Farah El Ali

From vehicle to Internet

Contribution

Architecture components

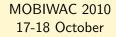
Realization

Conclusion



### Farah El Ali And Bertrand Ducourthial

 (1) University of Technology of Compiègne
 (2) CNRS Heudiasyc UMR6599, Centre de Recherche de Royallieu
 B.P. 20529, Compiègne, France (Email: firstname.name@utc.fr)











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## From vehicle to Internet

2 Contribution

3 Components of the architecture







CINIS

**5** Conclusion







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# Intelligent Transport Systems (ITS)

### Motivations:

- Safety
- Road traffic regulation (Infrastructure)
- New services aboard

Four applications families:

- Vehicle oriented
- Driver oriented
- Passenger oriented
- Infrastructure oriented



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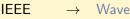


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- Contribution
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- Realization
- Conclusion





- $ISO \rightarrow Calm$
- IETF → Mobile IP, IPv6, Nemo MANET autoconfiguration (Autoconf)
- $\label{eq:C2C-CC} \mathsf{C2C-CC} \ \to \ \mathsf{Specific protocols for VANET}$
- $\mathsf{ETSI} \quad \rightarrow \quad \mathsf{Standardization}$ 
  - Large projects
    - USA (VII, CICAS, IVBSS, Intellidrive...)
    - Europe (CVIS, SafeSPOT, COOPERS, PReVENT, GST, HIGHWAY, FleeNet, SeVeCom, GeoNet ...)
      - Germany (NoW)
      - France (PREDIT)
    - Japan (SmartWay, VICS)
    - India (ITSIndia)
  - Need for V2V and V2I







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# DGA

• Vehicular networks are mobile, highly dynamic ad hoc networks:

- Message loss
- Frequent neighborhood change
- Kind of predictability
- Kind of protocols for V2I
  - IP in V2I communications: seems unavoidable
  - IP in V2V communications: subject of debate

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Inconvenient of using IP in V2V :

- Overhead control
- Autoconfiguration problems
- Hand-over

(WAVE  $\rightarrow$  no association with the road side unit)

Our proposition :

- VANET specific routing protocol
- IP only for gateway vehicle
- Using predictability (DTN)









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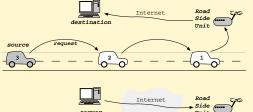
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- WiFi or 3G
- V2V until the gateway
- IPv4 or IPv6 only in the last hop
- Any VANET specific routing for gateway discovery

(Our implementation: Conditional transmissions)







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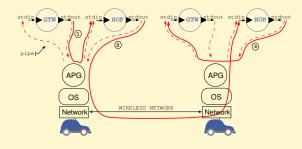
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Architecture Components

- No addresses
- Local/air
- Subscribing to applications







Airplug

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# Architecture Components GTW: gateway to the Internet

- Periodic scan of interfaces
- Sending the list of available interfaces periodically to all other applications through Airplug
- Gateway through: 3G, WiFi, LAN
- IPv4 or IPv6











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# Architecture Components HOP: Conditional transmissions

Routing technique adapted to dynamic networks (multi-hop retransmissions).

- · Receiver only known by conditions
- Messages sent with two conditions: CUP and CFW
- Conditions evaluated at reception

Identity or addresses, geographic positions, trajectory correlation (in front of, behind...), distance, duration...

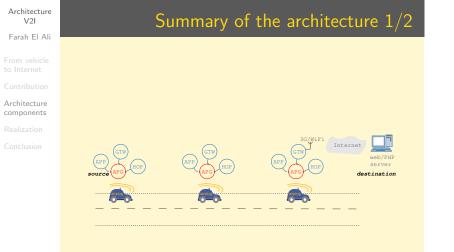








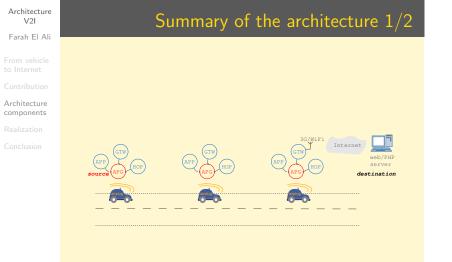










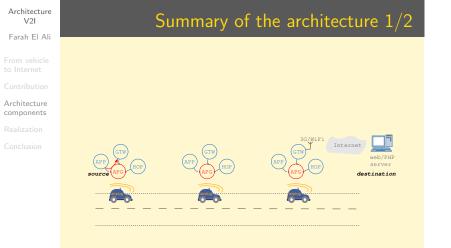




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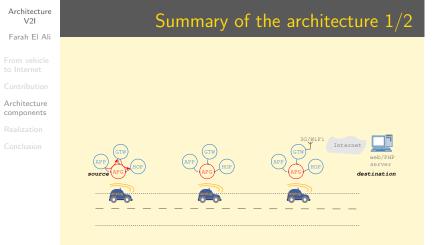
# Architecture Summary of the architecture 1/2V2I Farah El Ali Architecture components Internet access? urgent message ? 3G/WiFi server source destination







