Towards Multimodal: a Telecom Perspective

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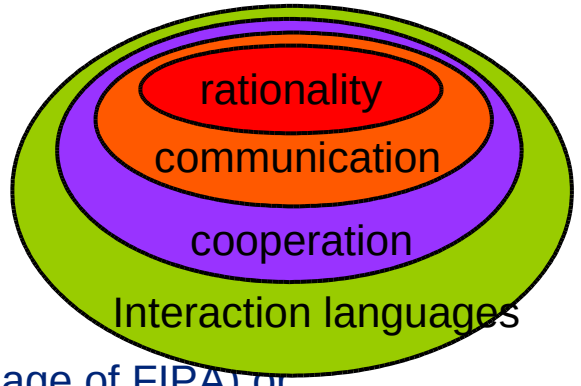
Rational dialoguing agent technology

Formal logical framework unifying theories of (communicative) actions and mental attitudes (e.g., intention, belief, uncertainty)

- Generic principles and mechanism for intelligent behavior
  - Rationality, communication, cooperation
- Language and media independent
  - Interaction languages processing = cognitive process
- Different interaction domain
  - **human/agent** dialogue,
  - **agent/agent** interaction (Agent Communication Language of FIPA) or
  - **human/agent/human** intermediation



Several applications on phone (fixe, GSM), Smartphone, PDA, PC.

Opportunity

France Telecom spans businesses in fixed-line, mobile and the Internet where Multimodality is perceived as an emerging enabling technology. Multimodality enables applications that have:

- ***Intuitive user interaction with an application*** combining the input and output modalities of a device. Visually though text, graphics and video, by voice though speech or a combination of voice and visual
- ***"Anywhere, anytime, anyhow services"*** **–** adapting to the network, environmental conditions, device capabilities and user preferences
- ***Integrated communication service proposition*** **–** well suited to mobile environment, due to form factor of today's mobile devices

The Rise of the Machine

Observations

Sensors can provide *unambiguous* environmental status as inputs to Multimodal applications via :

- **Notifications** of a devices state and conditions:
  "What's the status of my network?"
- **Events** indicating dynamically changing properties:
  "What's my devices current location?"
- **Changing patterns** in an application:
  "Can my application automatically adapt from quiet to noisy street conditions?"

Example: Location-Based Services (LBS)

"What's my devices current location?"

Several different forms of location determination

- Base station triangulation (in-network, EOTD)
- GPS local to the device (in-board,bluetooth)
- Dead based reckoning
- Others..

Characteristics

- Can be generated by local or remote events
- Possibly long response latencies (non-blocking events)
- Data Push or Pull

Example A: LBS Web-Request

1. Click on text field
2. ZIP code resolved based on handset location
3. Post results to text box

Request-based Location determination

- In-network zip code resolution
- Privacy issues easier to resolve

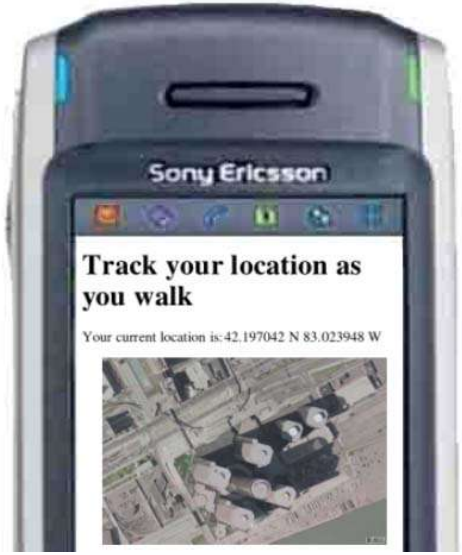
Example B: LBS Updates

1. Loading
2. ZIP code resolved based on handset location
3. ZIP code resolved as user moves

Updates location as user moves

- Update to the screen every ~20 seconds
- GPS or LBS services can determine devices location

