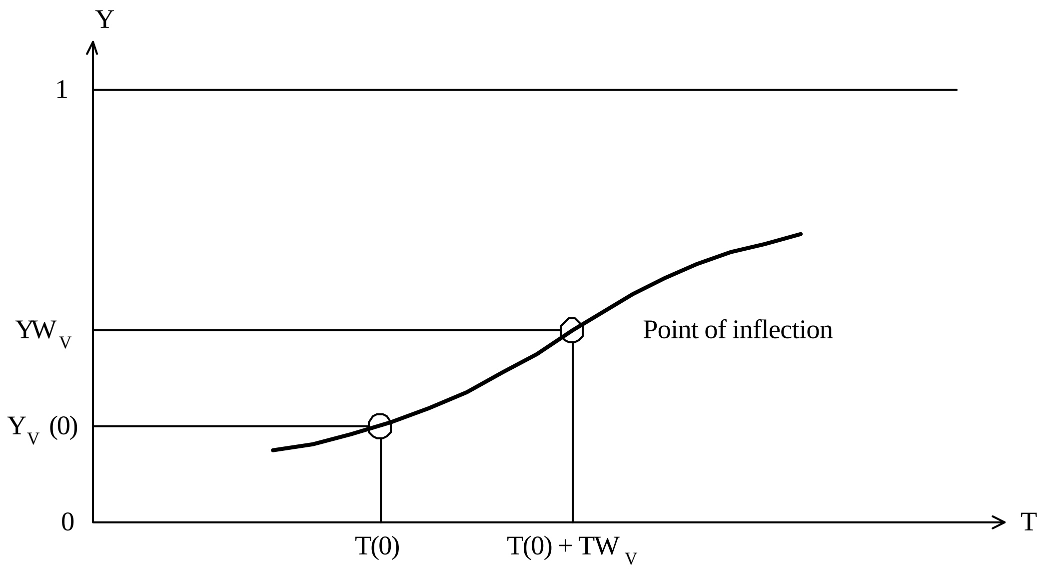
3. $T = -5, \quad Y = Y_V(-5)$ $\qquad C_V : C_V = 1/5 \cdot \ln\left\{\left(Y_V(-5)\right)^{-M_V} - 1\right\}$

4. $T = 5, 10, 15$ $\qquad Y_V(5),\ Y_V(10),\ Y_V(15)$

5. $TW_V = -\frac{\ln M_V}{C_V}$ *Distance in years from T = 0 to point of inflection*

6. $YW_V = \frac{1}{\left(M_V+1\right)^{1/M_V}}$ *Height of curve at point of inflection*

7. $D_V(T) = Y_V(T) \cdot DMAX_V(T)$



The logistic function has some valuable properties : it combines the use of historical data with a superimposed, separately estimated saturation level and can therefore work well even with very limited sets of data; it can also utilize more extensive sets of historical data through statistical curve fitting.

A limitation is however that a logistic curve always should be monotonously increasing or decreasing towards the saturation limit.

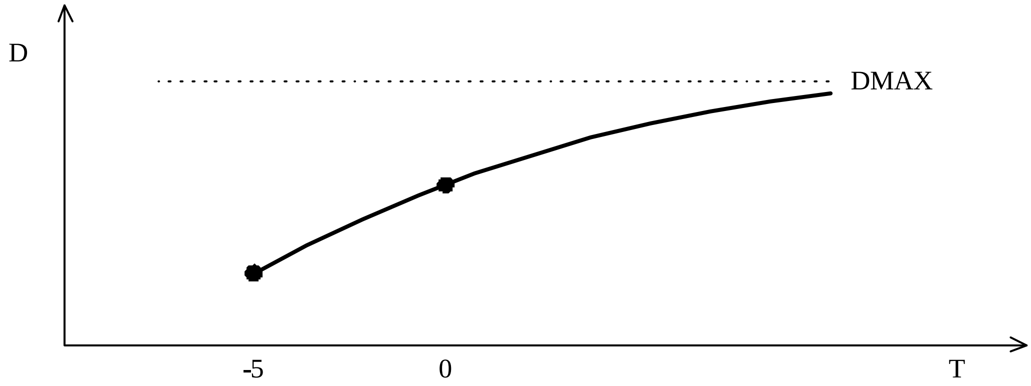
In this case study, there are historical data only for two points of time. Statistical curve fitting is therefore out of the question, so the logistic curve should preferably pass through both these points. Cases will however occur where historical data do not permit this exact fit.

