Regional Seminar for the EUR and CIS Region on Network Planning Strategy for Evolving Network Architectures

Session 3.6

Case studies with

traffic forecasting, optimization benefits

and impact on solutions

ITU, Warsaw - Poland, 06 – 10 October 2003

Case studies :

Traffic forecasting, optimization benefits and impact on solutions

Presented with application of the network planning tool PLANITU in the form of a live demo.

PLANITU is a tool for optimisation and dimensioning of telecom networks, based on an integrated interactive approach for finding minimum cost solutions for:

• location and boundaries of exchanges

• selection of switching and
    transmission equipment
• circuit quantities, traffic routing,
    switching hierarchy

• choice of transmission paths.
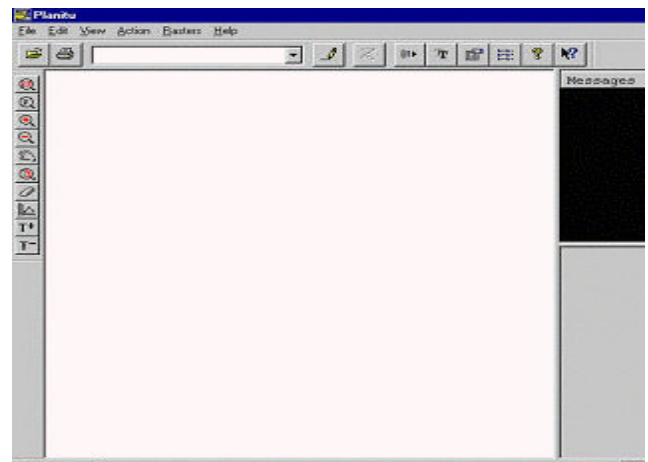
APPLICATION:

In PSTN circuit-switched (TDM) networks dimensioning and optimization , very limited for Data (packet) networks, limited for investigation of the evolution to NGN.
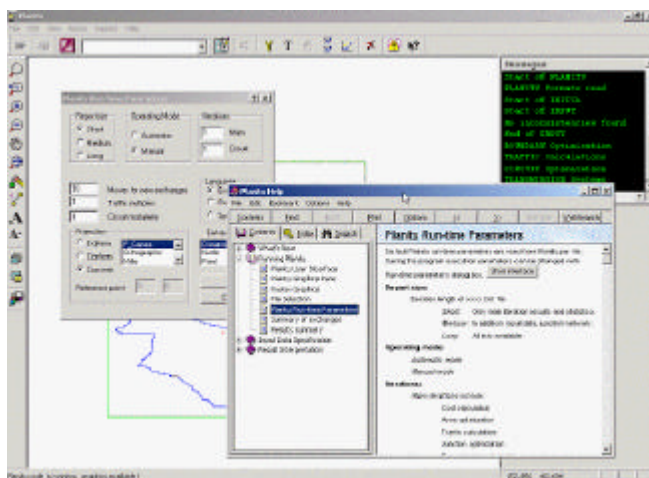
Application as training tool for network planning – set of real case studies data, self-training users manual, real-time help functions.

Service/Traffic forecasting:

Digitizing of zones

Subscriber zones

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

- usually the city centre is surrounded by urban areas with high customer density, while the areas in the edge are suburban areas

