Network Visualization

Hauptseminar "Information Visualization - Wintersemester 2008/2009"

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Overview

- Type of data

- Type of technique

- General Visualization

    - Definition

    - Graph specifications

    - Perception rules

- Aims of computer visualization

- Specific visualization

    - Flow monitor

    - Network Topology

    - Matrix visualization with VISUAL

    - Matrix visualization with SeeNet

- Alternative methods for monitoring

Source: http://kulisconsulting.com/images/ComputerNetwork.jpg

Type of data

- **One dimensional**
  - One attribute
  - For example: date, temperature
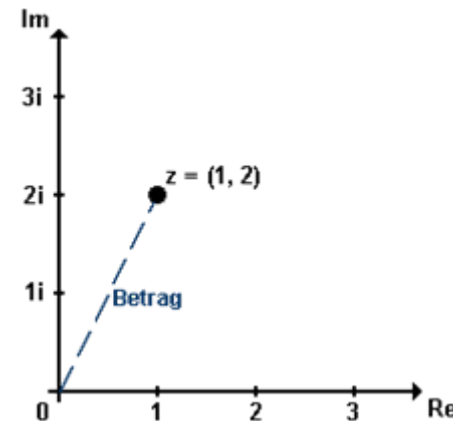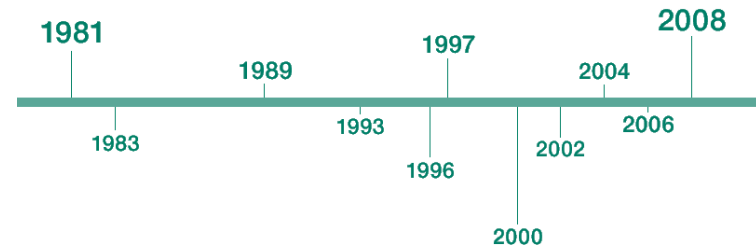- **Two dimensional**
  - Two attributes
  - For example: X,Y position
- **Three dimensional**
  - Three attributes
  - For example: X,Y position + time
- **Multi dimensional**
  - High number of defining attributes
  - Complex data structures

1981　1989　1997　2004　2008
1983　1993　2002　2006
1996
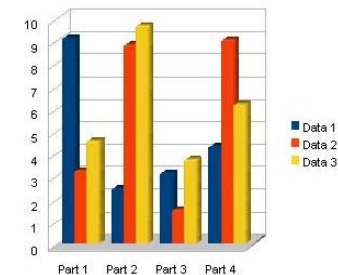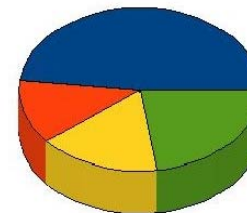2000

Im
$3i$
$2i$　　z = (1, 2)
$1i$　Betrag
0　1　2　3　Re

Source: http://www.informatik.uni-leipzig.de/~meiler/Schuelerseiten.dir/DPlotzki/bilder/betrag.gif
http://www.sage.de/baeurer/microsites/sage25/bilder/s25_geschichte_zeitleiste.gif
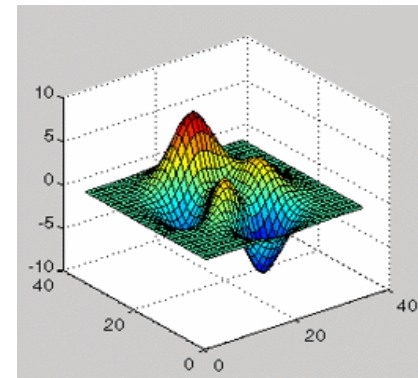
Type of technique

