RFID - Vision & Reality

serec@ETHZ, March 6th 2009

by

RFIDnet Bern GmbH

Swiss RFID Competence Network

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Berner Fachhochschule

Technik und Informatik

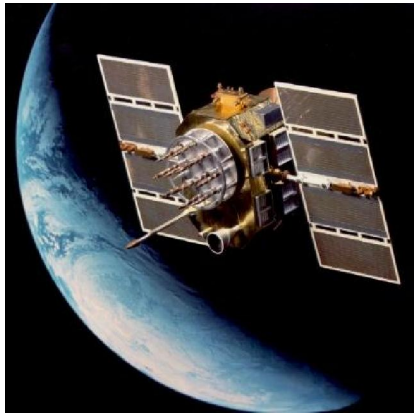
tcbe.ch

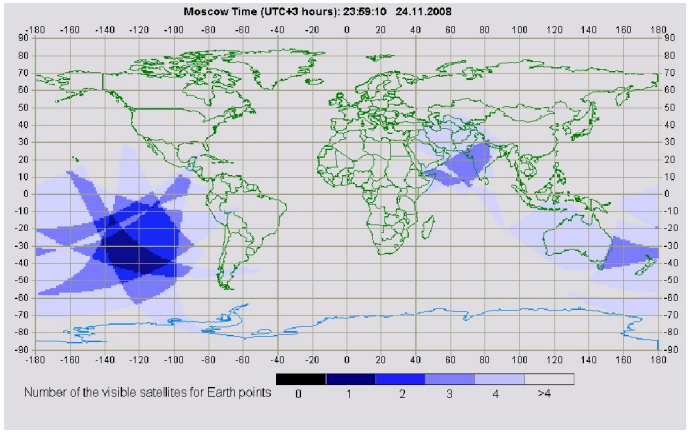
ICT Cluster Bern, Switzerland

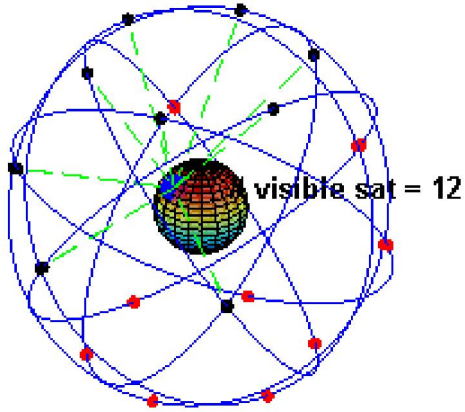
Indoor and Outdoor Positioning Systems – the limits of today's RFID positioning technologies

(David C. Gürlet, RFIDnet Bern, Bern University of Applied Sciences)

A look at today's GPS (outdoor) and RTLS (indoor) systems; followed by a review of the latest technologies (UWB, e-INS, active RFID, RFID via WLAN).







Agenda

1. RFIDnet Bern GmbH
2. Today's RTLS-World
    1. Basics / Technologies
    2. Position Accuracy
    3. Outdoor & Global - RTLS (NAVSTAR=GPS, GLONAS, GALILEO)
    4. Indoor – RTLS Systems & Positioning Technologies
    5. Each Technology: Active RFID / WLAN-Based / UWB / e-INS
3. Tomorrow's RTLS-World (combined)
4. Q & A's

1.1 RFIDnet Portfolio

1.2 Consulting

- Swiss Entrypoint for all RFID-Questions
- Neutral Consulting for all RFID-Markets & Applications
- Manufacturer neutral 2nd Opinion Analysis & Mediations
- Feasibility Studies & Proof-of-Concepts
- NEW: Workshop **„are you ready for RFID?“** (1 day)

1.3 Events & Trainings 2009

RFID-Events

- 3 Late Afternoon Events with RFID-Sitevisits
  à 17.4.09 / 12.6.09 / 6.11.09 – EM Marin, Manor, TicketCorner, etc.
- 1 Competence Day
  à Friday, September 4th, 2009 @ BEA-Expo Bern
- Presentations @ Events
  à ETH-Serec, e-healthcare summit, Inno-Day Bern, etc.