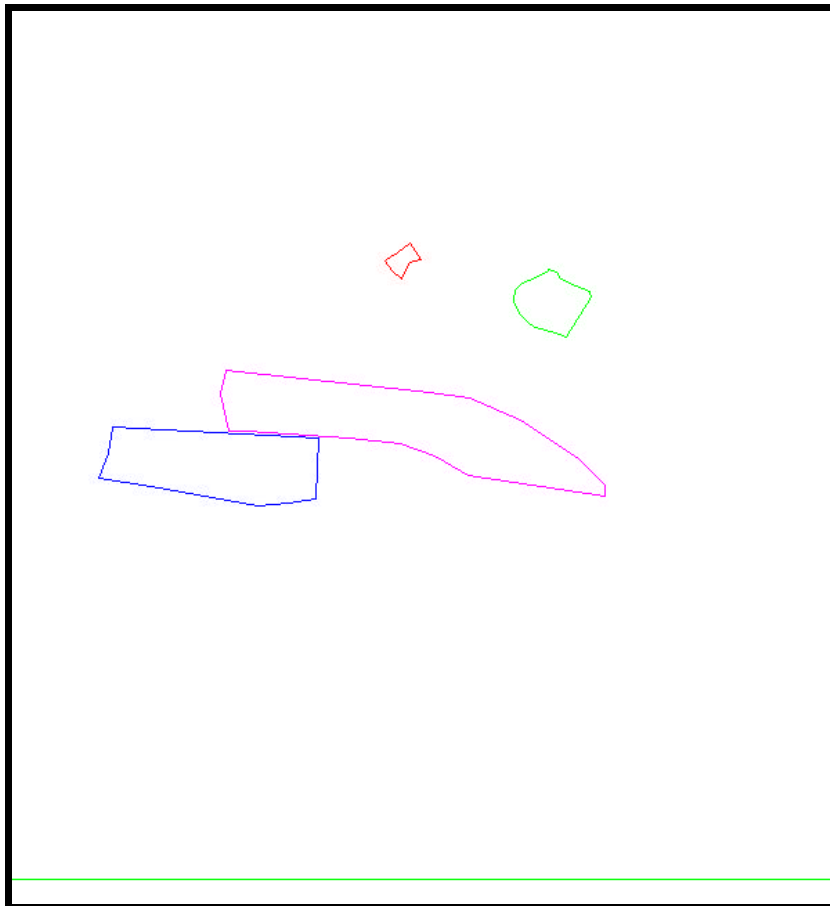- often the set of areas is similar to exchange areas

They can be from several to several hundreds.
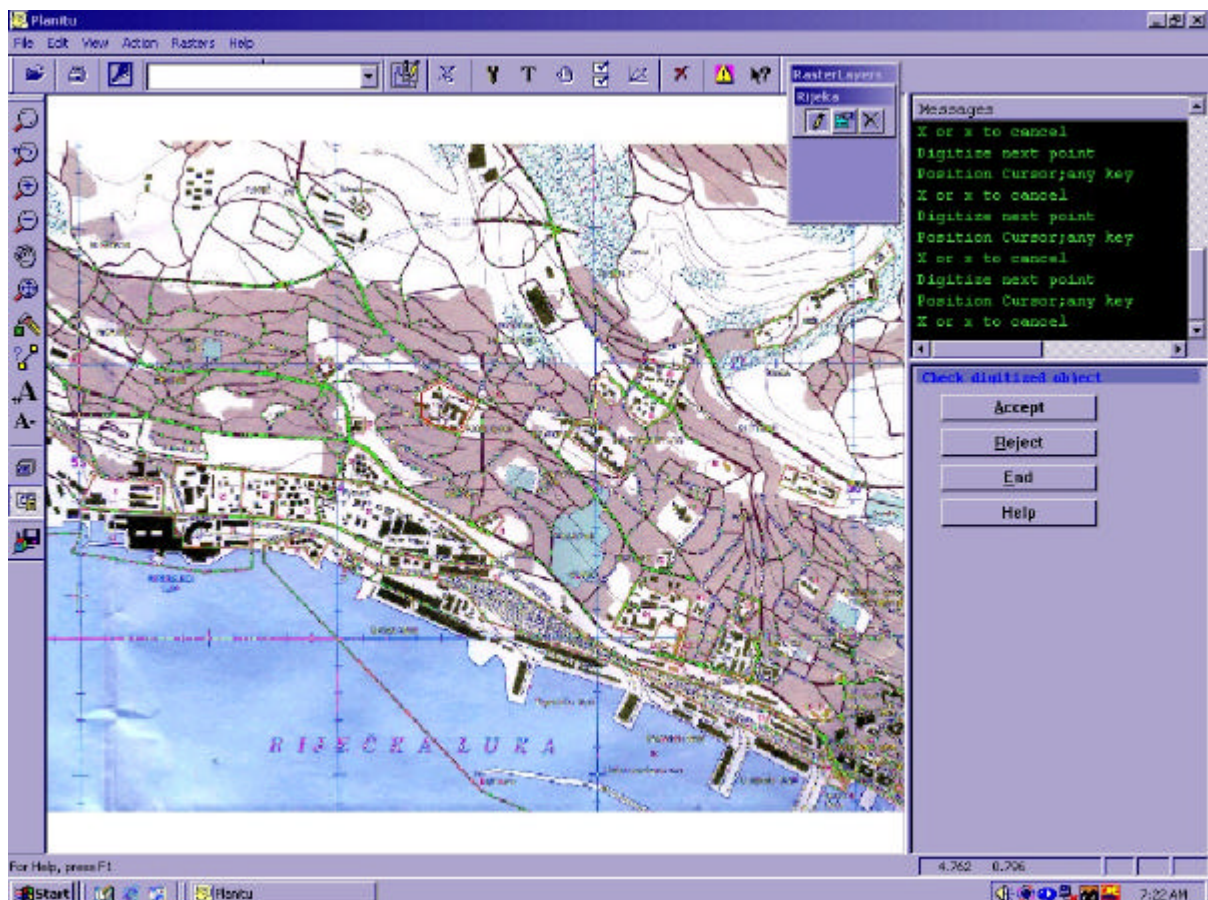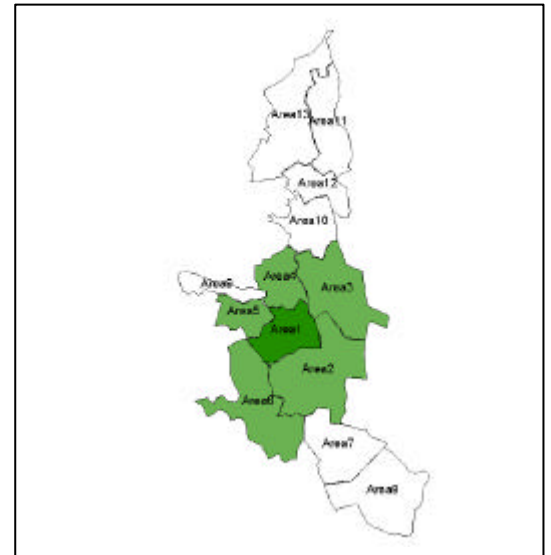
Digitizing of zones