≡ Icons

   ≡ Simple

   ≡ Few information

≡ Graphs and diagrams, matrices

   ≡ Combination of several information

   ≡ Simple or complex data structures

≡ Counterplots

   ≡ Interpolation of information

   ≡ Plain visualization

Source: http://www.mathworks.com/access/helpdesk/help/techdoc/creating_guis/pr_toggletool2.gif
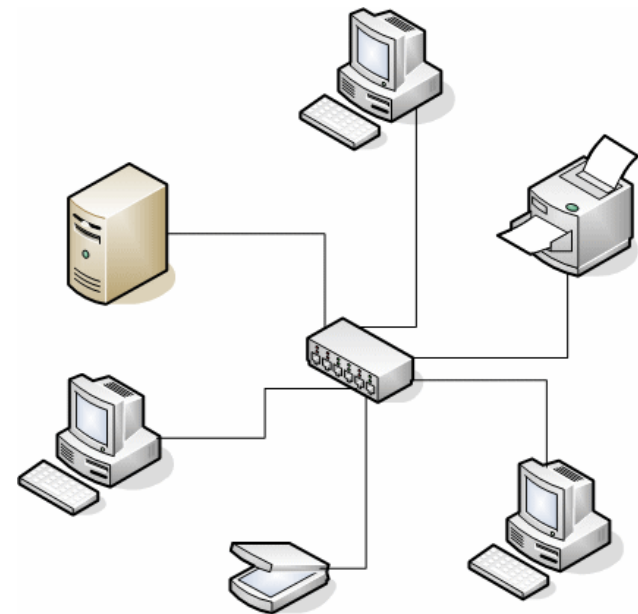OpenOffice.org

General Visualization

Definitions:

- Network
    - System of connected devices
    - Information exchange, controlling, monitoring

- Nodes or vertex
    - Atomic unit of a graph
    - Object within the the system
    - Representation of one device or simplification of a more complex structure
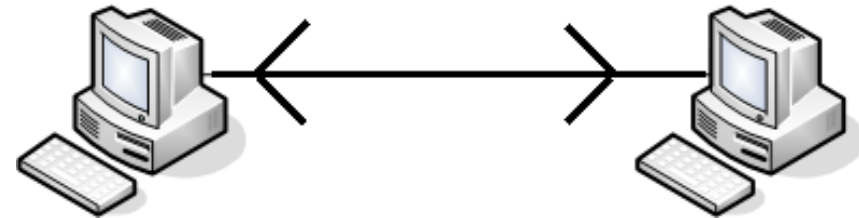
Source: http://www.functionx.com/illustrations/network2.gif
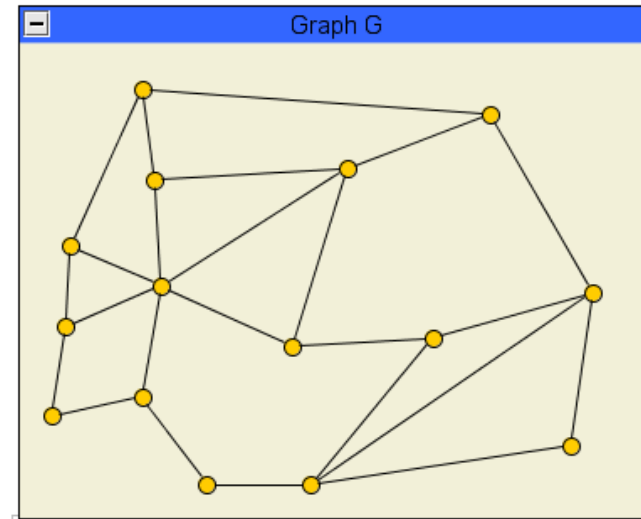
General Visualization

Definitions:

≡ Links or edges

  ≡ Connections between nodes

  ≡ Uni- or bi-directed

≡ Graphs

  ≡ Set of nodes and edges

  ≡ Relation of nodes and edges

    defined by the type of graph

Source: http://www.natur-struktur.ch/viren/images/graphG.png
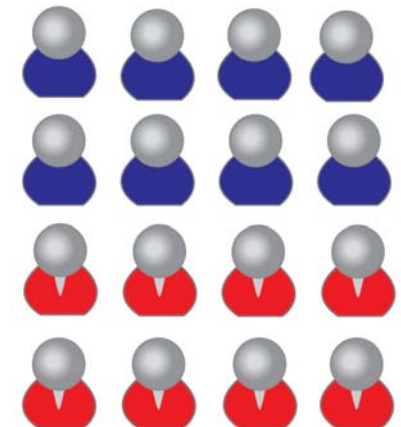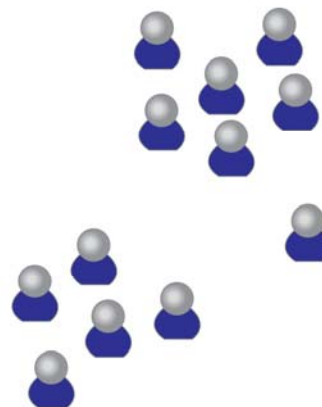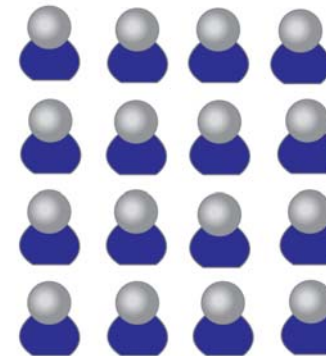http://www.functionx.com/illustrations/connect2pc1.gif