RFID-Trainings

- RFID-Basics, Applications, Economics
  à 21st + 22nd of April, 20th + 21st of October 2009
- RFID-BFH-Student Trainings (June & September 2009)
- WorkShop „are you ready for RFID?“ anytime@customer

1.4 Memberships / Links / Partner & Supporter

- Berner Fachhochschule TI www.ti.bfh.ch
- Member of SwissTnet RFID-Sektion 51 www.swissT.net
- Member of AIM Deutschland / Schweiz http://www.aim-d.de/
- Links to other international RFID-Organisations (Fraunhofer, EU-Research, RFID-im-Blick, AIM Global, etc.)

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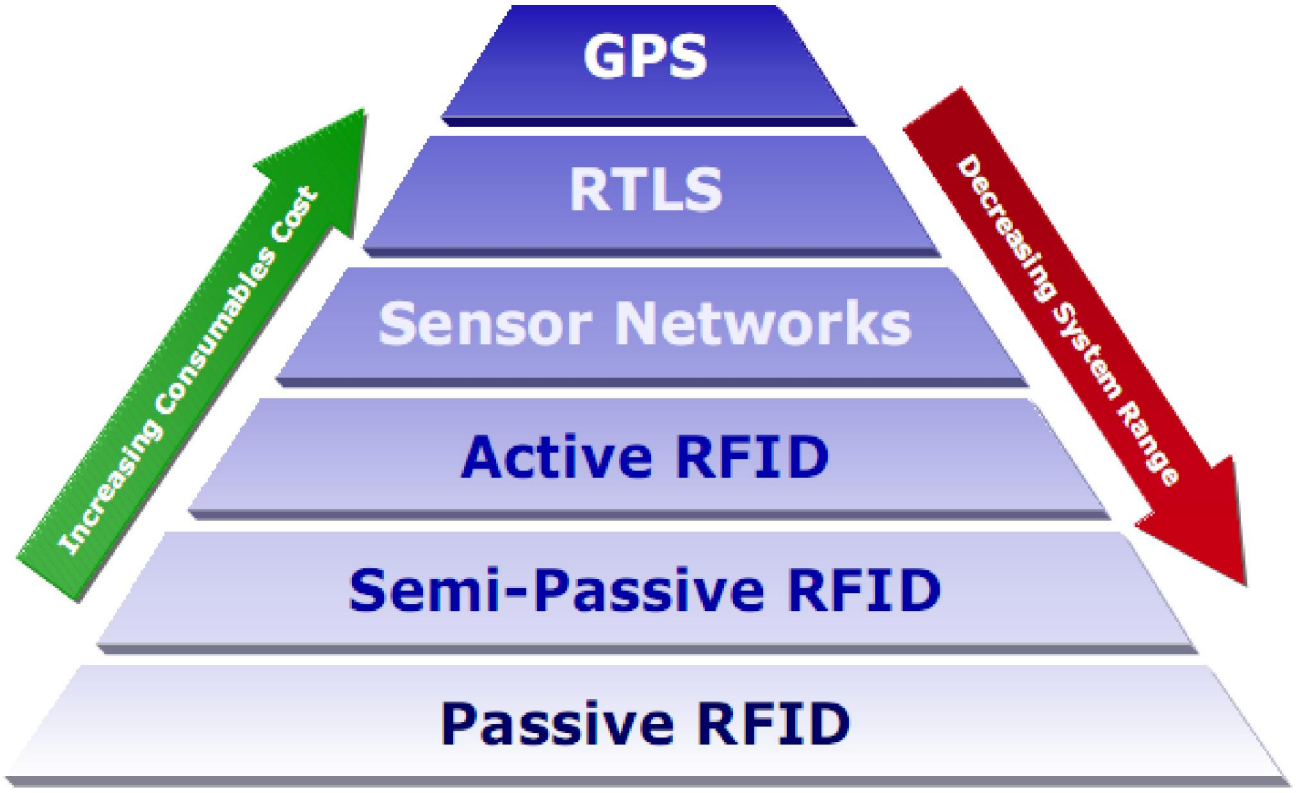
IDENTEC SOLUTIONS