Subscriber zones

Digitizing result – subscriber zones after digitizing with PLANITU as raster coordinates:

Digitizing result – data file with coordinates:

```
Z1          9  1Z    VT340           1.533     2.259     0.955     1.215  1 0 1
   1.533    1.041   1.565   1.128   1.578   1.215   2.259   1.179   2.250    0.977
   2.159    0.964   2.058   0.955   1.706   1.014   1.533   1.041
Z2         10  1Z    VT340           2.483     2.598     1.704     1.823  2 0 1
   2.483    1.764   2.511   1.727   2.538   1.704   2.547   1.736   2.566    1.759
   2.598    1.768   2.566   1.823   2.520   1.791   2.488   1.768   2.483    1.764
Z3         15  1Z    VT340           1.935     3.210     0.982     1.403  4 0 1
   1.962    1.201   1.935   1.325   1.953   1.403   2.625   1.329   2.762    1.311
   2.931    1.233   3.123   1.110   3.210   1.019   3.210   0.982   2.758    1.051
   2.648    1.119   2.529   1.160   2.364   1.179   2.022   1.201   1.962    1.201
Z4         18  1Z    VT340           2.908     3.164     1.512     1.736  3 0 1
   3.023    1.732   2.982   1.709   2.936   1.690   2.913   1.668   2.908    1.631
   2.931    1.585   2.954   1.563   2.977   1.544   3.014   1.535   3.059    1.521
   3.082    1.512   3.164   1.645   3.160   1.663   3.114   1.681   3.064    1.704
```