General Visualization

Perception rules:

"The whole is more than the sum of the parts"

≡ Law of Simplicity

≡ Law of Familiarity

≡ Law of Similarity

≡ Law of Good Continuation

≡ Law of Proximity

≡ Law of Common Fate

≡ Law of Connectedness

Source: Nesbitt : Applying Gestalt principles to animated visualizations of network data
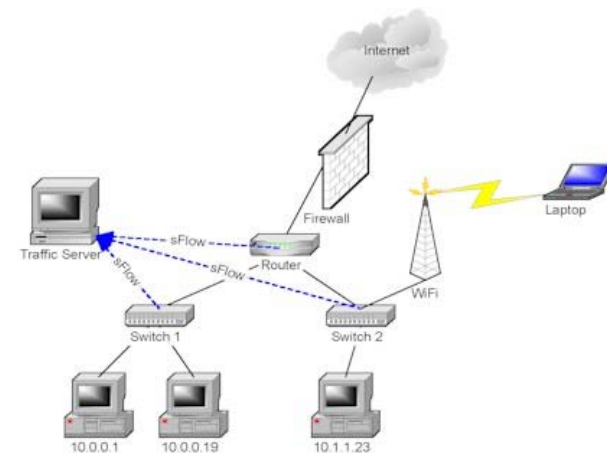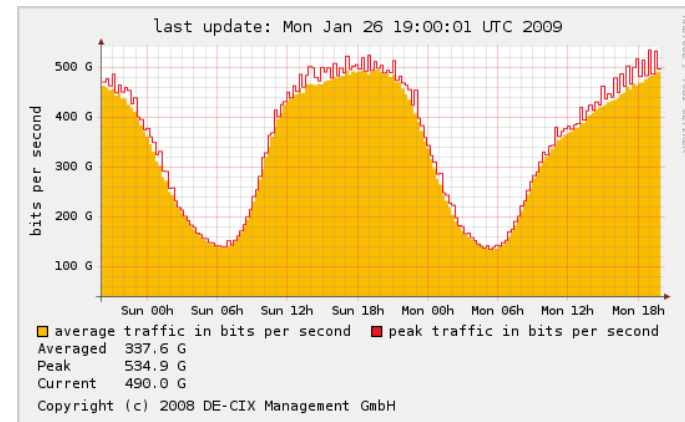
Aims of network visualization

- Flow monitoring
  - Load
  - Capacities
  - Single connection vs. whole network
- Security
  - Intrusion detection
  - Illegal usage
- Topology or status of the system
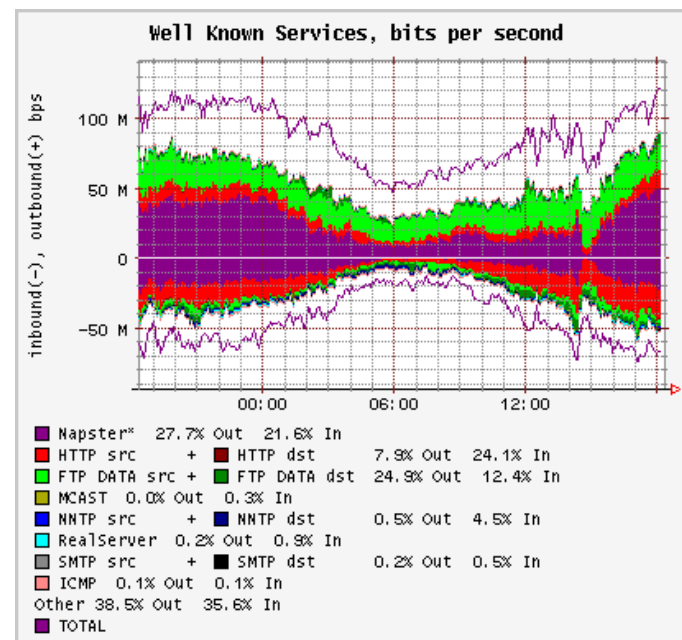 - State of components
  - Structural analysis

