



Hybrid Positioning GNSS,
Cell-ID, Wi-Fi[®], Bluetooth[®], FM & TV

Opportunistic Location Workshop
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The slide features a central image of a Broadcom chip with the company logo and tagline. Below the chip, the title and event information are displayed in white text on a red, curved background. The background of the slide is black with white, swirling lines.

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Hybrid Location



Why Hybrid Positioning?

- Available Technology
- Future Convergence



everything

A slide with a white background and a red border. At the top, the title "Hybrid Location" is written in red. Below it, a satellite icon is shown. The main text "Why Hybrid Positioning?" is in black, followed by two bullet points: "Available Technology" and "Future Convergence". In the bottom right corner, there is a small Samsung logo and the word "everything" in red.

Why Hybrid Positioning?



We Need It

GNSS will not work everywhere

We Can Do It

All the necessary hardware is available



A slide with a white background and a red border. At the top, the title "Why Hybrid Positioning?" is written in red. Below it, there is a photograph of a city street with tall buildings. To the right of the photo, the text "We Need It" is in blue, and "GNSS will not work everywhere" is in black. Below this, the text "We Can Do It" is in blue, and "All the necessary hardware is available" is in black. In the bottom right corner, there is an image of a hand holding a PDA device displaying a map, with a small red icon above it.



Indoor GPS Has Been Around for Almost 10 Years



Archival photo shows GPS demonstrated inside a shopping mall, CA 2001

Acquires signals down to almost -160dBm

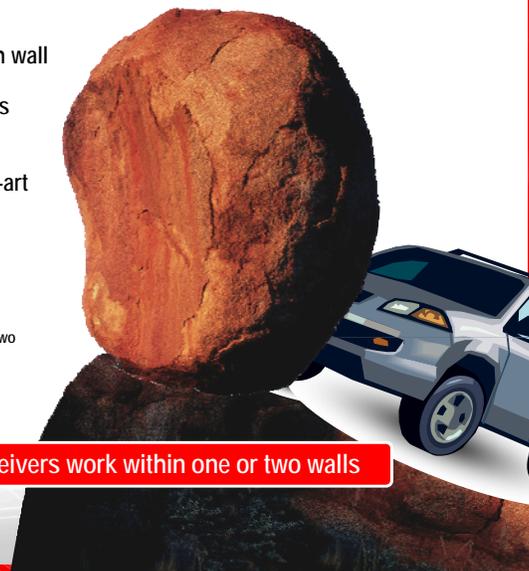
Computes position in center of mall

But, Indoor GPS, like *off-road vehicle*, describes the presence of a capability, not the absence of any limitation



Limitations

- GPS signals, around -125 to -130dBm outdoors, drop by 10 to 20dB with each wall
- Signals may pass through several walls before even reaching your building
- Approximately -160dBm is state-of-the-art for commercial GPS systems and improving, but slowly
- Much lower numbers (e.g., -170dBm) achieved in labs but not in practice (e.g., atomic clocks, completely stationary receivers and two antennas with one outside)



The most sensitive receivers work within one or two walls



Hybrid Positioning

- All necessary hardware exists today in consumer products
- Software is simple in some cases (cell-ID)
- More complex software for mobile TV, Wi-Fi, etc. is already mature (e.g. Rosum, Skyhook)

The slide features a satellite in the upper left corner and a radio tower in the center with a target symbol on its top. The Broadcom logo is in the bottom right corner.



Hardware Available Today

The diagram shows a central gear-like shape with eight spokes. Each spoke points to a circular inset containing logos and images of hardware. The central gear contains the following text: **WiFi CERTIFIED**, **GPS 3G Cellular**, **Bluetooth**, **FM TV**.

- Bluetooth Wi-Fi:** Apple, Dell
- GPS:** Sharp, James Bond
- Wi-Fi:** Cisco, Netgear, Thomson
- Bluetooth:** Planex, Koyol
- Mobile TV:** Nokia
- FM:** Nokia
- 3G Cellular:** Nokia



Convergence

All these technologies moving to the same chip

 BCM2048 Bluetooth + FM	 BCM4325 Bluetooth + FM + Wi-Fi
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 **Bluetooth**  **FM**  **Wi-Fi**

Conclusion: the necessary hardware is available –
Start building your hybrid location products.

 **everything**