

Svugdje moguća navigacija

- seminar -

Zavod za geomatiku
Integrirani sustavi u geomatici

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Sadržaj

Outdoor navigacija

- Uvod
- Sustavi
- Tehnike (integracija sustava)
- Rezultati i primjena

Indoor navigacija

- Uvod
- Sustavi
- Metode
- Primjene

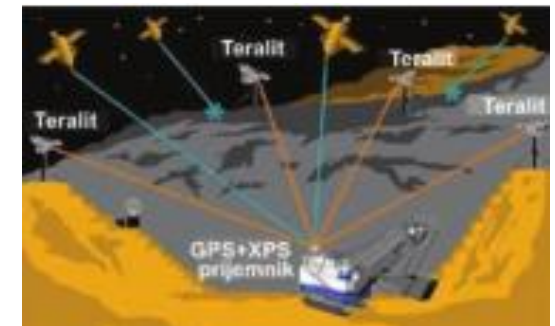
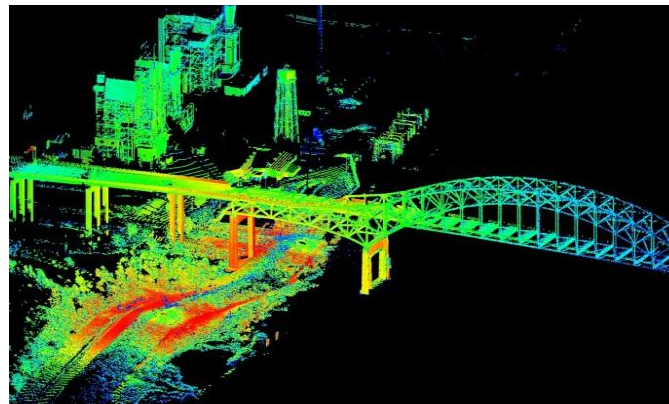
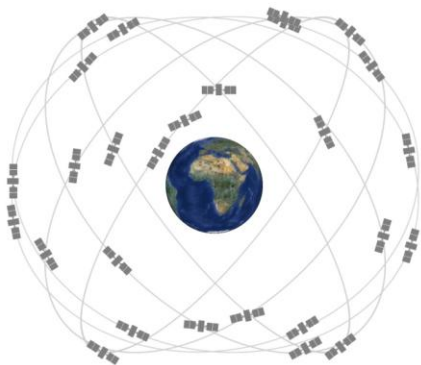
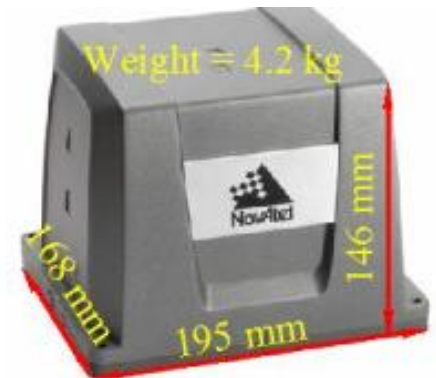
Utjecaj navigacije na društvo

Uvod u outdoor navigaciju

- Suvremene mogućnosti navigacije
 - GNSS
 - Današnje stanje
 - Utjecaj i važnost u outdoor navigaciji
 - Ostale tehnologije
 - MEMS (INS), LIDAR, Cloud Computing + Crowdsourcing, AGPS, pseudoliti
 - Potrebne zbog nedostataka GNSS-a
 - Postignuto integracijom senzora

Sustavi za outdoor navigaciju

- GNSS
- Akcelerometri i žiroskopi
- MEMS (INS)
- LIDAR
- pseudoliti
- AGPS



Tehnike outdoor navigacije

- GNSS + INS

- prednosti jednog sustava kompenziraju mane drugog

METODA INTEGRACIJE (GNSS + INS)	KARAKTERISTIKE
Labavo spregnuti <i>(eng. Loosely Coupled)</i>	<ul style="list-style-type: none">- najjednostavnija metoda- INS i GNSS rješenja neovisno generirana- profiltrirana prije integracije- prednost: ne zahtijeva pristup sirovim GNSS signalima- mana: potreba za minimalno 4 satelita
Jako spregnuti <i>(eng. Tightly Coupled)</i>	<ul style="list-style-type: none">- jedan jedinstveni filter- prednost: broj GNSS satelita može biti manji od 4
Duboka integracija <i>(eng. Deep Integration)</i>	<ul style="list-style-type: none">- podaci mjerenja oba sustava povezuju se u jedinstven filter u najranijoj fazi