Forecasting

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".
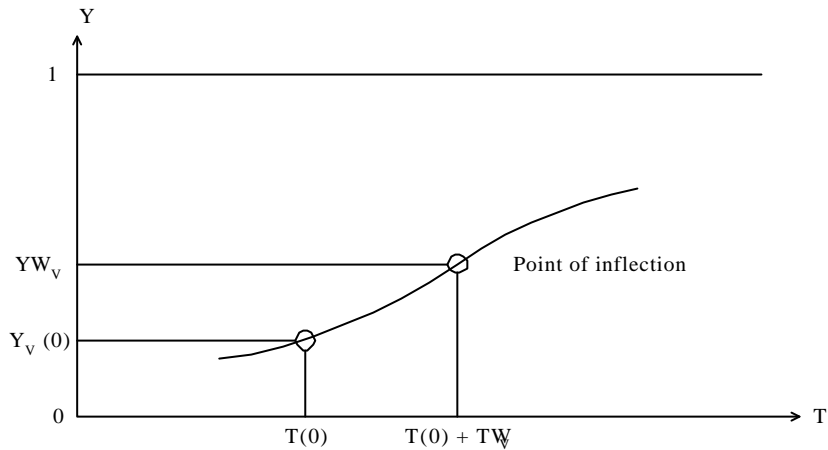
Forecasting of subscribers result – subscriber forecast after proceeding with PLANITU forecasting tool FCRURAL :
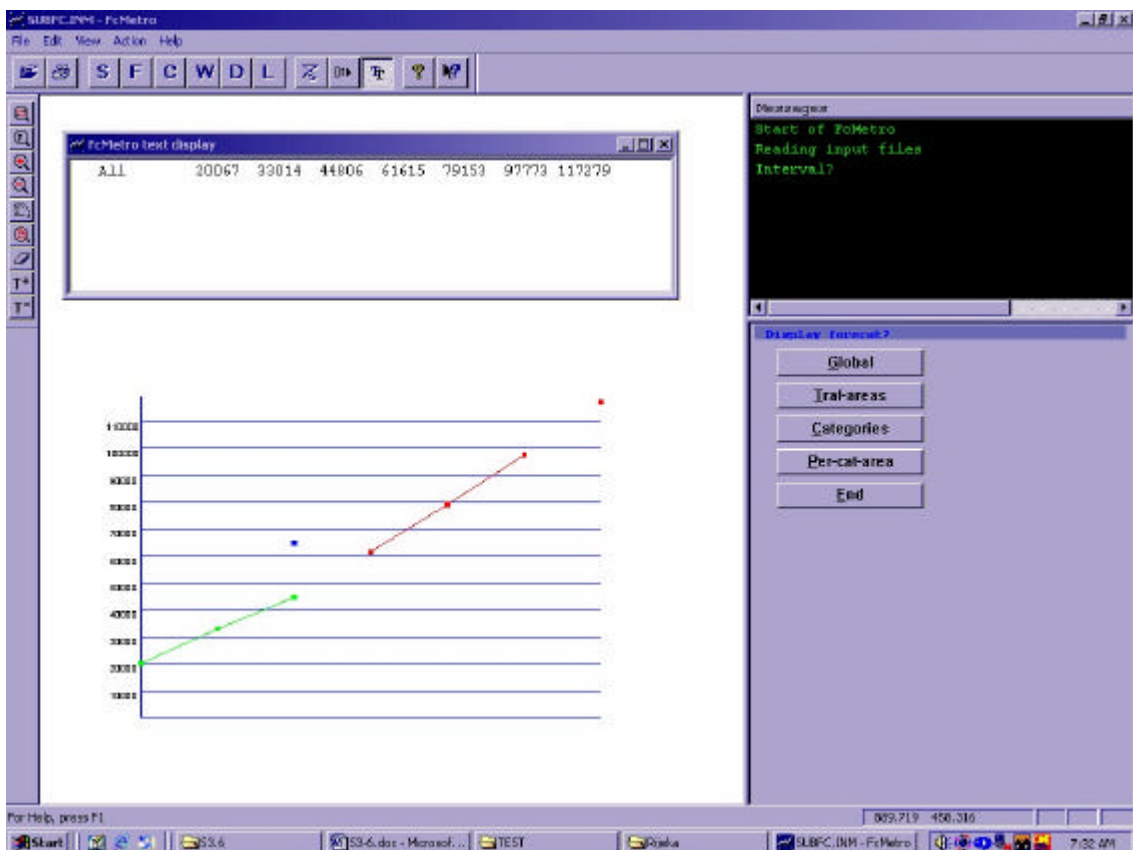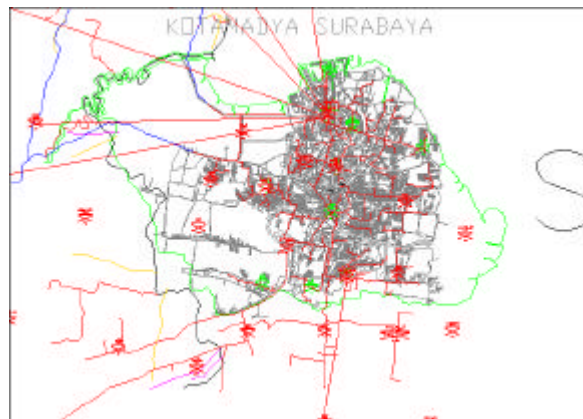
Optimization benefits and impact on solutions:

