TRITONIS: a planning tool to meet Transmission Network Analysis requirements

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Abstract

Most planning tools for transmission networks deal with green field architectures designing long term structures on them and applying demand matrices projected to the final target year. Unfortunately network operators (particularly the incumbents) have to manage capacitated networks, time scaled demands, current unavailability of equipment, limited budget frames per period, options to route traffic through old networks etc. Obviously this is a completely different approach which makes useless any tool operating on green field architectures. TRITONIS was developed to face these peculiar problems but as an open software structure in order to be adaptable for different usages like long term green field simulations, network cost accounting and so on.

Overview on network planning tools perspectives

Network planning used to be an activity based on solid hypotheses (traffic forecasts, services to be offered etc.) and requiring detailed technical outputs (pieces of equipment, ports …) to rely on while deciding about investments for the next three/five years. Unfortunately this is no longer possible due to:

- Extreme uncertainness for traffic demands (volumes, geographical distribution, bit rate …) unless with a time scope of some months where the signed contracts can help
- Marketing hyper-activity to launch different services
- Technical features of the equipment changing very rapidly
- Focus from the top management in medium-short term returns on investments

Planning tools have to comply with this trend and face the new needs. The “big thing” which in the past provided such planning results has to be revised, compressed from the top and bottom of the evaluation process by:

- quick hit tools at the top; often they are worksheets with extremely simplified network models and algorithms but a good insight on the financial points of views (e.g. cost accounting models). Quick hit tools are very suitable for strategic planning particularly for architecture and structure plans.
- design and provisioning tools at the bottom, largely integrated with company databases and workflow management tools; these tools have very detailed models and are very suitable for short term and fixed demands planning but do not have valid simulation performances for planning purposes. Design and provisioning tools are suitable for network design and service delivery.

Although these kinds of tools at the border of the traditional planning domain lack full planning functionalities, several operators have rethought at their real planning goals considering the context but in general the tool world to support these goals looks overcrowded. The events induced TELECOM ITALIA LAB to focus the attention to quick hit software (not related to this paper) and to Tactical Planning support by developing network analysis tools, that is software which analyses the ability of the network resources to face dynamic trends of the traffic demands. This kind of software deals with networks as they result from the company databases and from the current business plans and it manages the hardware involved with a good technical detail since it only approaches existing or near available equipment and fibres.

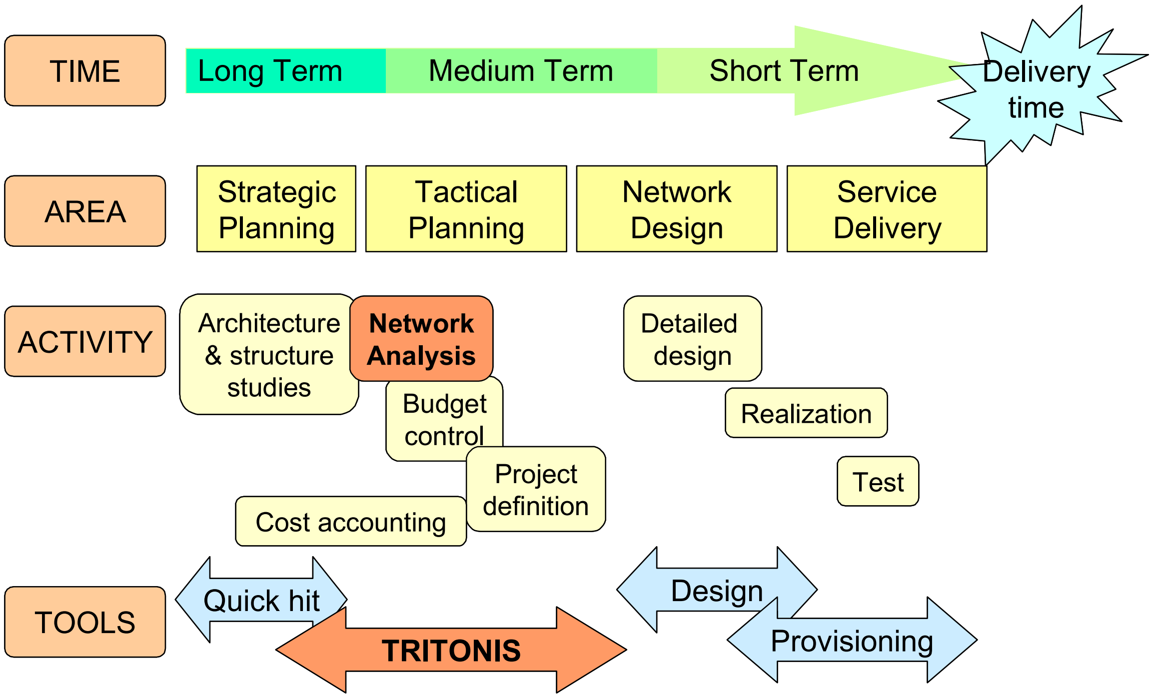

Figure 1: Domain identification for the Network Analysis and other planning activities