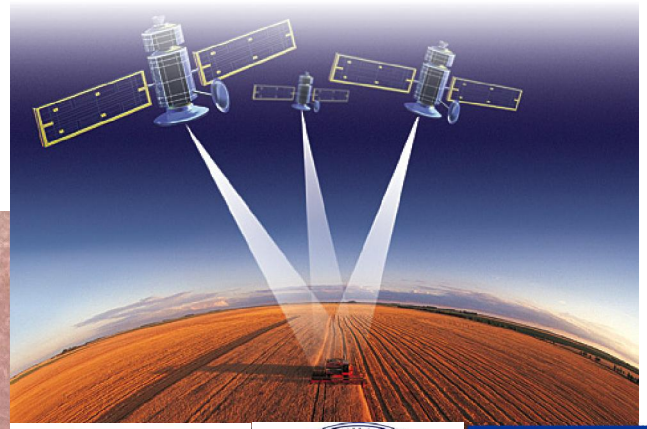
2.1 Basics - RTLS & RFID or what it is !



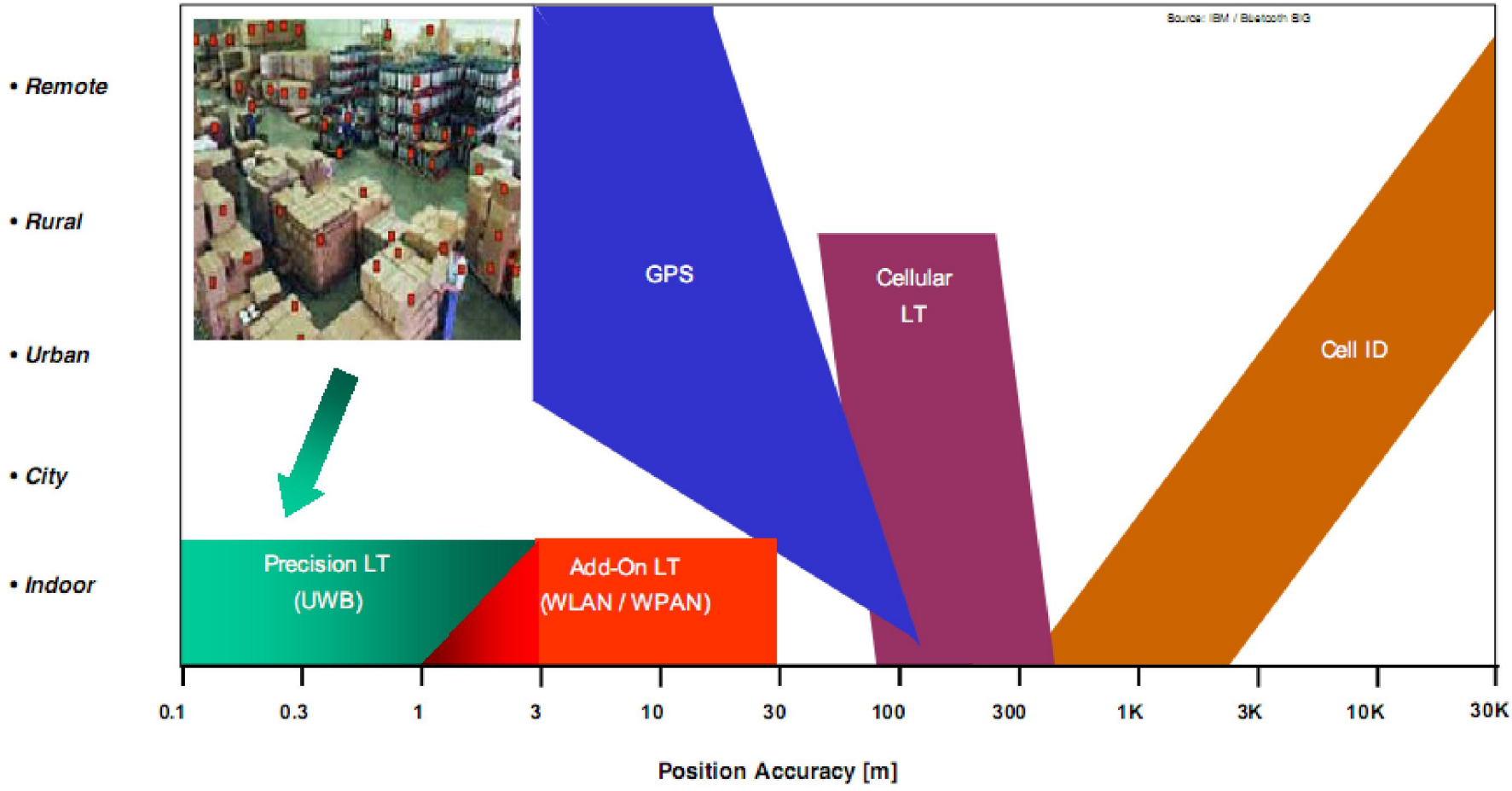
2.1 Basics - RTLS & RFID or what it is NOT!