Example C: GPS Device Location

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$GPGSA,A,2,20,31,11,,,,,,,,,,30.6,23.2,20.0*07
$GPGSV,3,1,09,28,69,132,27,07,67,306,00,04,40,207,00,20,29,092,33*76
$GPGSV,3,2,09,11,22,051,41,31,20,078,32,09,20,311,00,08,11,183,00*74
$GPGSV,3,3,09,24,05,214,00*44
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$GPGGA,091158.030,4219.7961,N,08302.1777,W,1,03,23.2,374.8,M,-34.0,M,0.0,0000*7D
```

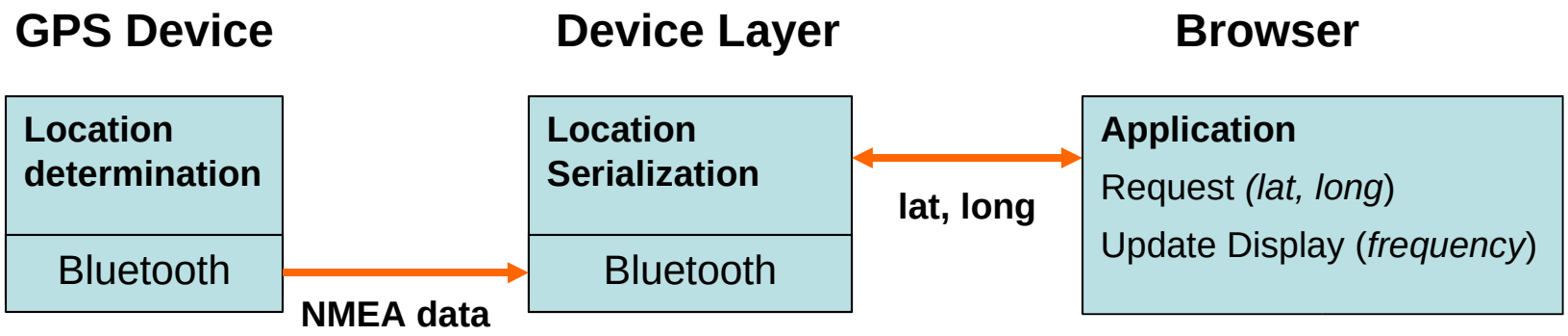
Automatic/Manual	A	2D/3D	2	Time Stamp	091157.030	Validity	A
Latitude	4219.7961	North/South	N	Longitude	08302.1777	East/West	W
Speed	0.000000	Course	299.06	Date Stamp	100604	Variation	
Variation East/West		checksum		Time	091158.030	Fix Quality	1
Number of Satellites	03	HDOP	23.2	Altitude	374.8	Alt. unit	M
Geiod Height	-34.0	Geiod unit	M	Time since DGPS	0.0	DGPS station id	0000
PRN #1	28	Elevation #1	69	Azimuth #1	132	SRN #1	27
PRN #2	07	Elevation #2	67	Azimuth #2	306	SRN #2	00
PRN #3	04	Elevation #3	40	Azimuth #3	207	SRN #3	00
PRN #4	20	Elevation #4	29	Azimuth #4	092	SRN #4	33
PRN #5	11	Elevation #5	22	Azimuth #5	051	SRN #5	41
PRN #6	31	Elevation #6	20	Azimuth #6	078	SRN #6	32
PRN #7	09	Elevation #7	20	Azimuth #7	311	SRN #7	00
PRN #8	08	Elevation #8	11	Azimuth #8	183	SRN #8	00
PRN #9	24	Elevation #9	[illegible]	Azimuth #9	[illegible]	SRN #9	[illegible]
PRN #10		Elevation #10		Azimuth #10		SRN #10	
PRN #11		Elevation #11		Azimuth #11		SRN #11	
PRN #12		Elevation #12		Azimuth #12		SRN #12	

National Marine Electronics Association (NMEA)

Browser in device updates as user moves location

- Updates every ~20 seconds
- GPS determines the devices location (downtown Detroit)

Example C: GPS Location Architecture

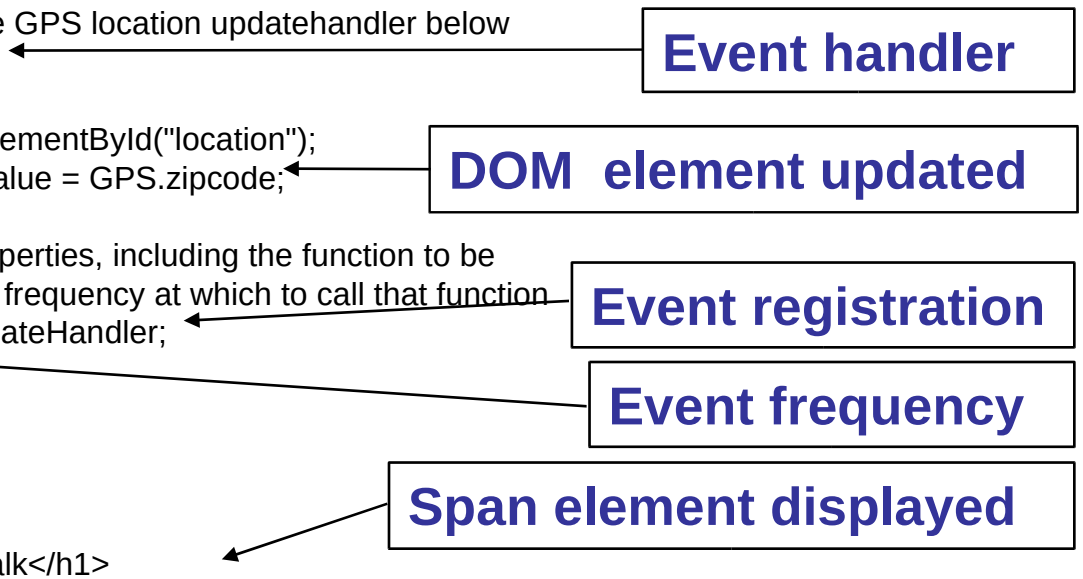


Data flow

- GPS pushes NMEA data over Bluetooth (~ 1 sec)
- Device layer maintains current location
- Browser requests an update from the device layer every ~20 seconds

GPS pseudo-code