Tehnike outdoor navigacije

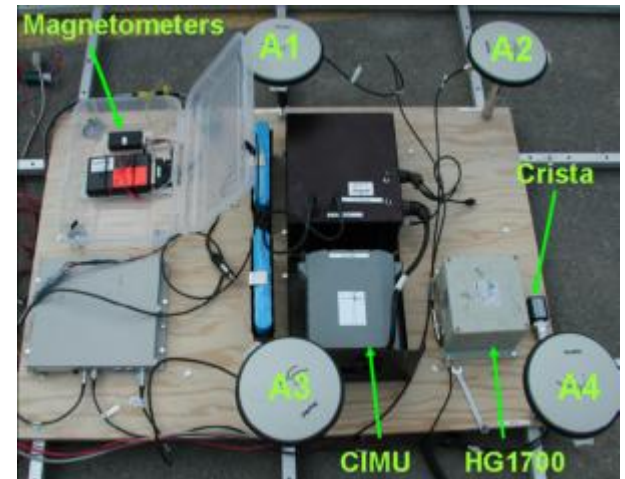
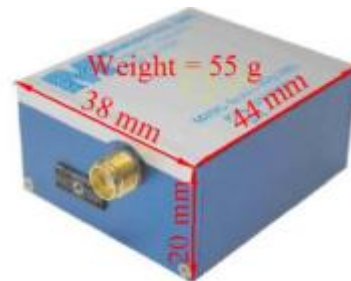
- GNSS + LIDAR
 - poboljšava GNSS navigaciju u smislu:
 - dostupnosti (mijenja GNSS kod potpunog izostanka GNSS signala);
 - točnosti (daje dodatne informacije);
 - integriteta (detekcija loših mjerenja)



Rezultati i primjena outdoor navigacije

- GNSS + INS

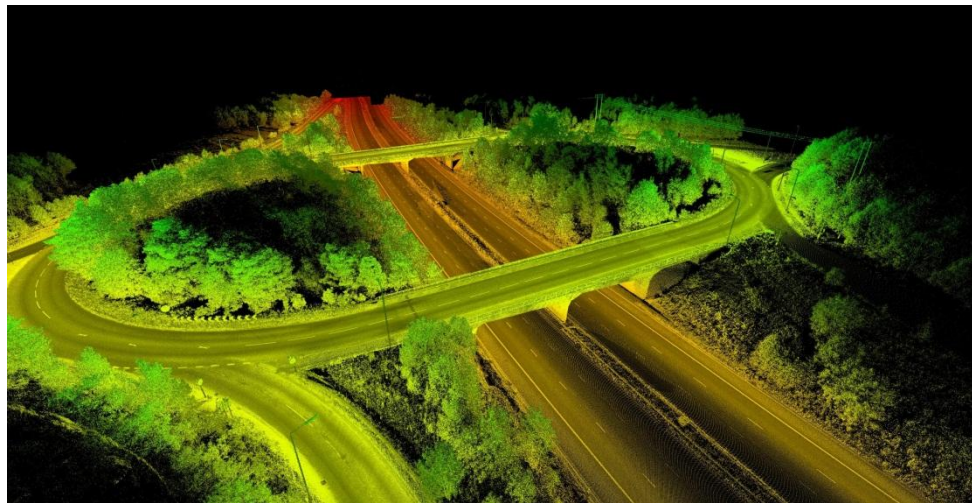
- BROJNA istraživanja, posebno vezana uz poboljšanje MEMS INS-a
- kvalitetni GNSS prijamnik + skupi INS = točnost bolja od 10 cm
- jeftini MEMS INS bez GNSS signala (oko 3 min) = točnost od 10 m
- primjena različitih metoda integracije
 - TC metoda poboljšava točnost sustava do 40 % u odnosu na LC