This network analysis tool, called TRITONIS, aims at a strong position in a sector still unaffected from quick hit (too generic and green field oriented) and provisioning tools (poor in terms of simulation and "what if" features). Figure 1 shows how to position this tool. Once established this positioning a modular software structure should enable the tool to upgrade towards parallel (but important) functionalities like network cost accounting or structural plans.

Main peculiar features for a Network Analysis tool

Performing Network Analysis for planning purposes involves mainly activities to compare dynamically network resources to circuit demands in order to evaluate through the time the best alternative to meet the traffic demands while sticking to the budget and technical constraints. Typically input/output for the tool could be synthesised as follows:

- Input: network architecture and structure, current available resources (equipment and infrastructures), periods of time to be studied, demand matrices for period, features and costs of new resources to be suggested, budget constraints;
- Output: new network resources to install, detailed circuits routing, un-routable circuits, spare resources levels, costs, capability to route demands unforeseen or slightly different in terms of time, location, quality requirement.

As the reader can understand, here the keyword is "time" because for example such circuits are urgent or prioritised, such periods are very budget edged, delaying investments could be worthwhile giving up following optimised routing rules and many other compromises should be considered compared to long term green field plans.

Another keyword is "flexibility" for the user that is supposed to be an experienced planner who aims to find the best possible solution by efficiently acting on the available options he has got in mind and which should be offered by the tool: a network analysis tool has to be highly interactive.