```
<?xml version="1.0"?>
<html>
  <head>
      <title>GPS location example</title>
      <!-- Initialize GPS location component -->
      <script type="text/javascript">
      <![CDATA[
       // This function is registered as the GPS location updatehandler below
      function locationUpdateHandler()
      {
              var field = document.getElementById("location");
              field.childNodes[0].nodeValue = GPS.zipcode;
      }
       // The GPS object has several properties, including the function to be
       // called location updates, and the frequency at which to call that function
      GPS.updateHandler = locationUpdateHandler;
      GPS.frequency="20s";
      ]]>
      </script>
  </head>
 <body>
      <h1>Track your location as you walk</h1>
      <p>Your current zip code is: <span id = "location">(please wait)</span></p>
 </body>
</html>
```



The Web today

Interactive Web implementations are typically request-driven requiring sub optimal solutions, for example

- **Reloading** - every N-seconds to refresh dynamic components
- **Scripting** - periodically load data into hidden frames and then examine the contents

Mobile device polling further exacerbates the situation

- **Network traffic** - keep alive data
- **Efficiency** - scripting “tricks”
- **Polling frequency** - needs to be determined per application
- **Processor power** - increased performance requirements

Web Options/Opportunities

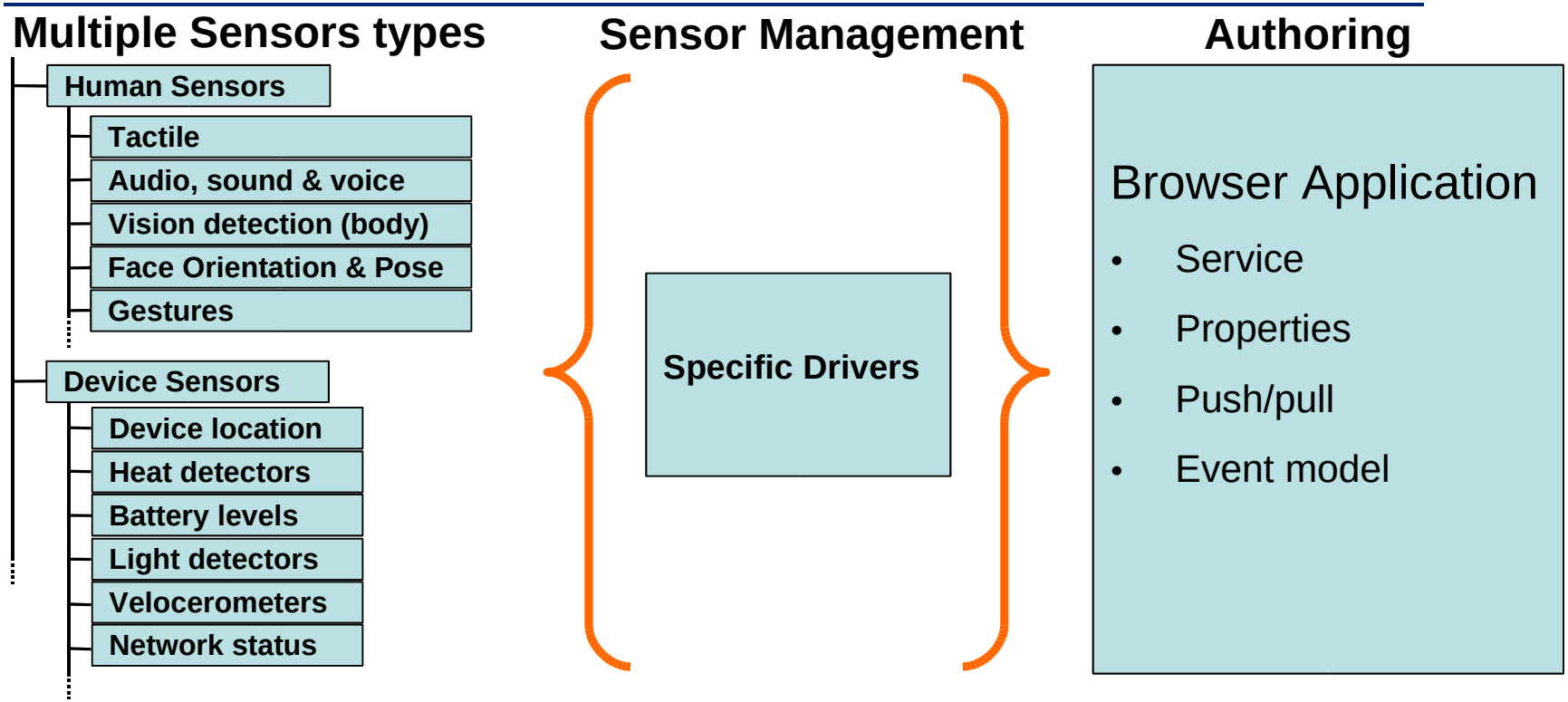
Basic component encapsulation to support

- Properties - screen width x height, bit-depth
- Events - changing property notifications
- Introspection - availability of properties and events