Source: http://www.de-cix.net/images/content/decix-daily-max.png
http://www.inmon.com/img/tutorials/ids_map.jpg

Specific Visualizations

Flow monitoring:

≡ Network load

≡ Connection between two or more devices

≡ Usage analysis

   ≡ Time of data appearance

   ≡ Type of information

≡ Visualisation technique:

   ≡ Graph

   ≡ Statusbar

   ≡ Pie-chart

Source: Plonka, D. : FlowScan: A Network Traffic Flow Reporting and Visualization Tool

Specific Visualizations

Network Topology :

≡ Status of components

≡ Geographical location

≡ Identification
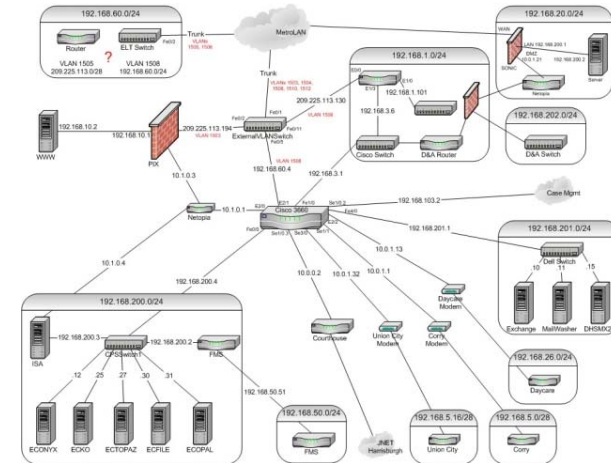
≡ Structural analysis:

   ≡ Exchange of components

   ≡ Reorganisation

   ≡ Need for new connections

≡ Visualization technique

   ≡ Hosts as icons

   ≡ Network as graph

Source: http://upload.wikimedia.org/wikipedia/commons/8/84/
Becker, R.A.; Eick,S.G.:Visualizing Network Data

Specific Visualisations

Matrix by VISUAL:

≡ Focus on connections between

 internal and external hosts

≡ Position defined by the IP-address

 ≡ X-position: first 16 bits

 ≡ Y-position: last 16 bits

≡ Recognition of devices

≡ Square-size related to the data volume sent

≡ Anti-overlapping algorithms

≡ Separate link for every connection
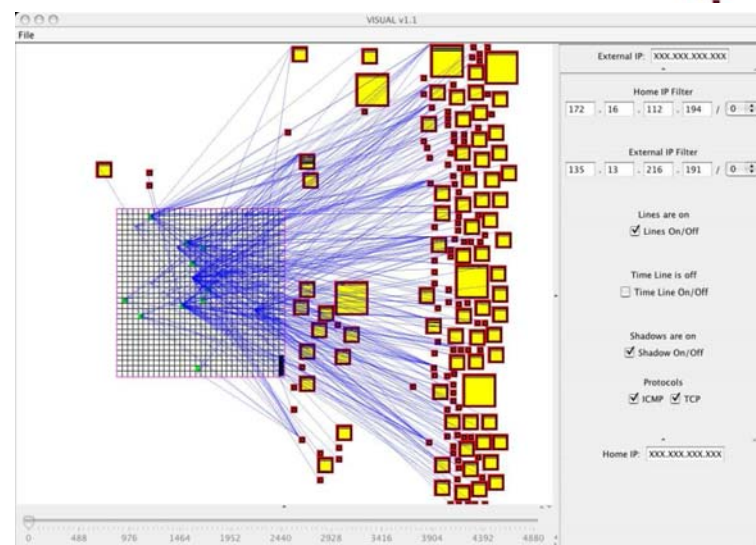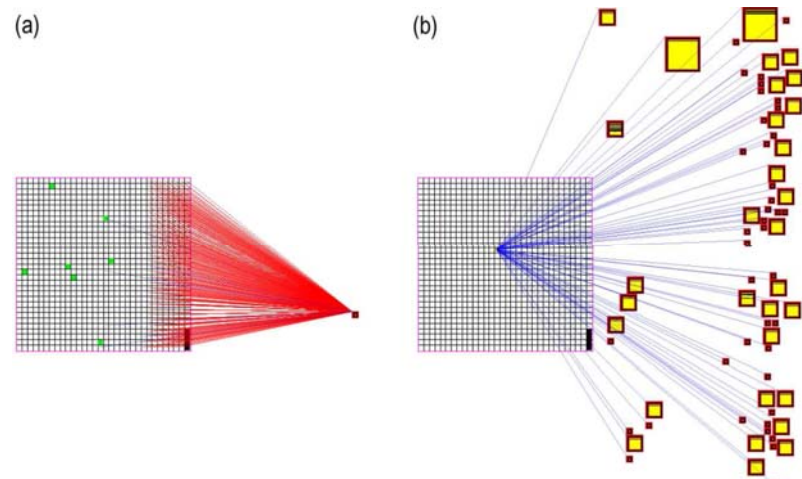
Source: Ball, Fink, North : Home-centric visualization of network traffic for security administration