Optimizing of telecom networks

Local Networks optimization objectives:

 • Exchange locations

• Exchange boundaries

• RSU locations & boundaries

• Inter-exchange network

• Exchange hierarchy

• Transmission systems

Rural Networks optimization objectives:

• Exchange locations & boundaries

• Exchange hierarchy

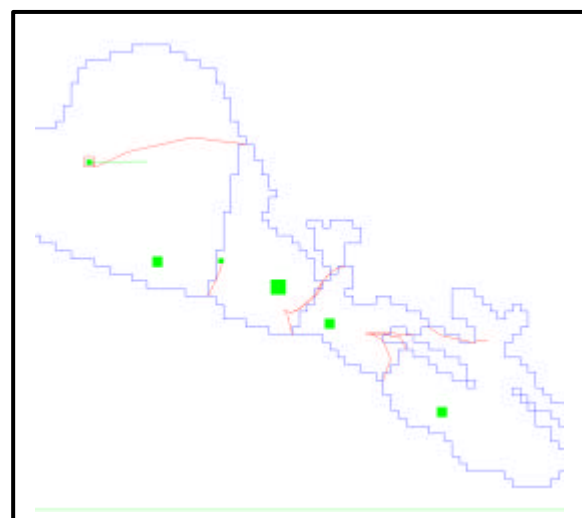• Inter-exchange network

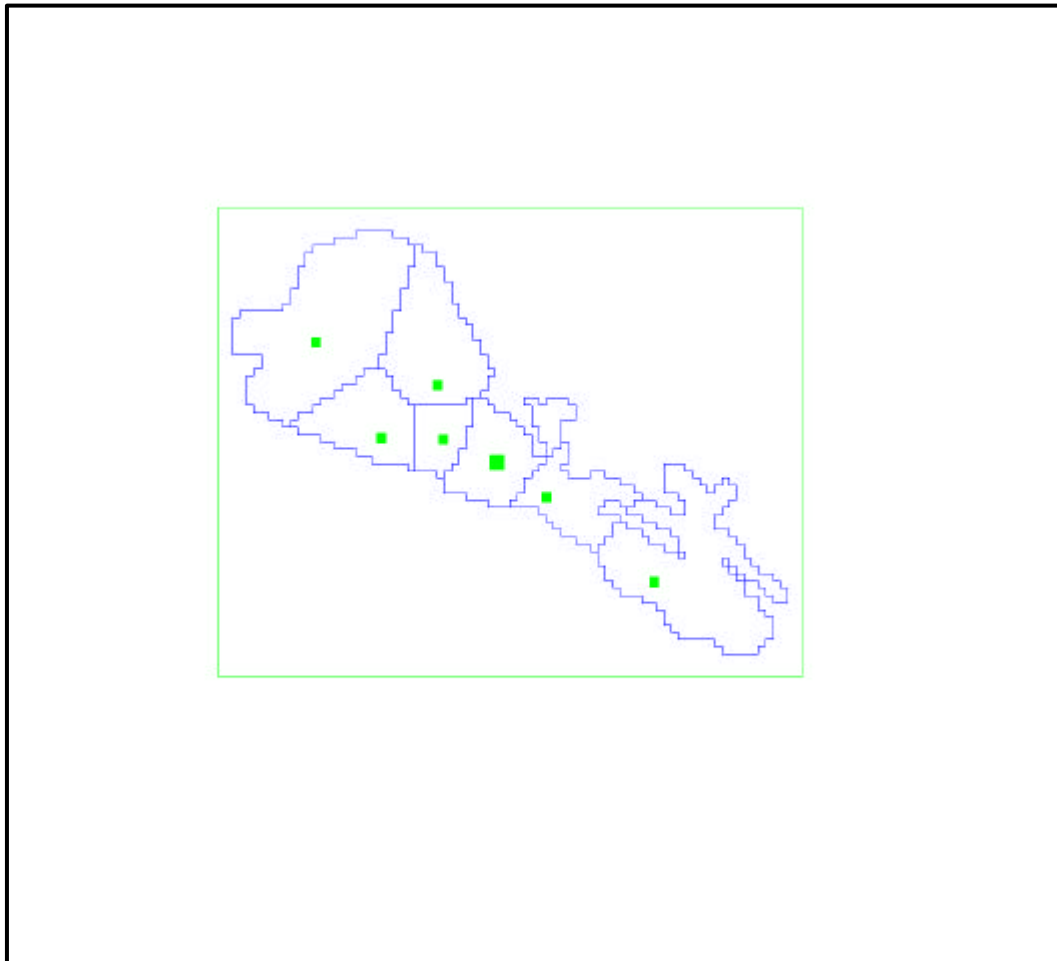• Transmission systems