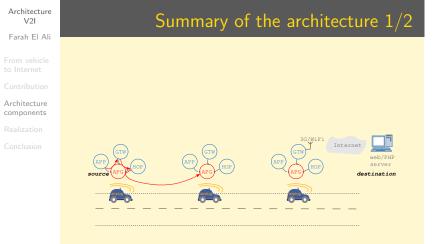










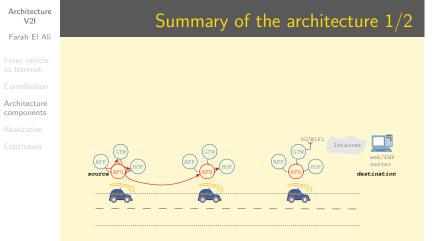










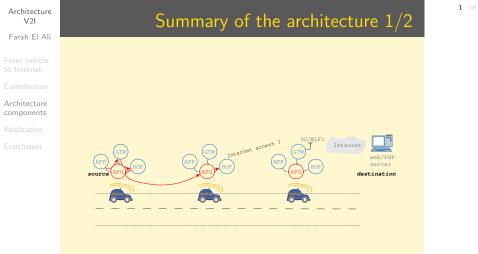










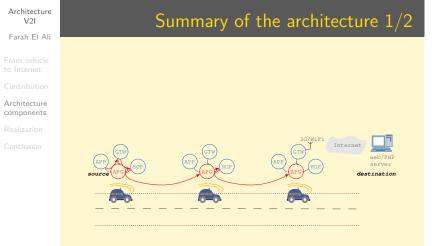




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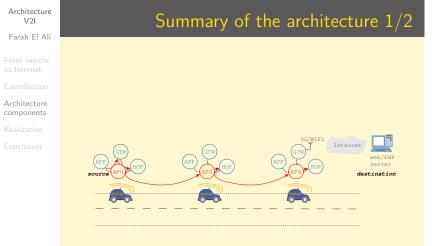










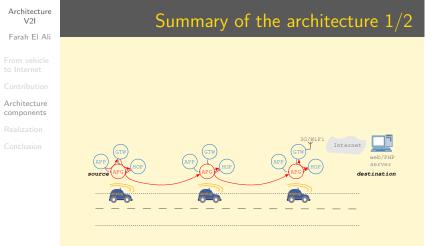








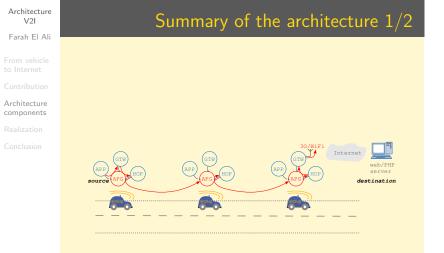










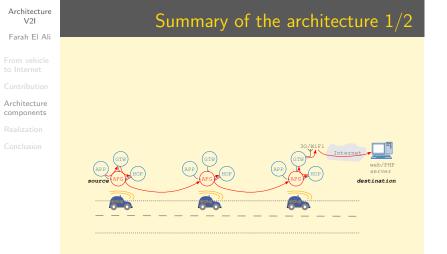










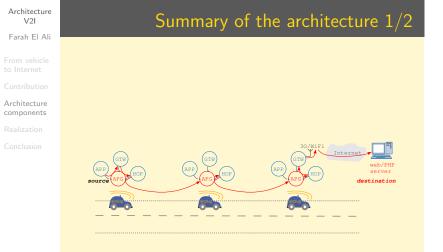




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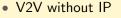
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#### Architecture components

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• IP communication between the gateway car and the server

Summary of the architecture 2/2

- VANET routing
  - conditional transmissions
  - gateway discovery
- privacy respect









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#### Realization

Conclusion



# Realization: GTW software

- Written in Tcl/Tk for NS-2 compatibility
- A link between Tcl/Tk and C for communications in IPv6
- Send keywords 3G or WiFi to HOP