« RFID is that 2-cents small spy-chip that we can't see, that holds 1'000 encyclopedias of data and that can be tracked by satellite with a precision of a few mm»

(Citation from customer discussion)



2.2 Position Accuracy RTLS (in- & outdoor)



2.3 Outdoor & Global

COMPASS – covering China
INRSS – covering India
QZSS – covering Japan

operational

„Navigational Satellite Timing and Ranging - Global Positioning System“ à NAVSTAR-GPS operational since 17.7.95 operated by US-DoD Acc. civil=15m, D-GPS = 0.01 – 5m (differential GPS)

GLONASS **(russ. ГЛОНАСС – Глобальная Навигационная Спутниковая Система, translated global navigation satellite system), operational since 1996 & again 2008, Reference for Galileo**

GALILEO GPS for Europe, compatible NAVSTAR-GPS III (2010= Costs today = 1.5 Mia Euros + 3.4 Mia Euros (Budget à 2013),
1st Satellite à GIOVE-A1 (Galileo In-Orbit Validation Element)
started 28th of December 2005/5:19 UTC from Baikonur (Kasachstan)
operational 2013, tested with GLONAS, Acc. Civil ~ 1m

Galileo Galilei (15 February 1564 – 8 January 1642)

2.3.1 Wer hat es erfunden?

- Die Grundidee, mittels Satelliten ein Navigationssystem aufzubauen, gab es bereits vor dem Zweiten Weltkrieg: Am 11. Mai 1939 meldete der deutsche Ingenieur Karl Hans Janke in Berlin ein Patent für einen „Standortanzeiger, insbesondere für Luftfahrzeuge“ an, welches am 11. November 1943 erteilt wurde. Im Patent geht er von zwei entfernten Körpern (Satelliten) aus, die permanent elektromagnetische Signale senden. Die Signale können empfangen werden und als Vektor auf einem Bildschirm angezeigt werden. Legt man nun eine Karte über den Bildschirm, könne man sogar die Herkunft und Richtung eines Objektes bestimmen. Karl Hans Janke wurde in der DDR wegen „wahnhaftem Erfinden“ eingesperrt und verstarb 1988 in der Psychiatrie Hubertusburg.[4]

See today‘s Satellites here ….