Rezultati i primjena outdoor navigacije

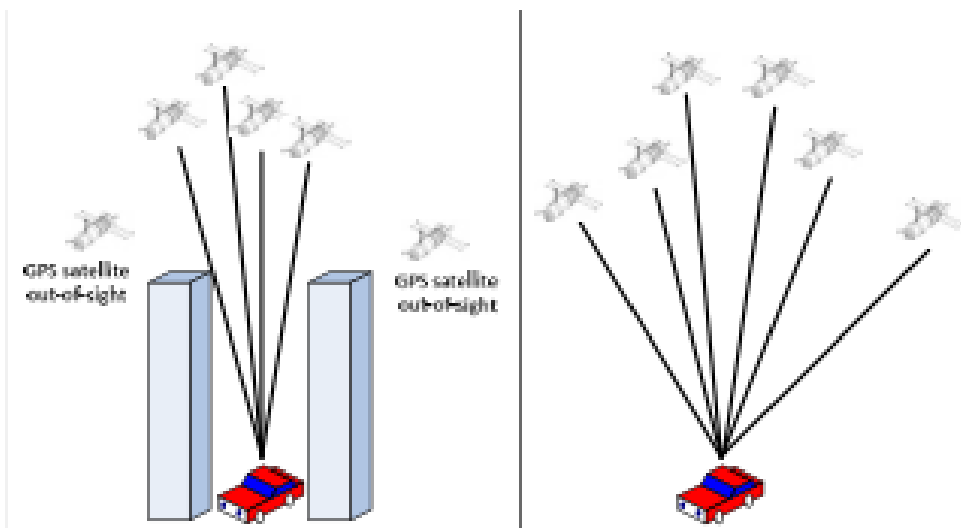
- GNSS + LIDAR

- LIDAR služi za detekciju rubova ceste kojom se vozilo kreće
- vozilo prvi put prođe po određenoj ruti s ciljem detekcije rubova ceste
- svaki sljedeći put kada vozilo prođe po istoj ruti, poboljšava se točnost navigacije uz odbacivanje loših GNSS mjerenja



Rezultati i primjena outdoor navigacije

- GNSS i smartphone
 - Cloud Computing + Crowdsourcing
 - Poboljšanje urbane navigacije



Uvod u indoor navigaciju

- ljudi preko 80% vremena provode u zatvorenim prostorima
- ne postoji jedinstveno rješenje za lociranje i navigaciju u zatvorenom prostoru

Time spent ...

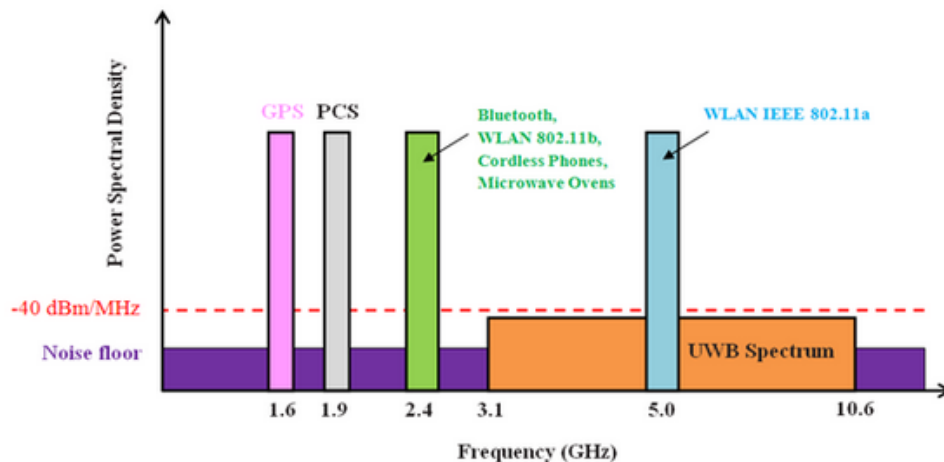
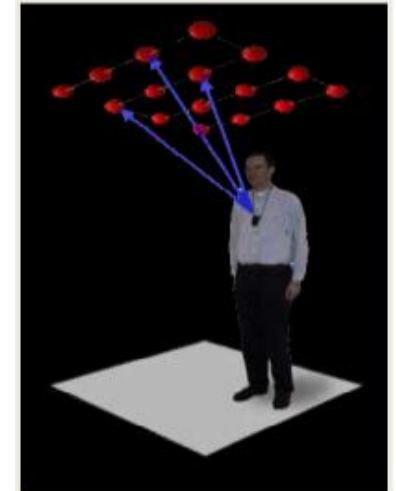
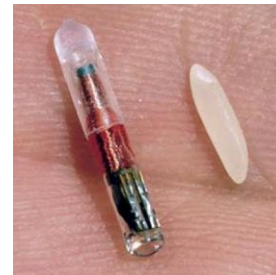


People spend 80-90% of their time indoors
70% of cellular calls and 80% of data connections originate from indoors.