Specific Visualizations

Matrix by SeeNet:

≣ Focus on connections inside

the own network

≣ Hosts listed as indices of the matrix

≡ Unidirected connections NxM

(for example N = senders, M receivers)

≡ Bidirected connections NxN

(N = number of devices involved)

≣ Link-representation as the intersection

of two indices

≣ Data volume as colored dots
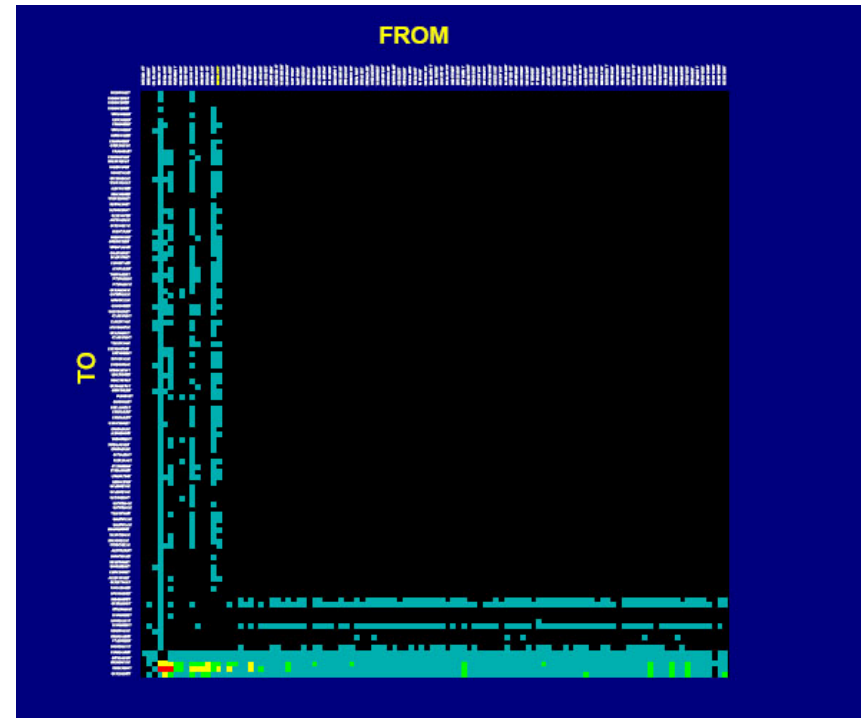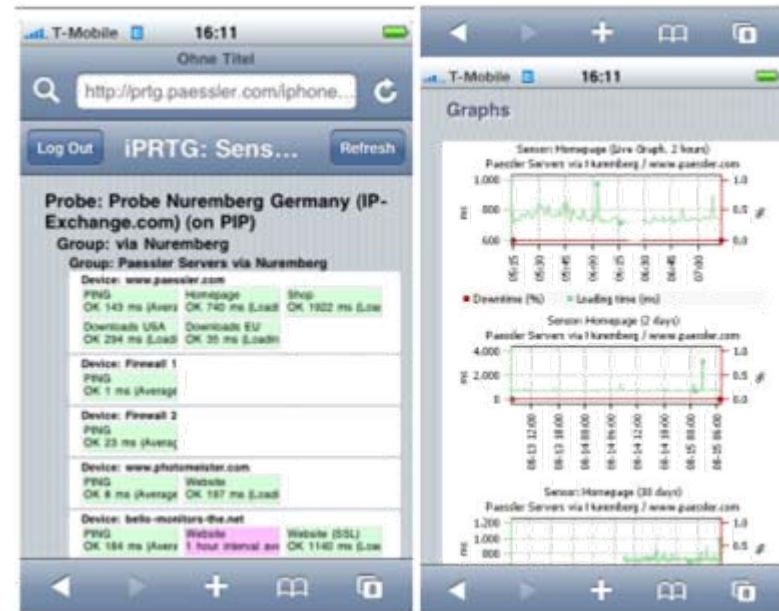

