Modeling of Mobile Objects Routes

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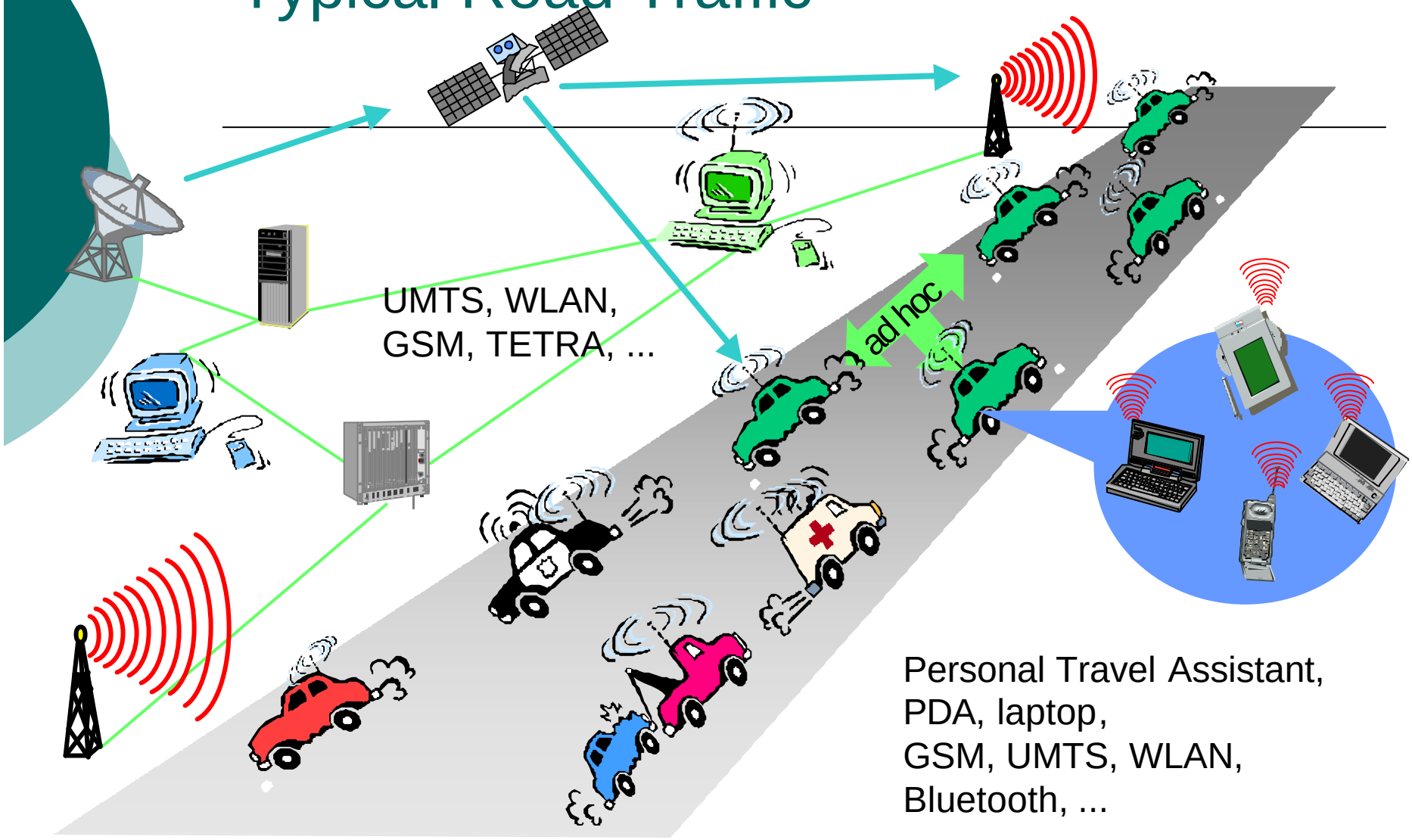