http://science.nasa.gov/RealTime/JTrack/3D/JTrack3D.html

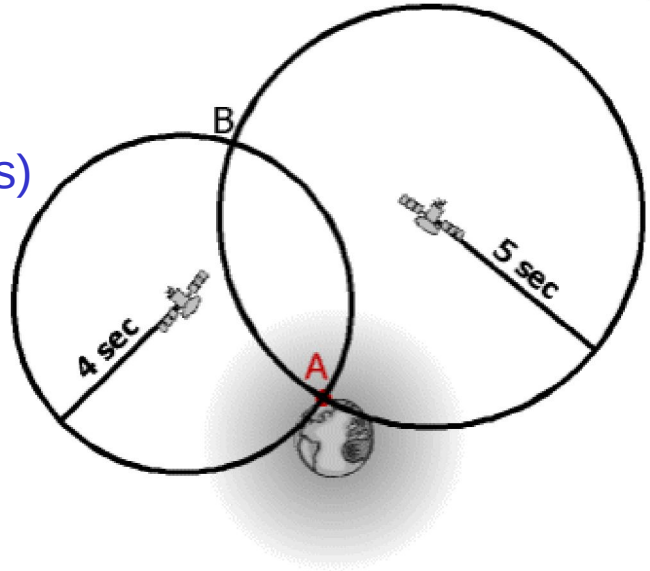
2.3.2 How does it work ? http://www.kowoma.de/gps/index.htm

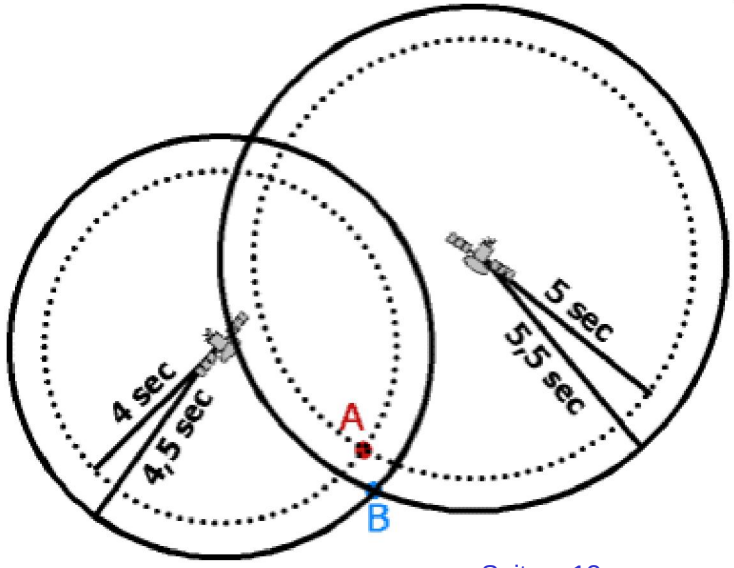
1. we need at least 21 satellites (usually 24-30) ..
2. on an 20.2 km Orbit, 55 deg. Inclination with very accurate time (3 x 10 power-8 sec. = 10meters)

3. we see 3 satellites @ same time for 2D position fix
4. we receive first satellite message „I am Sat X, was on Position Y at Time Z“ …
5. Second Satellite sends it‘s message
6. Third satellite sends it‘s message ….
7. GPS-Receiver calculates Position on earth with „time-of-arrival minus time-sent for signal“ (TOA) and Trilateration

8. For 3D position fix, we need to see at least 4 satellites @ same time

9. Speed on earth is measured by differential calc. of multiple positioning infos
10. Accuracy > 15 meters, with D-GPS < 1 Meter