Optimizing of local network

Optimization results – application of PLANITU for optimization of a local network with results for number of exchanges/RSUs, optimized locations and service areas, routing and dimensioning of junction network, etc. :
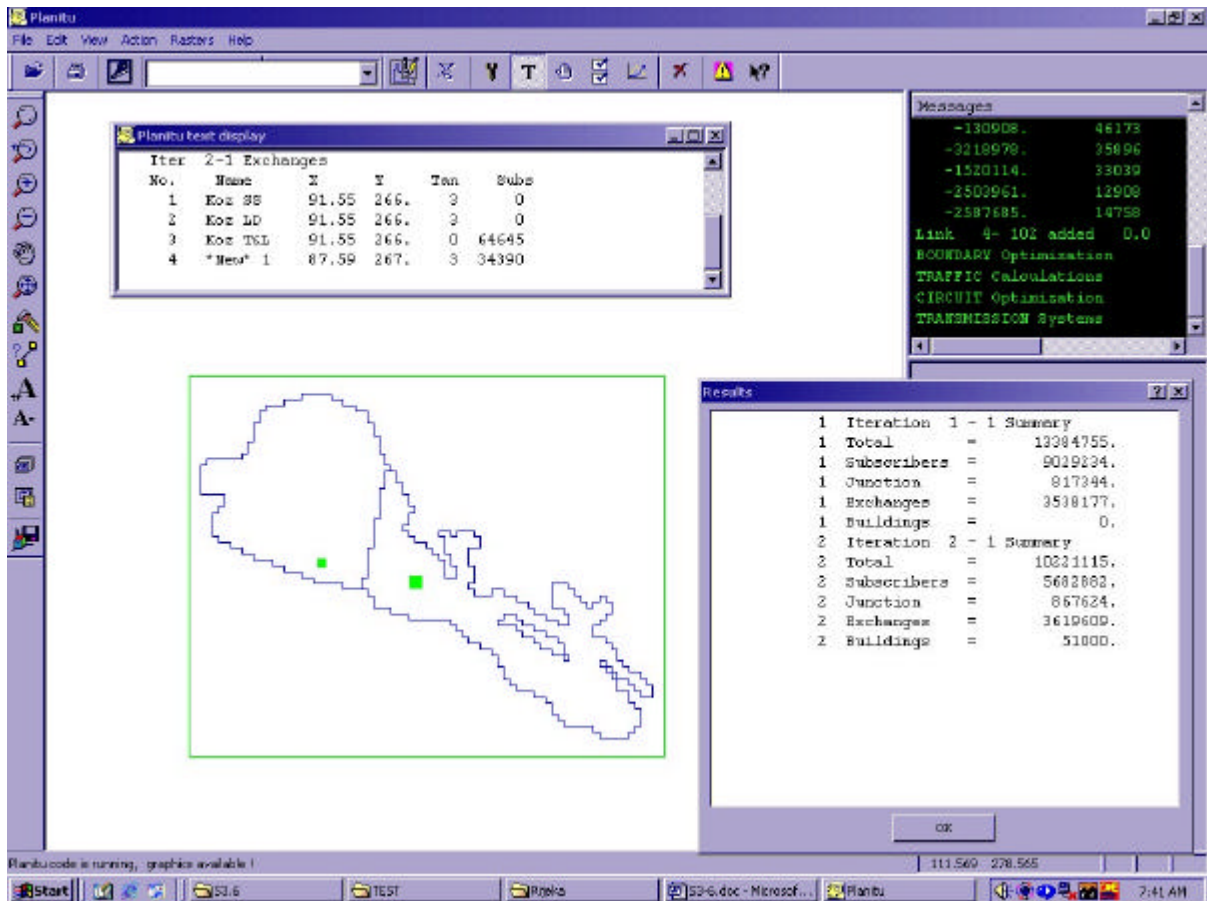
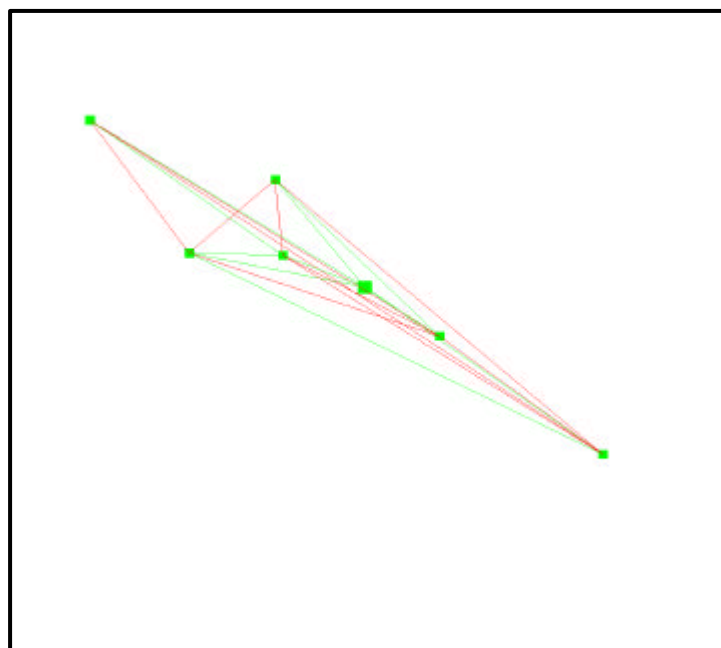Optimization results – application of PLANITU for optimization of a local network with results for new exchange locations :