These cases are usually small villages with very few main lines, often combined with a negative population development trend. Under such conditions, data are generally much less stable than otherwise. Density figures can, for example, jump up and down over time.

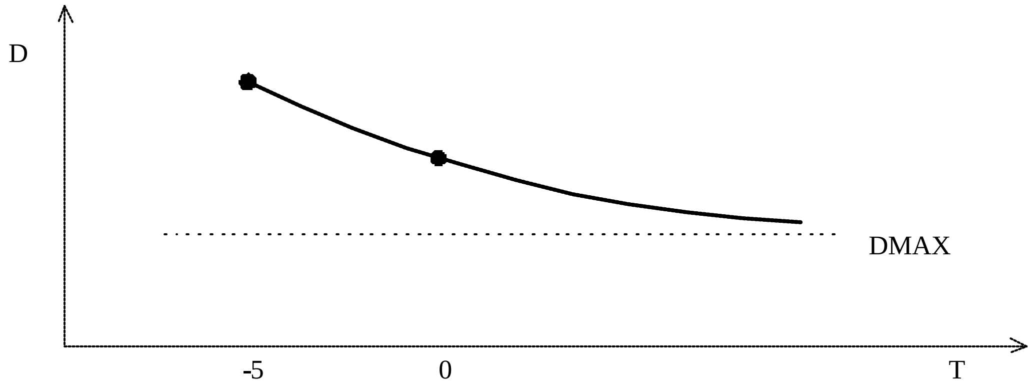
In these really very few cases, the forecast algorithm will trust the most recent historical data and the saturation level, and will thus adjust the older historical data so as to permit the logistic function to work properly.

Examples:

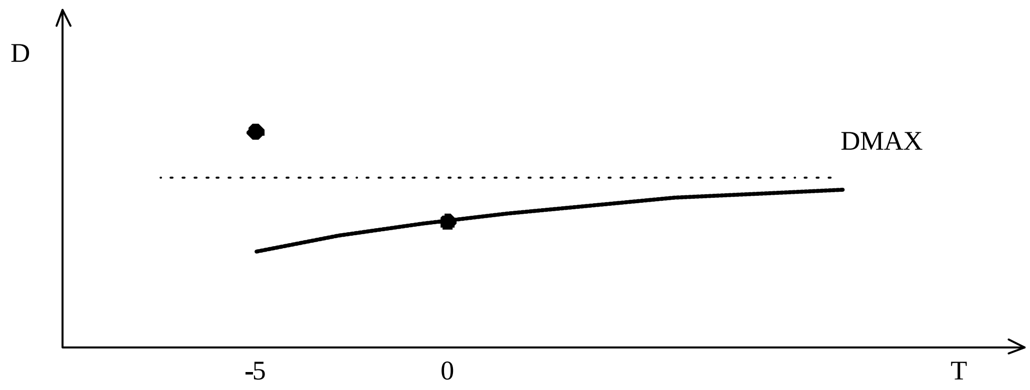
1. The most common case - growth of density both historically and in the future. The logistic function works without adjustment of data.



2. A more unusual case - density decreases both historically and in the future. Also this case is calculated without adjustments.



3. Density decreases historically - possibly even crossing the saturation level - but grows again in the future. Here, the older data is adjusted before applying the logistic function.



4. The opposite of (3) above - a historical growth followed by a future decrease. The older data is again adjusted.