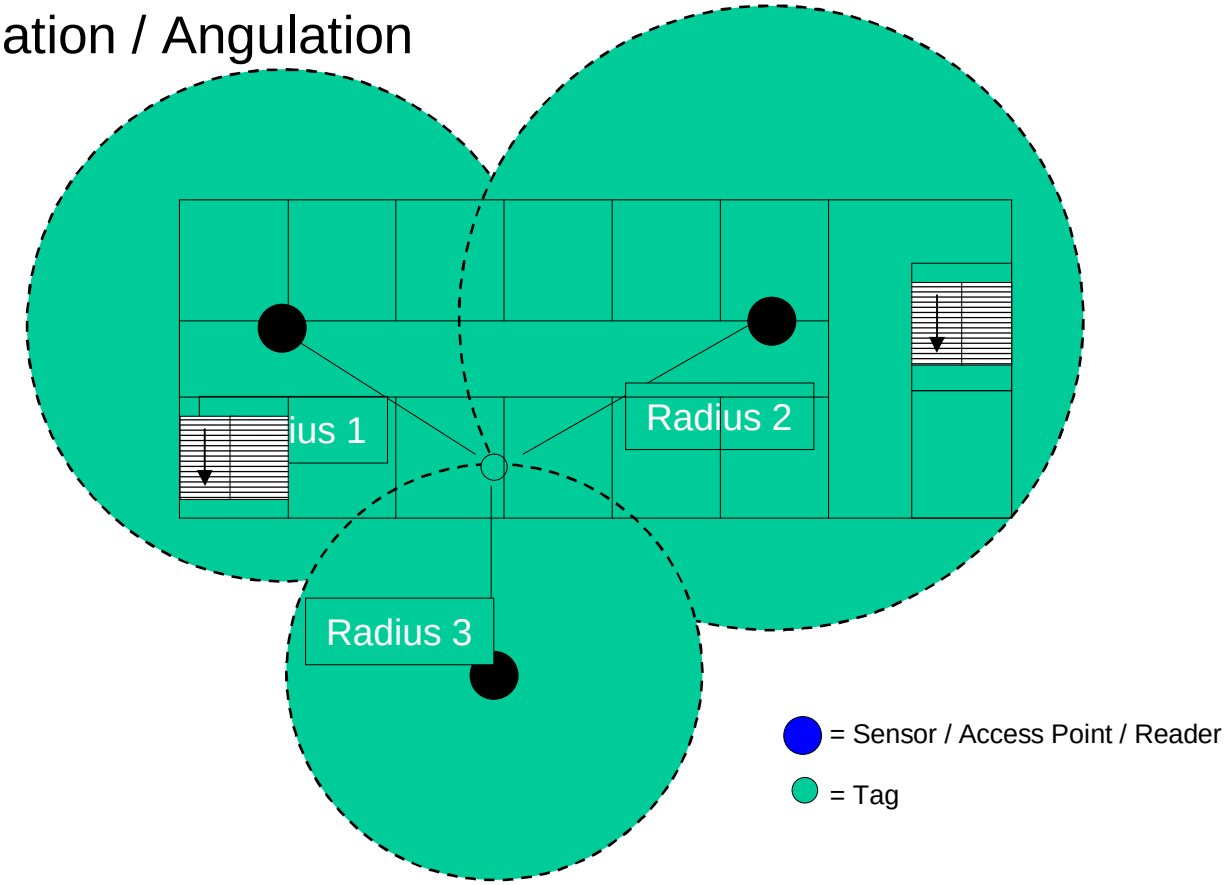
2.4 Indoor – RTLS Systems (active RFID, WLAN-based RFID, UWB, e-INS)

- **RTLS - 3 big families**
  - Triangulation / Angulation
  - Cell-based
  - Choke-point based
- **Identify AND locate**
- **Vision:**
  - Every person and object in a building is identified and located in real-time
- Location enables software applications
- Connects the real world to the virtual world
- RTLS is usually referring to indoor tracking or local positioning (contrary to outdoor GPS)

- **Used in:**
  - Hospitals (find assets, people)
  - Industry (WIP-Tracking)
  - Army (Combat training)
  - Container Management (Cargo)
  - Tourism (Auto-guides)
  - Security (Alarm localisation)
  - etc.

