ITU Seminar

Warsaw, Poland , 6-10 October 2003

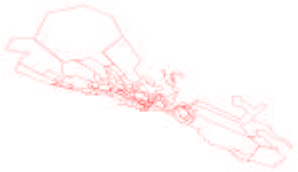
Session 3.2

Service and traffic forecasting

Service forecasting

Models for subscribers:

Subscriber zones / areas



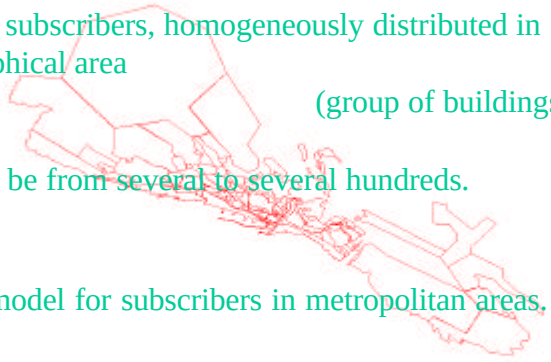
Subscriber nodes / sites

Subscriber areas

Group of subscribers, homogeneously distributed in a geographical area

(group of buildings, houses, etc.)

They can be from several to several hundreds.



Typical model for subscribers in metropolitan areas.

In the suburbs are quite big areas (e.g. diameter of one km), in the center they are much smaller (e.g. one administrative building).

Subscriber areas

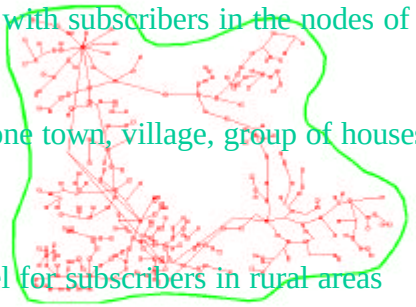
- usually the city centre is surrounded by urban areas with high customer density, while the areas in the edge are suburban areas
- often the set of areas is similar to exchange areas

Customer densities are defined per square kilometre

Each area is described with a specified mix between different categories of customers

Subscriber sites

Graph model with subscribers in the nodes of the graph



One node is one town, village, group of houses, business center, etc.

Typical model for subscribers in rural areas

Arcs of the graph represent geographical distances

Subscriber categories

Subscribers with approximately similar habits of using the telecom network

Generally used categories are:
Residential and **Business**

Could be based on the categorization of the populated places:

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

Subscriber categories

Access classes -

behind one access (subscriber) number of users may be hidden (e.g. in a company or a family); to calculate the overall number of potential accesses the number of households in a country (for residential customers) and the number of work sites (for business users) are the key parameters

Classification of users/subscribers -

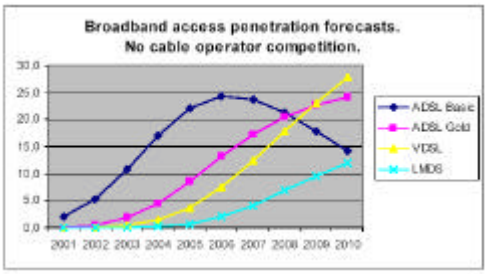
differentiate between residential users/subscribers and business users/subscribers; business is split usually into small business, medium business and large business users (e.g. it is obvious that a large business customer will rather use a high bit rate dedicated fibre access than a SOHO)

Subscriber categories

Subscriber categories defined with Customer Classes

Services - services offered to the customers :

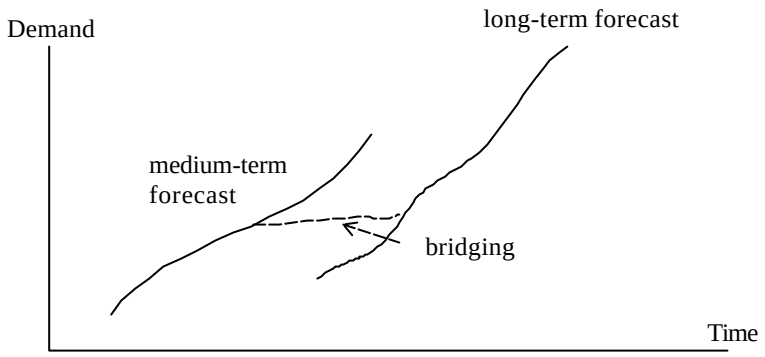
E.g. ADSL Basic, ADSL Gold, VDSL, SDSL-Medium Enterprises and SDSL-Small Enterprises.



Customer Classes – groups of customer using the same services (one or more) :

E.g. Residential ADSL Basic, Residential ADSL Gold, Small Enterprises (SDSL), Medium Enterprises (SDSL), Residential VDSL

Service/demand forecasting



Methods 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

Methods for forecasting of subscribers

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

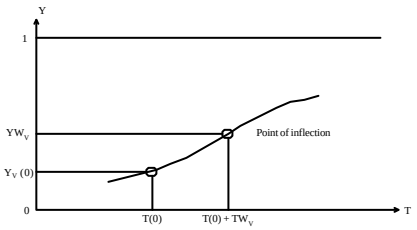
Methods for forecasting of subscribers

Logistic model

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"