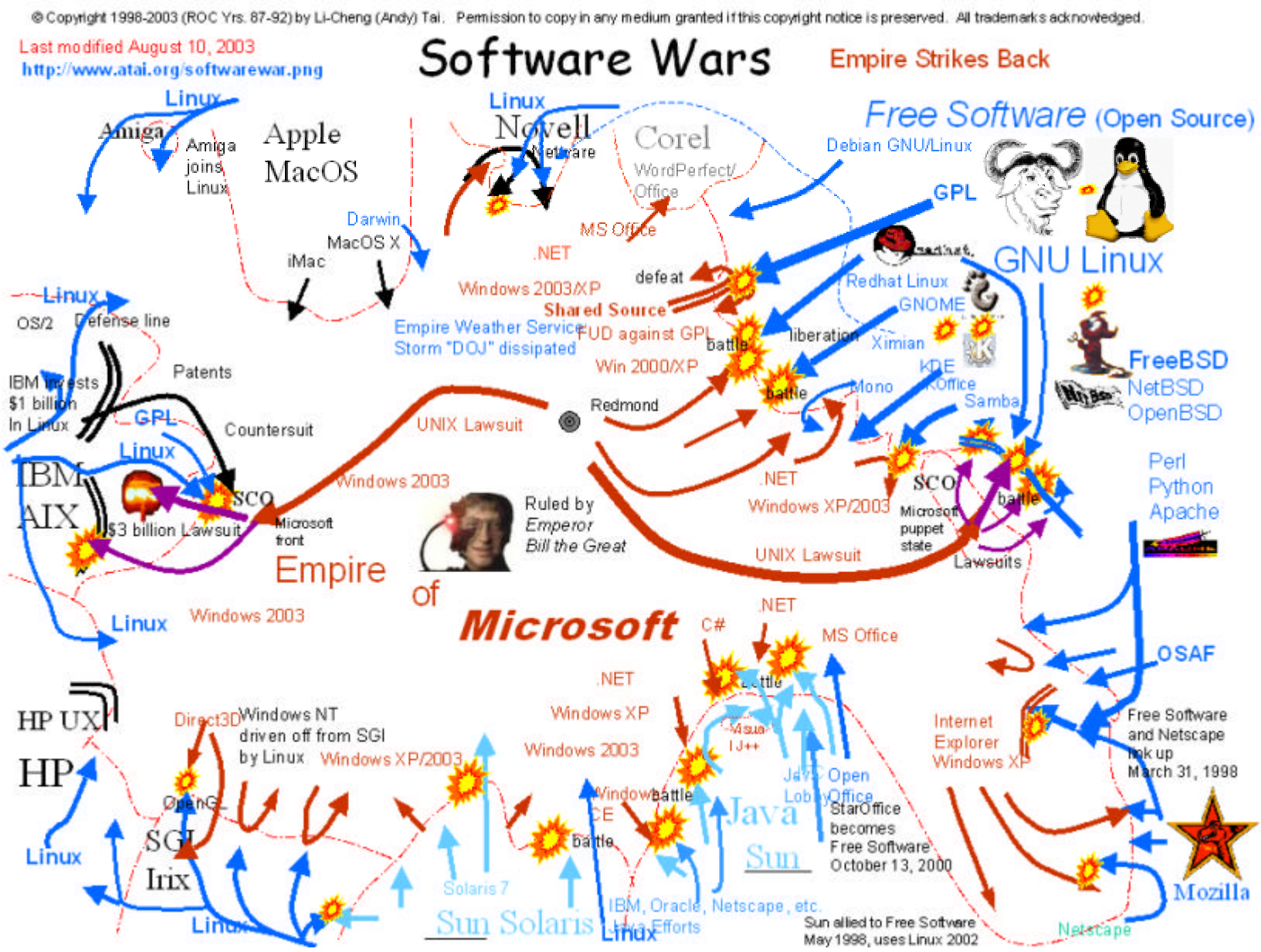
Where modeling of the mobile objects is needed?