Optimization results – application of PLANITU for optimization of a local network with results for optimal number of exchanges, locations and service areas :

Optimization results – application of PLANITU for optimization of a local network with results for routing in the network :

Optimization results – output text results from the application of PLANITU for optimization of a local network.

Results for the total network costs and summary for number of exchanges, coordinates of the locations and service areas as subscribers quantity:

```
        Iteration  9 - 1


           Total Cost of Network=      6472179.00

         Cost of Subscribers  =      1327214.62
            Cost of Junctions (S)=       697296.00
            Cost of Junctions (T)=       327495.56
            Cost of Exchanges    =      3814172.75
            Cost of Buildings    =       306000.00

      No.    Name      X      Y     Tan    Subs    SubCost    ExCost   BuildCst

        1    Koz SS   91.55 266.30    3       0         0.     57965.         0.
        2    Koz LD   91.55 266.30    3       0         0.     69000.         0.
        3    Koz T&L  91.55 266.30    0   24657    252233.    877750.         0.
        4    *New* 1  87.59 267.14    3   16800    201739.    620040.     51000.
        5    *New* 2  96.93 262.21    3   12142    284396.    456223.     51000.
        6    *New* 3  93.24 265.10    3   19412    204951.    705714.     51000.
        7    *New* 4  85.35 270.40    3    8446    201701.    334994.     51000.
```

Results for the transmission media used in the network as subscriber cables, inter-exchange transmission systems, etc. :

```
 Statistics for Cables

  Cable          Junction              Subscriber              Total
: Type     Pairs    PairKm       Pairs     PairKm       Pairs     PairKm

. 0.4         0        0.       96413    110983.       96413    110983.
: 0.6         0        0.        2543     10466.        2543     10466.
: 0.8         0        0.           0         0.           0         0.
: 0.81        0        0.           0         0.           0         0.
i pcm0     8760    36400.           0         0.        8760     36400.
i pcm1        0        0.           0         0.           0         0.
' pcm2        0        0.           0         0.           0         0.
: rsu         0        0.           0         0.           0         0.
i fict        0        0.          79       407.          79       407.
```