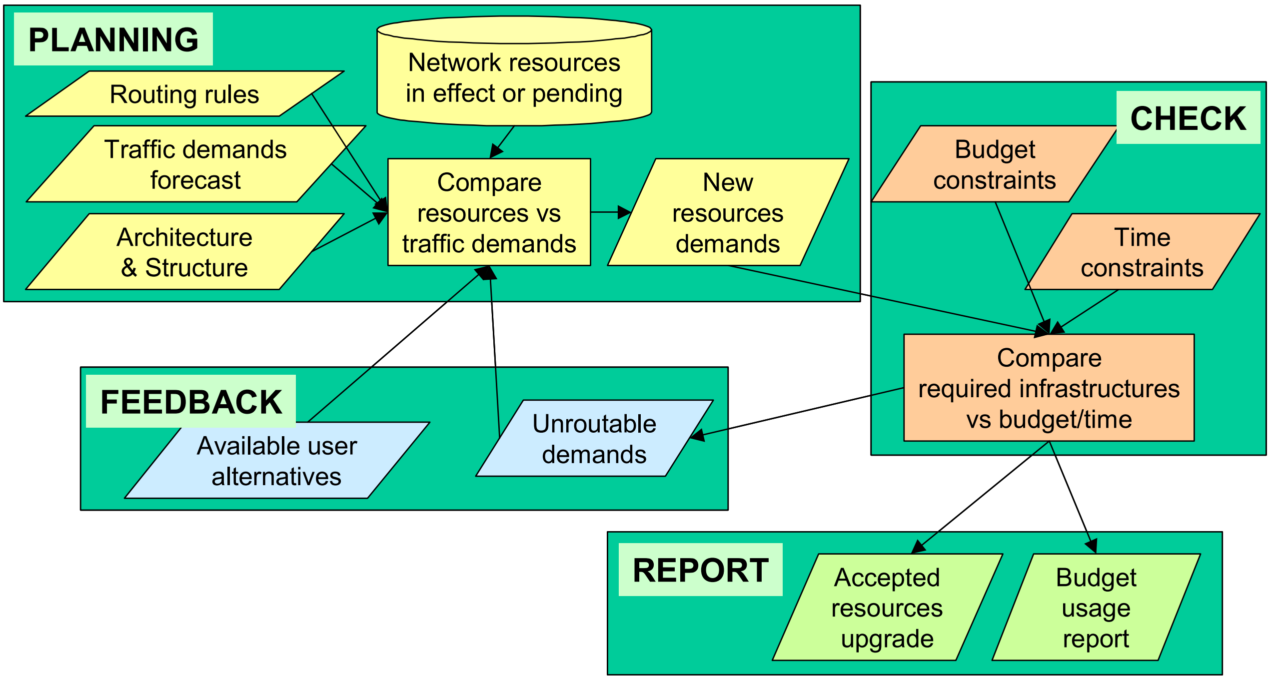

Figure 2: Block diagram of TRITONIS functionalities for network analysing

TRITONIS architecture

TRITONIS runs on Personal Computers (from Win95™ to Win2000™) and it requires Office ™ since it relies on the functionalities offered by Access ™ and Excel ™. The current version is configured as a stand-alone tool while the web-based multi-users extension is under study.

The software is written meeting as much as possible the requirement of maximum modularity in order to use a collection of modules as a tool but also each single module as a function accessible via Microsoft compliant tools (usually Excel). Different languages have been used to implement various algorithms.

Figure 2 shows the TRITONIS functional flow chart and the subsequent network analysis process activated. Four main areas are identified each of them clearly associated to a key phase of the process.

1. **Planning**: the basic activity focused on comparing thorough the time the network resources to the traffic demands;
2. **Check**: the activity whose goal is to verify against the budget and possibly crop the new network resources required as an output from step 1;
3. **Feedback**: the activity collecting the traffic which can not routed for lack of resources and preparing a new routing attempt by acting on the available parameters
4. **Report**: it generates output files ready to be loaded to the Network Design support software as well as printable report for spreading information about technical and economic plans resulting.

Two domains usage

The TRITONIS features supports a dual usage of this tool when two teams operate on the same managed objects. Actually routing new traffic on the existing network is an activity which can be considered as split between Planning and Engineering where:

- The *planning phase* performs tactical planning on time periods (usually more than three/six months) that make possible to evaluate a candidate set of investments for new network infrastructures. It means that the forecasts about the incremental traffic are limitedly reliable so that the circuit routing does not require to be fixed at once. On the other side there is time to plan civil works highly time (and budget) consuming.

- The *engineering phase* deals with network design on restricted time horizons. In this case the traffic requests are reasonably reliable to authorize to forward the planned routing to the realization team. On the other side there is no time to plan new consisting infrastructures and just some incremental resources like adding some pieces of (market available) equipment and ports could be requested.

TRITONIS helps the integration of the two phases by managing the reciprocal data interchange between them. Particularly (see figure 3) it allows data interchange in order to enable:

- a planning team to take into account the short term activities decided by an engineering team (like new routed demands and additional pieces of equipment or ports)
- an engineering team to take into account the planned infrastructures although not yet in effect if their due date is suitable to satisfy short term demands.