(Source Strategy Analytics)

Sustavi za indoor navigaciju

- IR – dogledanje, kratak doseg
- RFID - zahtijeva oznake i čitače
- Bluetooth – prenosivost mreže
- UWB – cijena, ometa ostale sustave
- Wi-Fi – propusnost, sigurnost
- ultrazvuk – multipath, buka



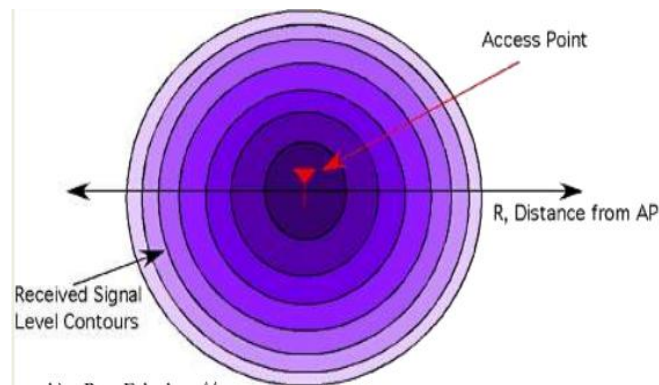
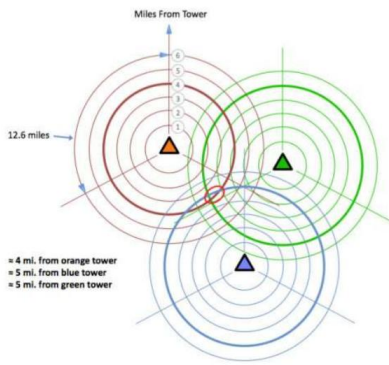
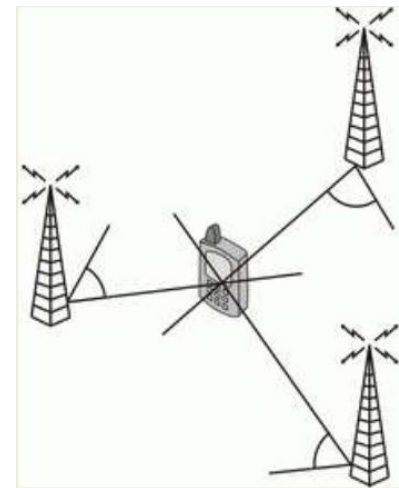
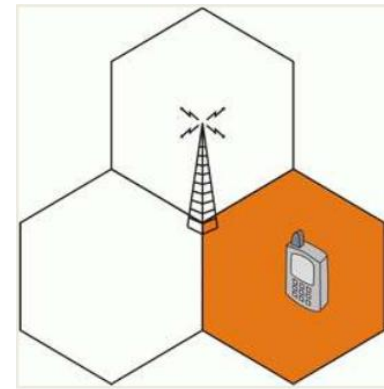
Metode indoor navigacije

- **Cell-ID**

- odašiljači dijele područje na blokove
- nedostatak: nepreciznost

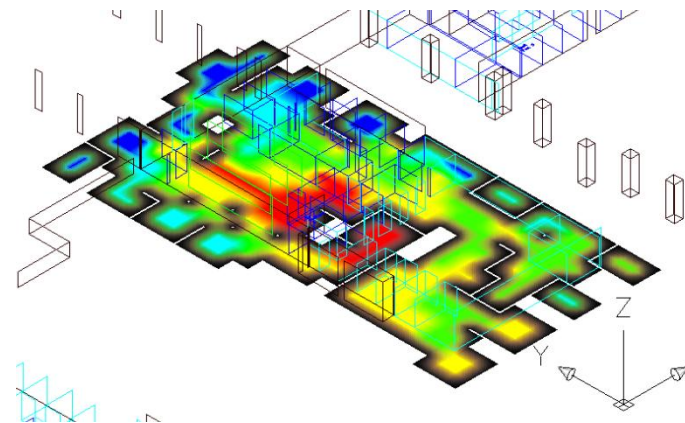
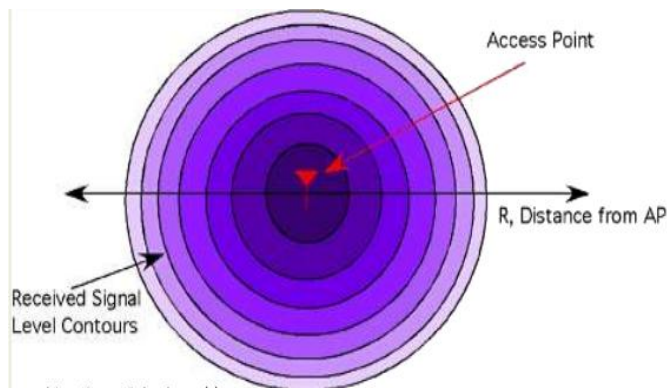
- **Angle-of-Arrival (AoA)**