	[airplug] app=GTW	ident=local			_ 🗆 🗙			
GTW	départ	affichage	aide	à propos	fin			
-Emission [GTW, ident - local]								
Retransmission	message reçu				app -			
Réception [GTW, ident = local]								
Connexion [GTW, ident = local]								
Scan interfaces OFF								
interfaces IPv4 : eth0 wlan0 interfaces IPv6 :								
Frequence de scan : 50000								
Etat du réseau								
1948 51 la réasem utilisée est un reasem interne UTO. l'addresse IP du serveur est 172.37.1.42 Si la réasem utilisé est un réasem acterna l'addresse IP du serveur est : www.hds.utc.fr 1948 Liste des interfaces à envoyer vers hop lan vifi: - Reaulta du test : IPOG Indisponible Wik Liste des interfaces à envoyer vers hop lan vifi: - Verse des interfaces à envoyer vers hop lan vifi: - Verse des interfaces à envoyer vers hop lan vifi: - Verse des interfaces à envoyer vers hop lan vifi: - Verse des interfaces à envoyer vers hop lan vifi:								
ip	port url				Interface			
www.hds.utc.fr	60 GET http://www.hds	s.utc.fr/~elalifar/sai	sie.php3?donn	188=	eth0 🜲			
Parametrage (IPv4 par dofault) _ Envolationalitye Ervolationalitye								
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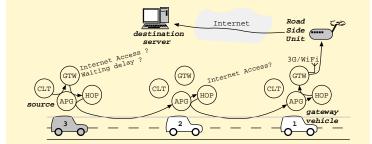
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# Realization: HOP software



- CUP: *WiFi* ∨ *3G*
- CFW:  $\neg$ *WiFi*  $\land \neg$ *3G*  $\land$  dst<2000  $\land$  dur<180

	[airplug]	_ <b> </b>					
HOP	départ	affichage	aide	à propos	fin		
Informations réceptions par HOP sur local							
estampilles reçu	les						
-							
_gps -> hopapp	ı -> hop⊤air -	> hop_hop -> a	air—hop -> aq	ob—abb locale:	s abonnées —		
0	0	0 0	0				

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- netbooks (Ubuntu)
- GPS
- WiFi USB cards
- Antennas
- 3G card

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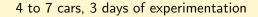
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Conclusion

# Experimentation: Test bed 1/2













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# DGA CTTS

# The application used for the validation is a data collect application.



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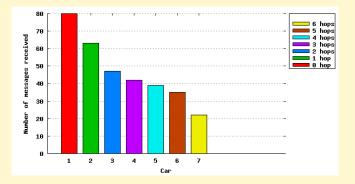
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# Validation: performances

- IPv6 on LAN
- A hop delay about 30 ms
- Delay gateway-server about 250-350 ms
- Loss rate about 20% per hop





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# Reception rate per hop in the convoy

- Only 10% of good reception is guarantied after 5 hops.
- Results vary from one test to another due to experimental and environmental conditions.

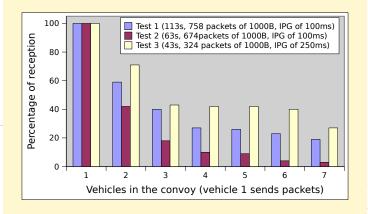


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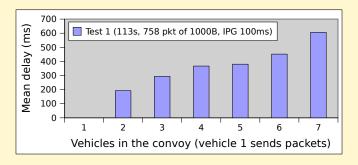
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# Delay per hop in the convoy

# • The delay grows with the number of hops



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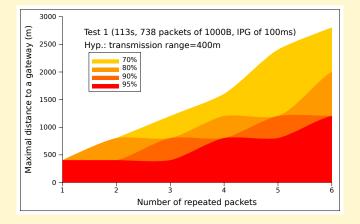
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# Admissible distance to an AP

• Max. distance reached in function of the number of repetitions



HEUDI SIC



# Conclusion

Architecture V2I

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Connecting vehicles to the Internet

- Required by several important ITS applications
- Dynamic network ~ hard to realize
- Contribution
  - kind of pervasive architecture
  - IP only on the last hop
  - VANET routing
    Conditional transmissions
  - Efficient gateway discovery
  - Few control messages
- Validation
  - Implementations and tests on road
  - Interesting performances
- Future work
  - Complete the architecture with I2V
  - Specific transport protocols

 $http://www.hds.utc.fr/{\sim}ducourth/airplug/doku.php$ 

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