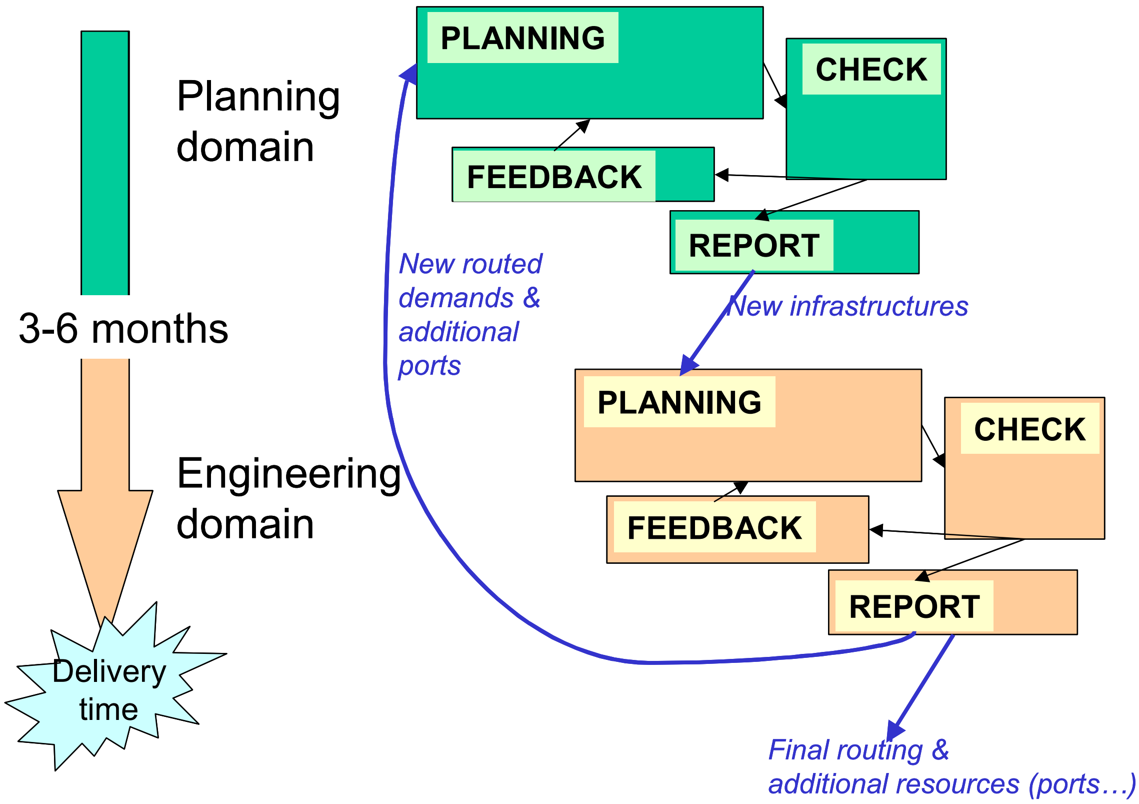

Figure 3: Team inter-working through a coordinate use of TRITONIS

Current TRITONIS functionalities

This chapter briefly describes the main functionalities already available.

1. Data Input (from Access, Excel or manually)
    - Network description (architecture and structure)
    - Available network resources (equipment, ports, cable infrastructures) with associated costs
    - Traffic demands (characterised by due date, customer priority, bit rate, resilience constraints)
    - Routing rules (paths, protection schemes …)
    - Equipment catalogue (up to the card/port detail) and related costs
2. Modelled networks
    - Ring or meshed networks
    - MS-SPRING, SNCP, linear MSP or restoration recovery

- PDH, SDH and WDM networks

3. User switches for budget management
   - Set of alternatives to the default routing rules
   - Set of options to crop investments according to the budget constraints
   - Dynamic management of spare resources balancing risk and costs
4. Generated outputs (on screen or Excel)
   - Monitoring of the resource usage (organised by periods of study and up to the card/port detail)
   - Time scaled additional resources required to route new traffic
   - Reports on investments for periods and compliancy with the budget frames
   - Un-routable traffic when complying with budget or technical constraints
   - Detailed routing for incremental traffic

TRITONIS upgrades

The current version of TRITONIS is actually a medium term network planning tool acting on capacitated networks. TELECOM ITALIA LAB is now studying how to integrate long term performances which enable to design and evaluate innovative alternatives to the current network architecture. Possibly this modules will be developed with less technical details since they will deal with equipment not yet available and because the goal is different.

A very important upgrade already scheduled concerns network cost accounting. Cost accounting has not to be considered a domain for accountants and not worth the planner contribution. Actually evaluating Long Run Incremental Costs is becoming an activity so complex and crucial for the business development that it needs a common effort to evaluate network perspectives both on technical and economic point of view enforcing the cooperation between experts in network planning and economics. TRITONIS wants to be the common operational support for these two categories of experts.

Figure 4 shows how to use the next scheduled release of TRITONIS in order to perform network cost accounting. An additional module called *Cost assigning and partitioning module* will provide results concerning investments and amortizations related to each service class with full economic and technical details.