- određivanje kuta iz kojeg dolazi signal
- nedostaci: dogledanje, multipath



Metode indoor navigacije

- **Received Signal Strength (RSS)**
 - metoda otiska (fingerprinting)
 - 2 faze: offline i online (faze treniranja i praćenja)
 - offline: određuje karakteristike signala na nekoj točki i sprema u bazu podataka
 - online: uspoređuje karakteristike signala na određenoj točki sa spremljenim u bazi



Primjene indoor navigacije

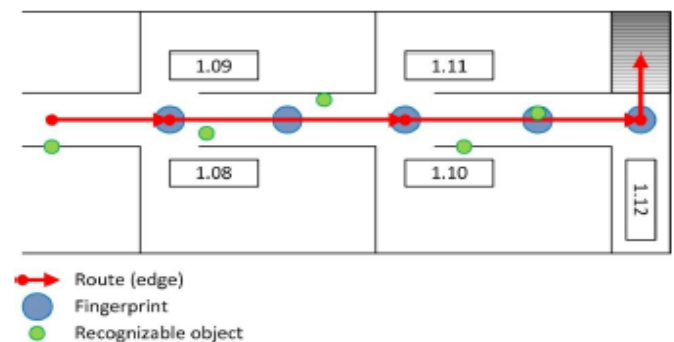
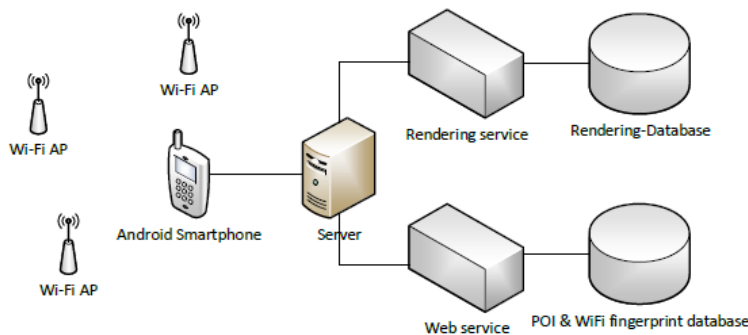
- Smartphone aplikacije temeljene na:

- 1) bazi otisaka Wi-Fi signala
- 2) bazi karakterističnih objekata
- 3) kartografskoj bazi podataka

- TU Delft, Utrecht: 1) + 2)

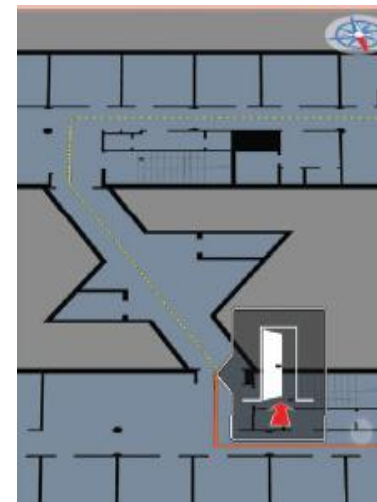
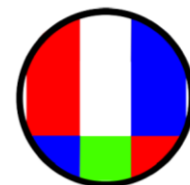
- Sveučilište Ulm: 1) + 3)

– točnost: 3-7 m



Primjene indoor navigacije

- Smartphone aplikacije temeljene na:
 - vizualnim markerima i detekciji zapreka
 - razvijena na Imperijalnom koledžu u Londonu
 - koristi podatke ugrađenih inercijalnih senzora
 - korekcija orijentacije i položaja korisnika pomoću markera
 - QR kodovima ([URL](#))
 - razvijena na sveučilištu u Torinu
 - procjena udaljenosti korisnika od QR koda (pomoću kamere)
 - dobivanje orijentacijskih parametara iz baze podataka pomoću QR koda
 - točnost orijentacije: 3.5°



Komercijalne primjene indoor navigacije

- Pole Star, Francuska
 - NAO Campus (2008.) – Windows Mobile OS
 - NAO Cloud (2012.): online servis za lakšu implementaciju
 - uključena aplikacija za Android i iOS mobilne uređaje
 - pokriveno 250 lokacija diljem svijeta (aerodrom Charles de Gaulle)
 - RSS metoda, Wi-Fi, Bluetooth, GPS (na otvorenom)
- Macy's – američki trgovački lanac
 - shopBeacon sustav za pomoć pri kupnji baziran na lokaciji korisnika
 - mobilna aplikacija + Wi-Fi i/ili Bluetooth odašiljači unutar trgovine
 - testirano u New Yorku i San Franciscu → širenje na sve poslovnice
 - može identificirati i locirati korisnika unutar trgovine (personalizirani kuponi, ekskluzivne ponude...)

