Generic Network Visualization: Applications for NATO

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by

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INTRODUCTION

Our syndicate began to construct a set of two taxonomies:

- The sorts of network of use to NATO; and

- The set of tasks to be accomplished with/by network visualizations of each.

Of the first, we noted three subtypes:

1) Physical networks [railroad, air transport, human blood system];

2) Logical networks [electronic networks—viz the Internet, banking transactions, human central nervous system]; and

3) Conceptual networks [between references or concepts in technical literature, human immune system.].

Of the tasks to be done by network visualization aids, we noted so many and varied tasks useful to NATO that we determined instead to conceptualize a framework to be broadly illuminating across as much of the NATO-useful-task domain as possible.

This rapidly led us to define networks technically and to begin to list the properties we need to be ready to include in network-visualization aids concerning the links, nodes, and agents operating within networks of interest.

We also noted, importantly, that networks intersect in many ways physically and conceptually that will be critically important in many situations. In a major event involving the rail system, its points of intersection with other infrastructure networks—electric, water, road, others—will be critical.

A concept map of this domain follows overleaf.
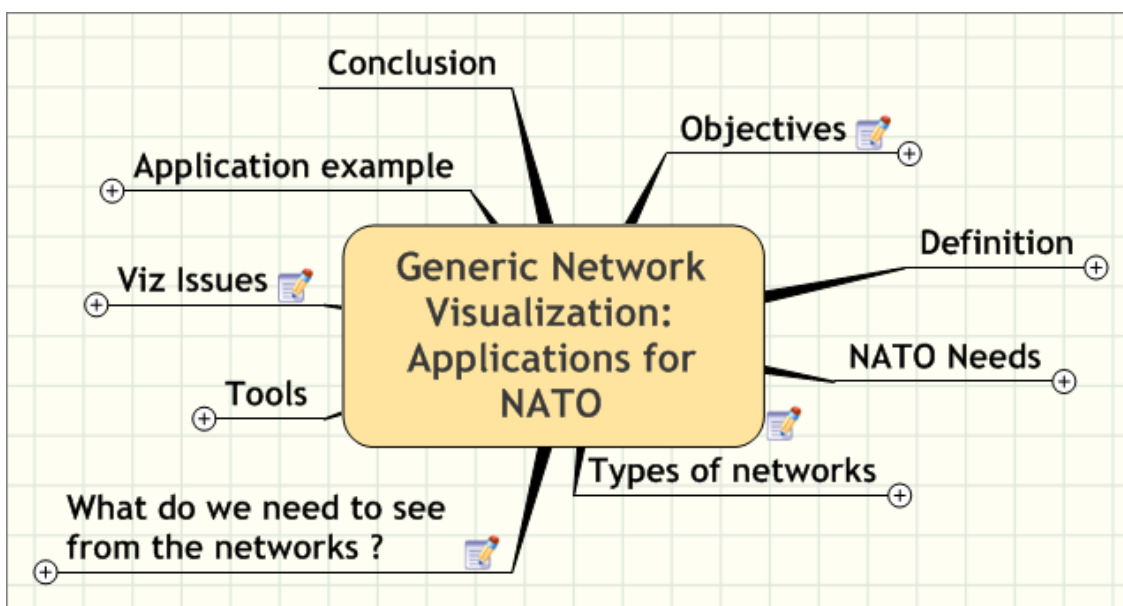
This working group was focused at developing a taxonomy and framework of generic network properties which are required for decision support.

1.0 OBJECTIVES

• To develop a network visualisation tool which can be used by NATO.

• The development of a common language to describe networks and enable interoperability.

• Graph ML, GML (xml based network description language).

• Problem space is huge; we are looking for generic network visualization.

Definition: A Network is an array of nodes and links that exchange "stuff" on containers under a certain protocol and fallowing a determined path.

2.0 NATO NEEDS ON NETWORK ANALYSIS/VISUALIZATION

• Counterterrorism

• Knowledge Management

• Information Assurance

• Logistic Support Management

• Disease Management

• Security Awareness

• Etc.

3.0 VARIABLES OF NETWORKS

• Constraints
  • Rules

- Nodes
  - Location
  - Node type
  - Simbology
  - Open/Closed
  - Node ID
  - Input/output property
- Links
  - Capacity
  - Weight
  - Strength
  - Direction
  - Availability
  - Type of traffic
  - Location
  - Route
  - Identification (Unique)
  - The medium
- Thresholds and changes
- Traffic
  - Flow
  - Path
  - Routing
- Topology
  - Symmetric/asymmetric
  - Boundaries
  - Layout
  - Hierarchical
  - Tree
  - Topology evolution in time and space
- Logical/physical
- Redundancy
- Partially connected graph
- Protocols
- Networks interconnections
- Location
- Open/Closed
- Layers
- Hierarchy

4.0   EXAMPLE 1: COUNTERTERRORISM

- Thresholds and changes
- Nodes
  - Location
  - Node ID
  - Input/output property
  - Number/Type of Links
- Links
  - Strength
  - Direction
  - Availability
  - Type of traffic
  - The medium
- Traffic
  - Path
- Topology
  - Symmetric/asymmetric
  - Layout
  - Hierarchical
  - Topology evolution in time and space
- Protocols
- Networks interconnections
- Location
- Hierarchy

5.0   EXAMPLE 2: INFORMATION ASSURANCE

- Thresholds and changes
- Nodes
  - Open/Closed
  - Input/output property
- Links
  - Availability
- Traffic
  - Flow
- Topology
  - Layout
  - Tree
  - Topology evolution in time and space
- Redundancy

- Protocols
- Networks interconnections
- Open/Closed
- Hierarchy

6.0   EXAMPLE 3: LOGISTIC SUPPORT MANAGEMENT

- Thresholds and changes
- Nodes
  - Location
  - Node type
  - Input/output property
  - Number/Type of Links
- Links
  - Capacity
  - Weight
  - Strength
  - Direction
  - Availability
  - Type of traffic
  - Location
  - Route
- Traffic
  - Flow
  - Path
  - Routing
- Topology
  - Layout
- Redundancy
- Networks interconnections

7.0   CONCLUSIONS

- Network analysis/visualization is task oriented.
- The same framework can be used for most types of networks.
- The most critical issue is to set the correct thresholds.
- Network Analysis can be focused on nodes, links, etc.