Source: Becker, R.A.; Eick,S.G.:Visualizing Network Data

Alternative Methods for Monitoring

Monitoring goes Mobile:

≡ Anywhere and any time

≡ Interface designed for mobile devices

≡ Quick response

Soundmonitoring with NeMoS:

≡ Ambient

≡ Every component has its own channel

≡ Sound-personalisation

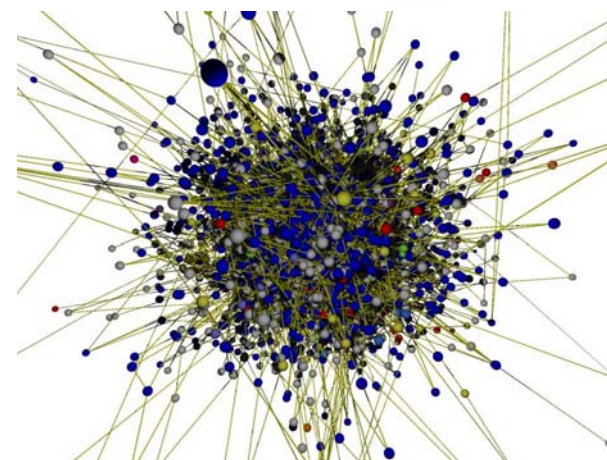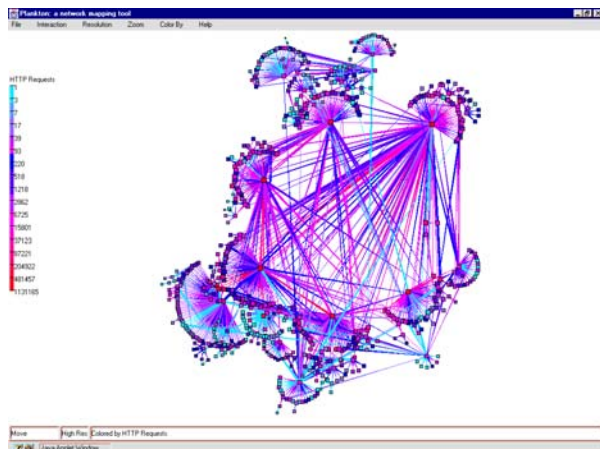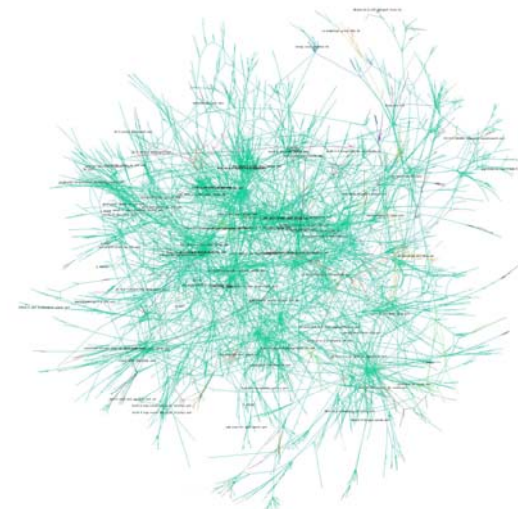≡ Alerting via volume adjustment

Source: Twardawa, C.: network computing journal 10/08: Monitoring goes Mobile

Alternative Methods for Monitoring

Ambient Visualization, when monitoring becomes art:

≡ Subliminal information transfer

≡ No need for permanent attention

≡ Integration into working environment

≡ Information filtering and abstraction

Source: The opte project (Mapping the internet in a single day) - www.opte.org
IP Mapping - /www.fractalus.com/steve/stuff/ipmap/
Plankton - http://www.caida.org/tools/visualization/plankton/

Network Visualization

≡ Thank you for listening!

≡ Questions?