Results for the traffic flows accumulation in the exchanges as incoming, outgoing and transiting traffics and the corresponding conversion to equipment (inter-exchange circuits) :

```
      Statistics for Circuits & Traffics

  Exchange          Circuits        Peak Traffics
    #     Name      Inc   Outg     Inc    Outg   Transit

     1   Koz SS      150     0      98.      0.      0.
     2   Koz LD     1680  1440    1535.   1272.      0.
     3   Koz T&L    2430  2460    1806.   1779.    253.
     4   *New* 1     960   930     780.    780.      0.
     5   *New* 2     660   900     543.    747.      0.
     6   *New* 3    1020  1380     867.   1194.      0.
     7   *New* 4     510   480     398.    369.      0.
     8   *New* 5     930   870     758.    715.      0.
```
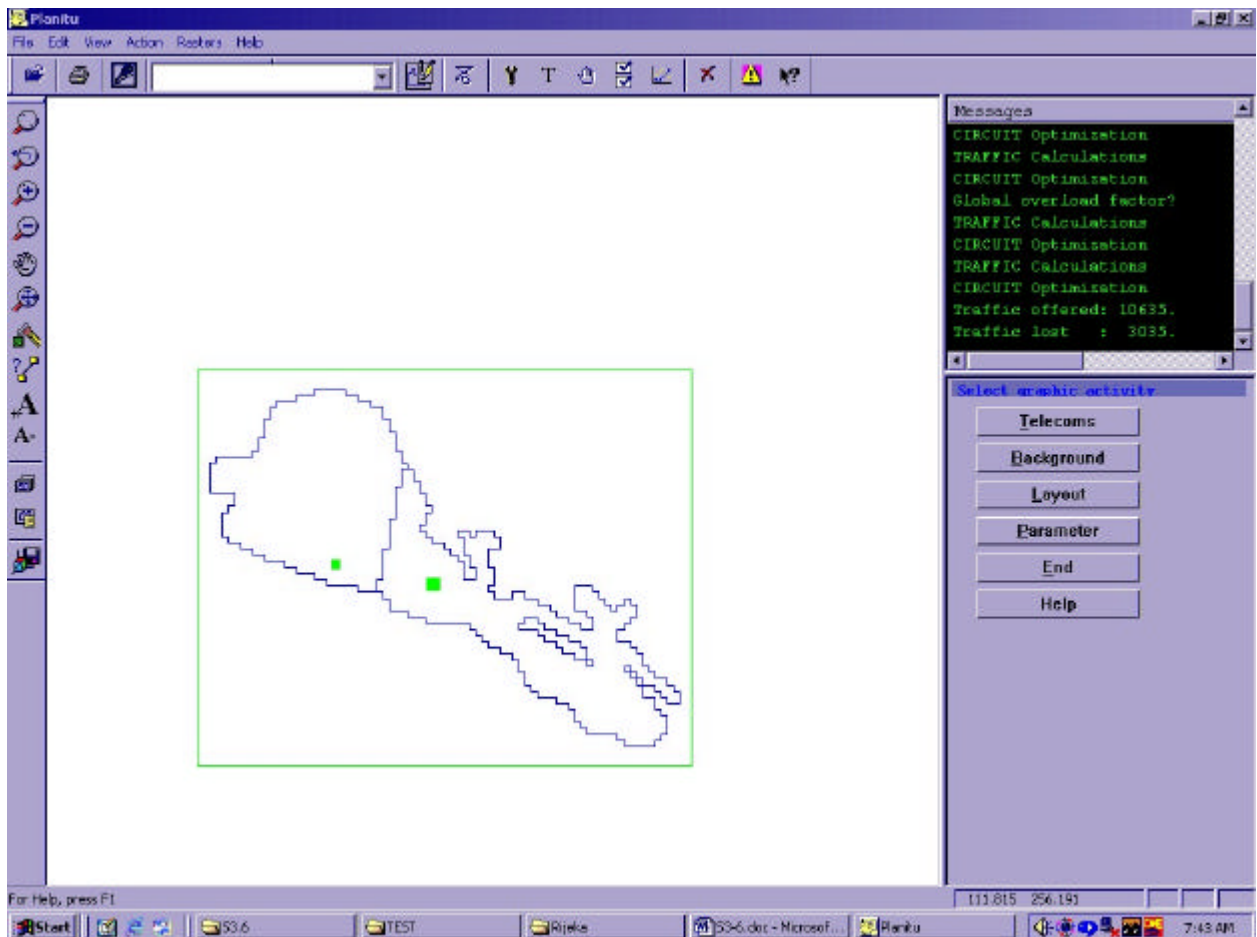
Sensitivity analysis

Sensitivity analysis results – application of PLANITU for verifying of the sensitivity of the optimized network for traffic overload :

End of the case study for traffic forecasting optimization benefits and impact on solutions with the application of the PLANITU network planning tool.