In any kind of network:

- Road traffic network
- LAN / WAN / Internet / Intranet
- GSM
- UMTS
- WLAN
- Neural
- Social
- And many others

Typical Road Traffic

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http://www.atai.org/softwarewar.png
Software Wars
Empire Strikes Back
Free Software (Open Source)
Linux
Amiga
Amiga joins Linux
Apple MacOS
Darwin
MacOS X
iMac
Linux
Novell
Netware
Corel
WordPerfect/ Office
MS Office
.NET
Windows 2003/XP
defeat
Shared Source
Empire Weather Service
Storm "DOJ" dissipated
FUD against GPL
Win 2000/XP
Debian GNU/Linux
GPL
GNU Linux
Redhat Linux
GNOME
Ximian
liberation
battle
KDE
KOffice
Mono
Samba
FreeBSD
NetBSD
OpenBSD
Linux
OS/2
Defense line
IBM invests $1 billion In Linux
Patents
GPL
Countersuit
Linux
IBM AIX
$3 billion Lawsuit
SCO
Microsoft front
UNIX Lawsuit
Redmond
Windows 2003
Ruled by Emperor Bill the Great
Empire of Microsoft
.NET
Windows XP/2003
SCO
Microsoft puppet state
UNIX Lawsuit
Lawsuits
Perl
Python
Apache
Linux
Windows 2003
.NET
C#
MS Office
OSAF
HP UX
HP
Direct3D
Windows NT driven off from SGI by Linux
Windows XP/2003
.NET
Windows XP
Windows 2003
Internet Explorer Windows XP
Free Software and Netscape look up March 31, 1998
OpenGL
SGI
Irix
Linux
Solaris 7
Sun Solaris
IBM, Oracle, Netscape, etc. Java Efforts
Linux
Java
Sun
StarOffice becomes Free Software October 13, 2000
Sun allied to Free Software May 1998, uses Linux 2002
Mozilla
Netscape

Such model is needed to

- know where mobile object can go;
- find the fastest/best route from S (source) to D (destination);
- find the average route from S to D;
- find the most used places in network;
- locate bottlenecks;
- try predicting traffic in network and find possible problems in current topology

The model

First we need a matrix which consist of elements p_{sd}, where its value means that we can take a path from s to d with probability p_{sd}

Then the probability of the route can be calculated:

$$Route \; ? \; \prod_{s,d} \; p_{sd}$$

The model

To get some specific route data we need a matrix with specific information. For example with times needed to travel each direction:

- then t_{sd} value in matrix shows the time needed to travel from s to d is t_{sd}

Then time needed to travel a certain route can be calculated:

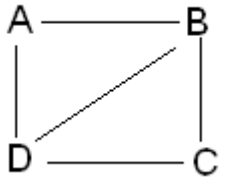
$$Route? \sum_{s,d} p_{sd} * t_{sd}$$

The model

- In many cases average time spent in route is needed. Average values can be calculated like this:

$$Average = \sum_{i \in Routes} route_i probability \cdot route_i time$$

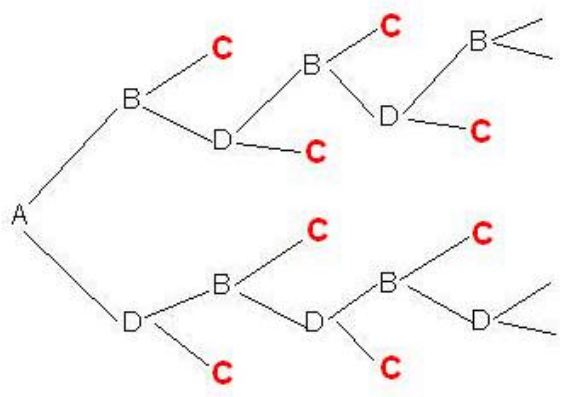
Example in network of 4 elements



	A	B	C	D
A	?	½	?	½
B	?	?	½	½
C	?	?	?	?
D	?	½	½	?

Let us consider a homogeneous network. Then all available links have the same probabilities (B and D can not return to A), if probability is equal to ? then it is known that travel on such link is not possible.

Example in network of 4 elements



Possible routes from A to C:

- ABC = ADC = ½ * ½ = ¼
- ABDC = ADBC = ½ * ½ * ½ = 1/8
- ABDBC = ADBDC = ½ * ½ * ½ * ½ = 1/16
- and so on

This model capabilities

With this model is possible to:

- find probability of a route;
- find the best / worst / average route;
- find the best / worst / average time (or other quantity) having additional data

Research directions

- Model a bigger network
- Model and Analyze network usage:
  - throughput
  - guarantied service
  - delays
  - Bottlenecks

?