- Customization - loading new properties and events
- Persistence - maintaining history

W3C Document Object Model (DOM):

- **Property hierarchies**
  - Property Interfaces to *Add/Remove, Access/Search and Modify*
  - Property values accessed at leaf nodes
- **Events**
  - Provides a mechanism to build event models
  - Ability to bind properties to events

Multiple Sensor Management



Exposing multiple sensors to Web authoring

- *What sensors are available for Multimodal authoring?*
- *What properties/attributes can be accessed?*
- *How are requests performed: push/pull mechanisms?*

Conclusions

Machine sensors provide

- *Unambiguous* data for Multimodal applications
- Environment conditions indicating what modes could/should be used as well as a “fall-back” operation

Tomorrow's mobile Multimodality should consist of modular components

- Event models - provide distributed remote eventing (client <--> server)
- Attributes - enquires and binding

Additional examples

Example 2: Network Signal Strength

1. Low: t + 0 min

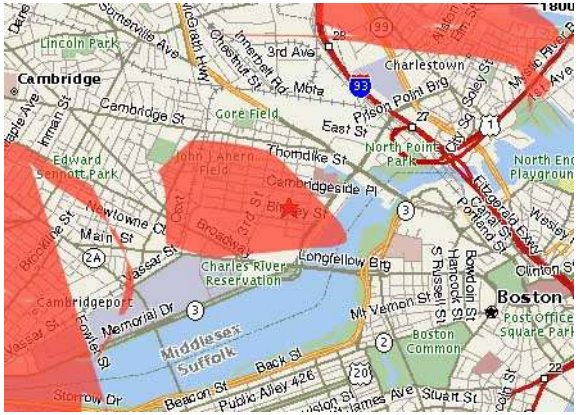
2. Medium: t + 1 min

3. High: t + 7 min

Variable signal strength over space and time

- **Blackhole computation -** historical patterns of network service

Space & Time Network Signal



Two modes: Location and network strength

- As the user's location changes the signal strength is collected
- Over time a map displays results of regions where signals were weak, strong or non-existent
- Such information could be used for a variety of purposes such as signaling users that they're entering a bad signal area
- Service “Black hole” application