Utjecaj navigacije na društvo

LBS pomaže u:

- Lociranju korisnika
- Navigaciji
- Praćenju vozila
- Hitnoj pomoći
- Snalaženju u prostoru

Tržište LBS-a:

- 8,3 mlrd. \$



Privatnost

FOX NEWS U.S. & WORLD
Updated: 3:28:08 9-4pm ET
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Man Accused of Stalking Ex-Girlfriend With GPS
 Saturday, September 04, 2004
 Associated Press

GLENDALE, Calif. — Police arrested a man they said tracked his ex-girlfriend's whereabouts by attaching a global positioning system (search) to her car.

Ara Gabrielyan, 32, was arrested Aug. 29 on one count of **stalking** (search) and three counts of making criminal threats. He was being held on \$500,000 bail and was to be arraigned Wednesday.

"This is what I would consider stalking of the 21st century," police Lt. Jon Perkins said.

Authorities: GPS system used to stalk woman
 KENOSHA, Wis. (AP) — A man was charged Monday with stalking his former live-in girlfriend with help from a high-tech homing device placed under the hood of her car.

Paul Seidler, 42, was arrested during the weekend. On Monday, he was charged with stalking, burglary, second-degree reckless endangerment and disorderly conduct, and ordered held on \$50,000 bail.

According to a criminal complaint, Connie Adams asked Seidler to move out of her apartment Oct. 25 after a three-year relationship. Prosecutors say he immediately began following her, including when she ran errands and went to work.

GPS





ANDROID

Mobiteli (Smartphone)



AT&T, T-Mobile, Verizon

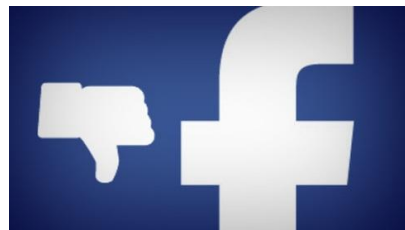
- Prikupljaju podatke o:
 - Pozivima
 - Porukama
 - Mailovima
 - Lokacijama
- Imaju uvid u:
 - Slike
 - Video zapise
 - Imenik
 - Spol
 - Dob
 - Lozinke



Wall Street Journal

- 101 aplikacija za Android i iPhone
 - 56 – ID korisnika
 - 47 – Lokacija
 - 5 – Dob, spol, osobne podatke
- HTC Android
 - Prikuplja podatke o:
 - Lokaciji
 - Nazivu i snazi WiFi mreže
 - Šalje ih Googleu i Appleu

FREE
WiFi



WiFi

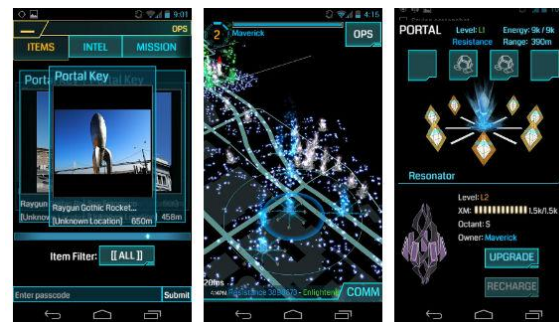


Današnje stanje

- WiFi signal – radioval
- Enkripcija mreže???
- New York
 - Stare telefonske govornice postaju HiTech kiosci
 - 200 mil \$
 - Reklamni monitori

Interesi

- Baze otisaka WiFi signala za navigaciju sa smartphoneom
- Google
 - StreetView + WiFi
 - Ingress



Data brokers

Information Aggregators

Acxiom Corporation

- Promet – 1,1 mlrd. \$
- Profit – 57,6 mil. \$
- Kupci
 - Banke
 - Autoindustrija
- Prodaju:

education level

estimated net worth

types of recent purchases

investments

habits (like smoking & gambling)



number of kids

contact info

religious & political views

marital status

mortgage amount

salary

Procjene profita

- Acxiom, Google, Facebook, itd.
- 2014. – 3 mlrd. \$
- 2018. – 50 mlrd. \$

