# Using GeoFaces to route Interests and Data in Vehicular Networks

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## Applications running on cars

They include traditional Internet applications as well as specific vehicular applications such as safety alerts, parking, traffic jam notifications.

## Vehicular application scenario

The content:
* concerns a specific **geographic area**
* it's produced **in-loco**, by some sensors/nodes in that location

The **natural binding** between content and geographic areas can be exploited to **guide the interest forwarding process**. The NDN daemon can forward the relative interest on the Ad-Hoc Vehicular network toward that specific area
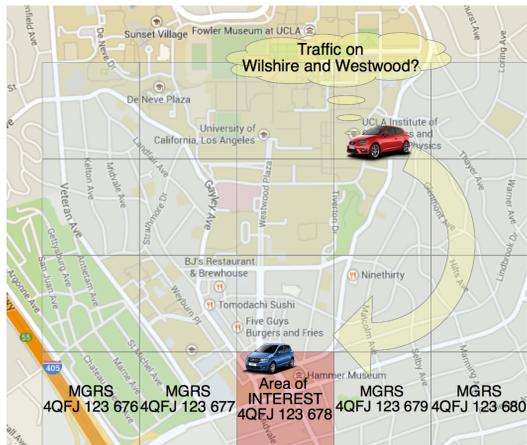


Likely someone nearby Wilshire and Westwood will be able to satisfy my interest

## GeoFace

A priori, the NDN daemon does not know:
* where such location-based contents can be found
* the semantics of the name

A consumer can guess where location-based interest could be satisfied and can use GeoFaces to share this information with the NDN daemon

* We divide the world into regions according to the Military Grid Reference System (MGRS)
* Each area is associated with a particular face, so called GeoFace
* **All packets going toward a specific area A or coming from A (on the V2V network) are sent/received using the GeoFace_A**
* The consumer binds the name of the content located in such areas with the relative GeoFace using the standard FIB prefix registration
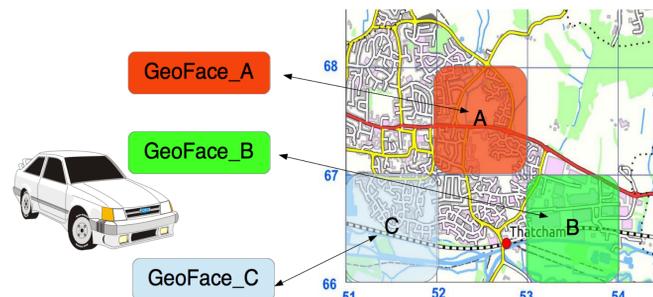


## How it works by example

Consumer interested by traffic updates on *Wilshire and Westwood*

* A Location Service maps the location *"Wilshire and Westwood"* with the area *"4QFJ 123 678"* and the relative GeoFace GeoFace_X
* The consumer registers the pair *< /traffic/WilshireAndWestwood, GeoFace_X >* in the FIB
* Whenever the NDN daemon receives an interest for *"/traffic/WilshireAndWestwood"*, it forwards it on GeoFace_X
* The GeoFace_X passes the interest to the Link Adaptation Layer



### Link Adaptation Layer

* Forwards the interest toward the destination area associated with the GeoFace
* Takes care of the retransmission / acknowledgment process
* Associates incoming packet to the corresponding GeoFace (based on source/Internet access point position)

## Link Adaptation Layer (LAL)

Adaptation layer between NDN and the WiFi Ad-Hoc Vehicular interface

* Based on the GeoFace used, the LAL sends the interest towards that specific area ("4QFJ 123 678")

### When the content comes back

* Either the LAL running on the car replying to the interest or the LAL running on RSUs attaches the node position to the data packet
* Whenever the LAL receives the data, it extracts the source position and passes the packet to the corresponding GeoFace

## Some results – Traffic application
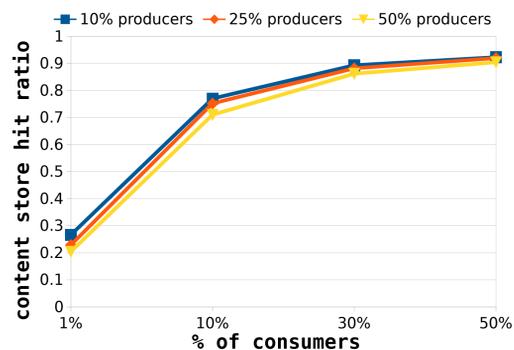


* Scenario
  * Urban scenario: a 2 km x 2 km residential area
  * All cars (1373) equipped with a WiFi Ad-Hoc interface
* Application
  * Producers: a subset of cars that collect information about the traffic situation on the roads they travel
  * Consumers: a subset of cars that periodically ask for traffic updates for a specific road
* Preliminary results
  * A higher consumer penetration rate increases cache usage
  * Cache utilization helps reducing path stretch and therefore improves the overall network efficiency
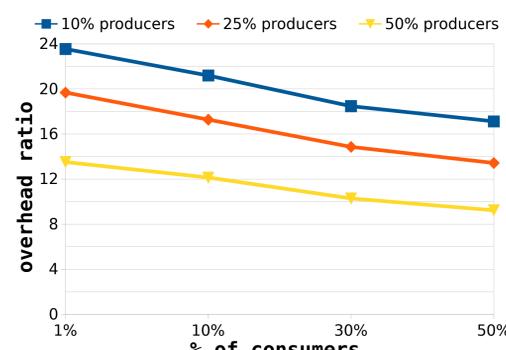


## GeoFaces: not only for consumers

Use cases for GeoFaces can be extended:
* They can be used by a forwarding strategy to **learn** where the content (producer or mules) or an Internet point of access can be found
* Such information can be useful to improve the performance of vehicular communication

**GeoFaces enable NDN to transparently manage geographic areas**
* The NDN daemon does not have any geographic knowledge, what it uses are simply faces
* No changes are required in the NDN daemon

## Considerations on scalability

* GeoFaces can be created on demand. It's not necessary to have GeoFaces up all the time for each area
* The size of the FIB depends on name structures
* To limit the size of the FIB, as soon as a consumer is not interested anymore on information about a specific area, it can remove the corresponding entry in the FIB