



# A Topological Structure for Ubiquitous and Mobile GIS

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## Introduction

◆ The widespread deployment of wireless network, mobile computing and positioning devices is pushing Location Based Services toward the era of ubiquitous and ambient intelligence. Ubiquitous or pervasive GI provides right spatial services to the right people in the right place at the right time using context awareness .

◆ Generally speaking, a Ubiquitous and Mobile Information Environment has the following properties:

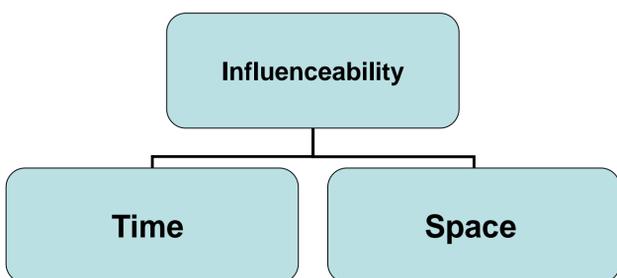
- ✓ No Global Sense
- ✓ Incomplete information
- ✓ 4-dimensional space-time continuum

## Proposed Spatial Structure

◆ Causality is widely known and esteemed concept. In our view, influenceability stands for spatial causal relation, i.e. objects must come in contact with one another. Although influenceability as a primary relation does not need to prove, it has some exclusive properties which show why it is selected. Influenceability supports contextual information and can be served as a basis for context aware computing which is a very important subject in ubiquitous computing. In addition, this relation can play the role of any kind of accident and collision. It is well-known that the accident is the key parameter in most transportation systems.

\* influenceability is irreflexive, antisymmetric, but transitive, i.e.

$$\forall a, b, c : (a \prec b) \wedge (b \prec c) \Rightarrow (a \prec c)$$



\* Temporal Relations:

$$(a \prec b) \Rightarrow (t_a < t_b)$$

$$t_a \ll t_b := [(t_a < t_b) \wedge (\neg \exists z (a \prec z \prec b))]$$

\* Spatial Relations :

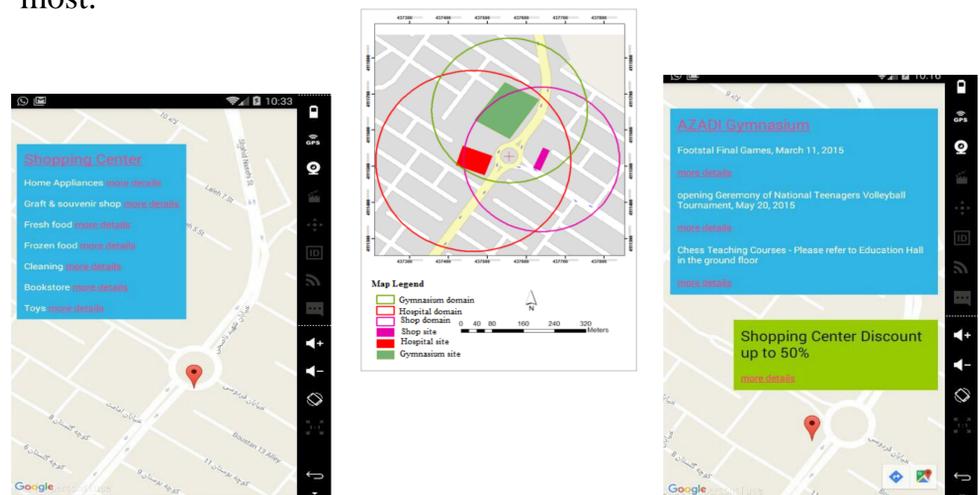
$$\forall x, y \ C(x, y) := \{[(x \prec y) \vee (y \prec x)][(\neg \exists a)((x \prec a \prec y) \vee (y \prec a \prec x))]\}$$

Relation	Description	Definition
DC(x, y)	x is disconnected from y	$\neg C(x, y)$
P(x, y)	x is a part of y	$\forall z [C(z, x) \rightarrow C(z, y)]$
PP(x, y)	x is a proper part of y	$P(x, y) \wedge \neg P(y, x)$
EQ(x, y)	x is identical with y	$P(x, y) \wedge P(y, x)$
O(x, y)	x overlaps y	$\exists z [P(z, x) \wedge P(z, y)]$
DR(x, y)	x is discrete from y	$\neg O(x, y)$
PO(x, y)	x partially overlaps y	$O(x, y) \wedge \neg P(x, y) \wedge \neg P(y, x)$
EC(x, y)	x is externally connected to y	$C(x, y) \wedge \neg O(x, y)$
TPP(x, y)	x is a tangential proper part of y	$PP(x, y) \wedge \exists z [EC(z, x) \wedge EC(z, y)]$
NTPP(x, y)	x is a non-tangential proper part of y	$PP(x, y) \wedge \neg \exists z [EC(z, x) \wedge EC(z, y)]$

## Applications

### Policy Conflict Resolution in Ambient Intelligence

Increase in the use of ambient services may cause service domain overlapping in which many of the users are located in several domains simultaneously. Influenceability can be used to present the best information service composition to such users. If a user influences the service site, its services are in priority to be sent to him/her. Moreover, if a user influences several service sites, then the priority will be allocated to the site which was influenced the most.



When the user is influenced by shopping center

When gymnasium influences the user more than shopping center