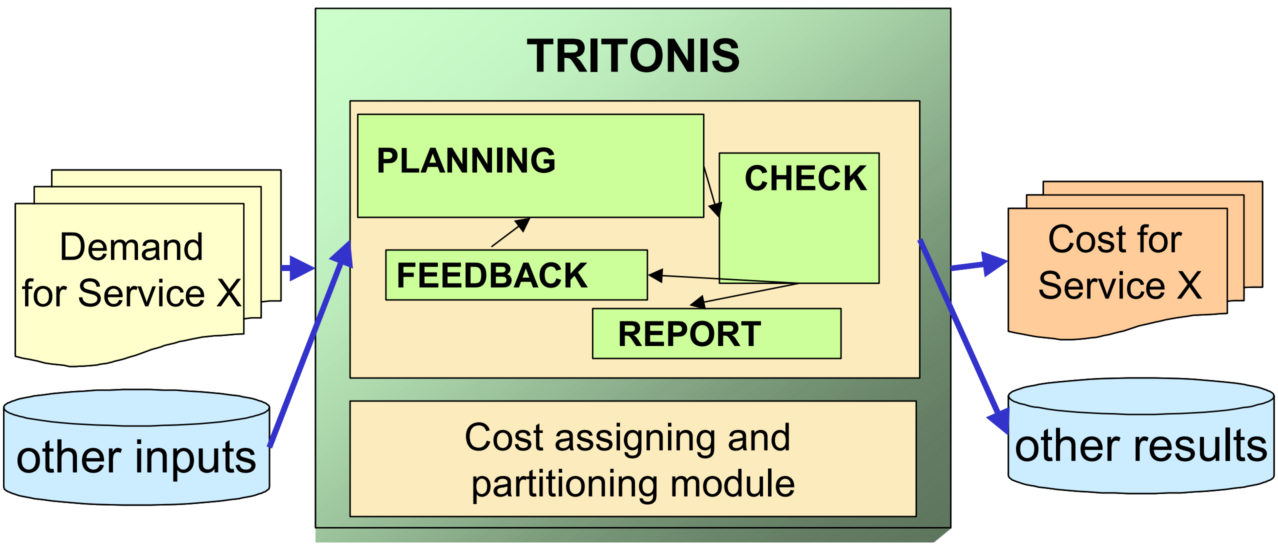

Figure 4: Cost accounting additional module

Conclusions

This paper reported our perception of the current trend about requirements for transmission network planning tools, alerting that things are fast changing and a re-focus could be advisable. Then it showed the current TELECOM ITALIA LAB vision about tools and explained the reason that brought to project a network analysis tool called TRITONIS to meet the new requirements.

This paper includes a survey of its main current functionalities and the future upgrades to cover parallel topics. The processes involved are described as well and the TRITONIS functionalities to enable an efficient process implementation are underlined.

References

[1] Bettin M. : *Location and suitable time for introduction of optical architectures in a medium term plan*, DRCN2000

[2] Clemente R., Ferraris G., Girardi R.: *Planning of optical networks*, DRCN2000

Abbreviations

MS-SPRING	Multiplex Section Shared Protection Ring
SNCP	Sub Network Connection Protection

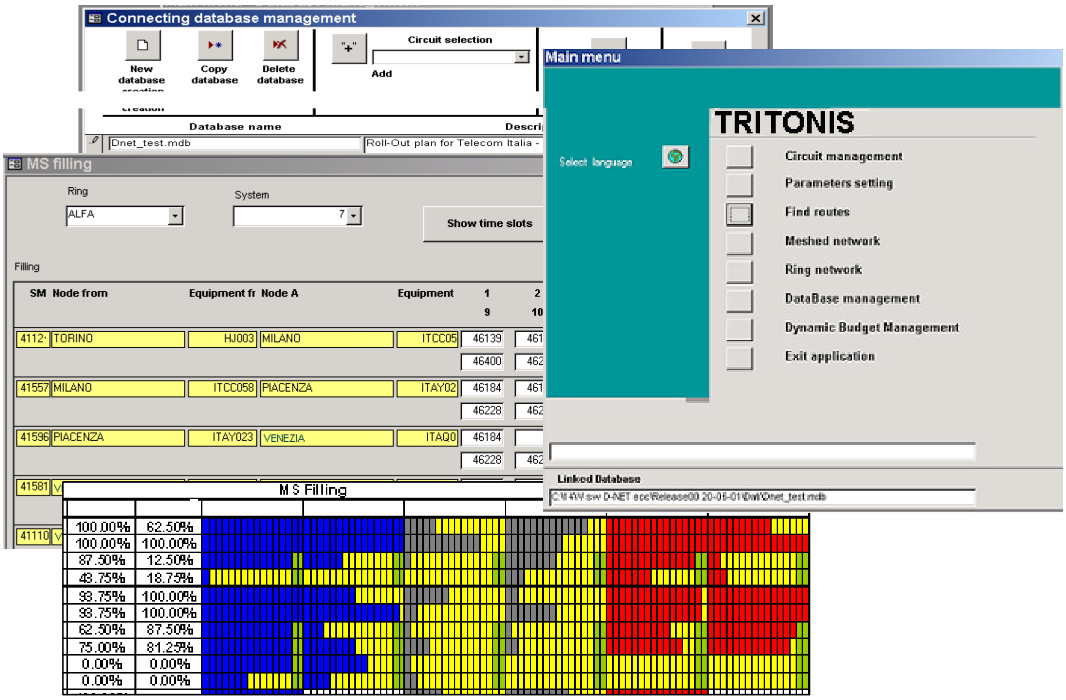

Figure 5: Images from TRITONIS