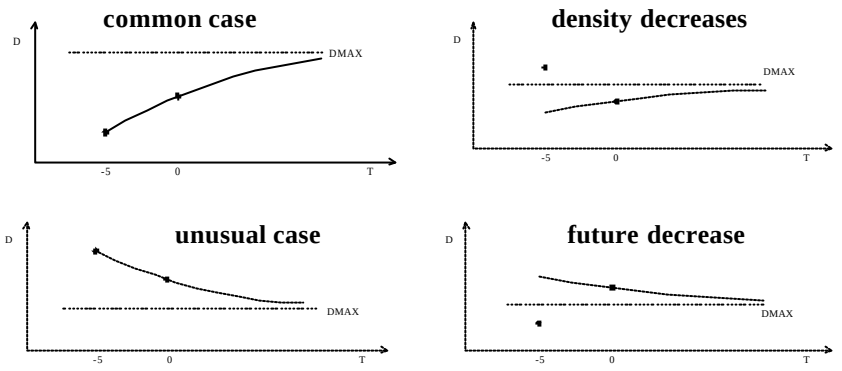
$$D_V = Y_V \cdot DMAX_V$$

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



Methods for forecasting of subscribers

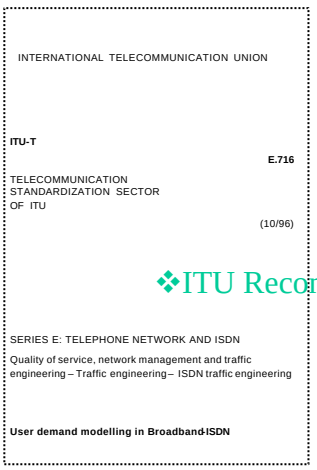
Logistic model



Traffic forecasting

Models for traffic

scope of teletraffic engineering


INTERNATIONAL TELECOMMUNICATION UNION

ITU-T

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TELECOMMUNICATION STANDARDIZATION SECTOR OF ITU

(10/96)

SERIES E: TELEPHONE NETWORK AND ISDN

Quality of service, network management and traffic engineering – Traffic engineering – ISDN traffic engineering

User demand modelling in Broadband-ISDN

❖ITU Recommendations


TELETRAFFIC ENGINEERING HANDBOOK

❖ TTE Handbook

Traffic forecasting

User demands are modelled by statistical properties of the **traffic**

Usually description of the traffic properties is split into stochastic processes for **arrival of call attempts** and processes describing **service (holding) times**

Models also exists for describing the **behaviour of users** (subscribers)

Calling rates – traffic per subscriber(user) from corresponding category, per service (e.g. with percent for each service)

Traffic forecasting

Voice traffic – traffic flow modeled with mean expressed in Erlang, calculated as multiple of 64 kbit/s per connection.

Voice over IP (VoIP) – constant bit stream application, where the mean rate equals the peak rate, compression techniques used, e.g. to 5.3 kbit/s

Internet traffic - *HTTP service (web-browsing)* – traffic modeled with mean rate, peakedness, packet loss ratio, buffer size and Hurst parameter (other parameters like mean session time – e.g. 35 min in Germany)

Traffic forecasting

Traffic generated –
The traffic generated by residential or business customers is dominated by the services used and not by the access classes.

Real traffic depends not only on the access class but mostly on the services and the user behaviour

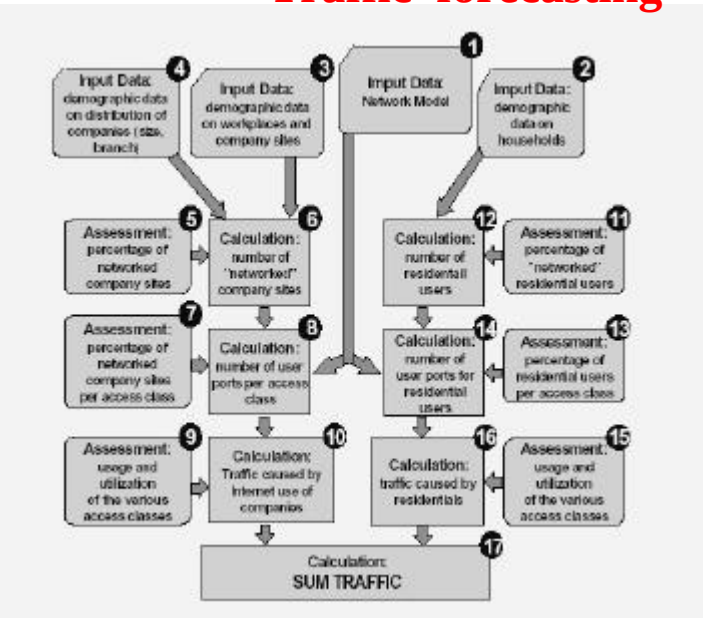
(e.g. residential users are usually active in the Internet only for a limited time and they retrieve a certain amount of data, e.g. expressed in terms of Web-Pages)

Traffic forecasting

Influence of the access classes –
Number of services will require higher bandwidth, higher bandwidth and therefore better performance will encourage some users to generate more traffic.

User/subscriber classification –
Business users are assumed to generate more traffic than residential users. Even between the business user categories different traffic is assumed.

Traffic forecasting



Methodology for Estimation of Total traffic

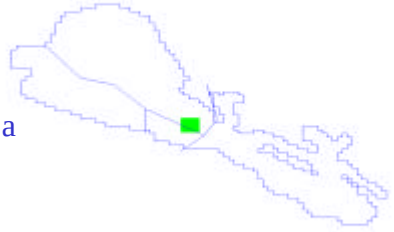
NETWORKS 2002 (Germany study)

Traffic forecasting

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.)

Traffic forecasting

Traffic interest –
of subscriber,
between traffic zones

Forecasting –
based on subscribers forecasting
and calling rates

Traffic matrix –
to specify the traffic needs in a region with *n* traffic zones (exchanges) - n^2 traffic values are required

Traffic forecasting

Traffic matrix

Set of traffic matrices – one for each services

Based on total originating and terminating traffic – distribution of the total traffics