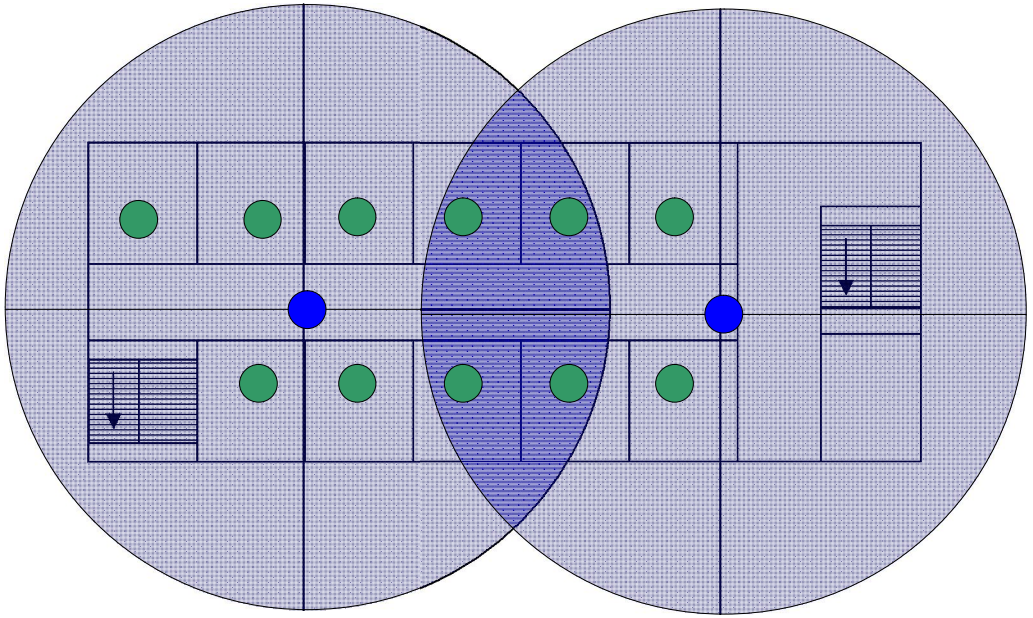
2.4.1 Indoor – Positioning Technologies

- Triangulation / Angulation



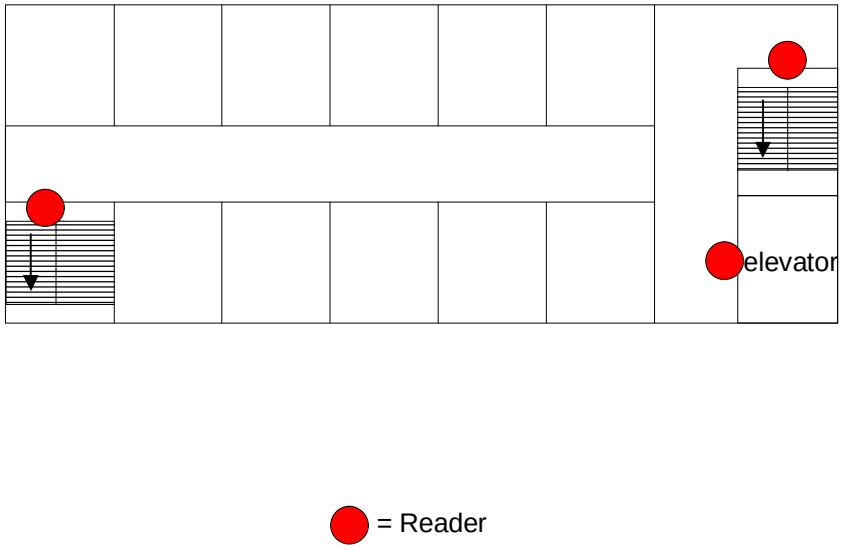
2.4.2 Indoor – Positioning Technologies

- Cell-Based

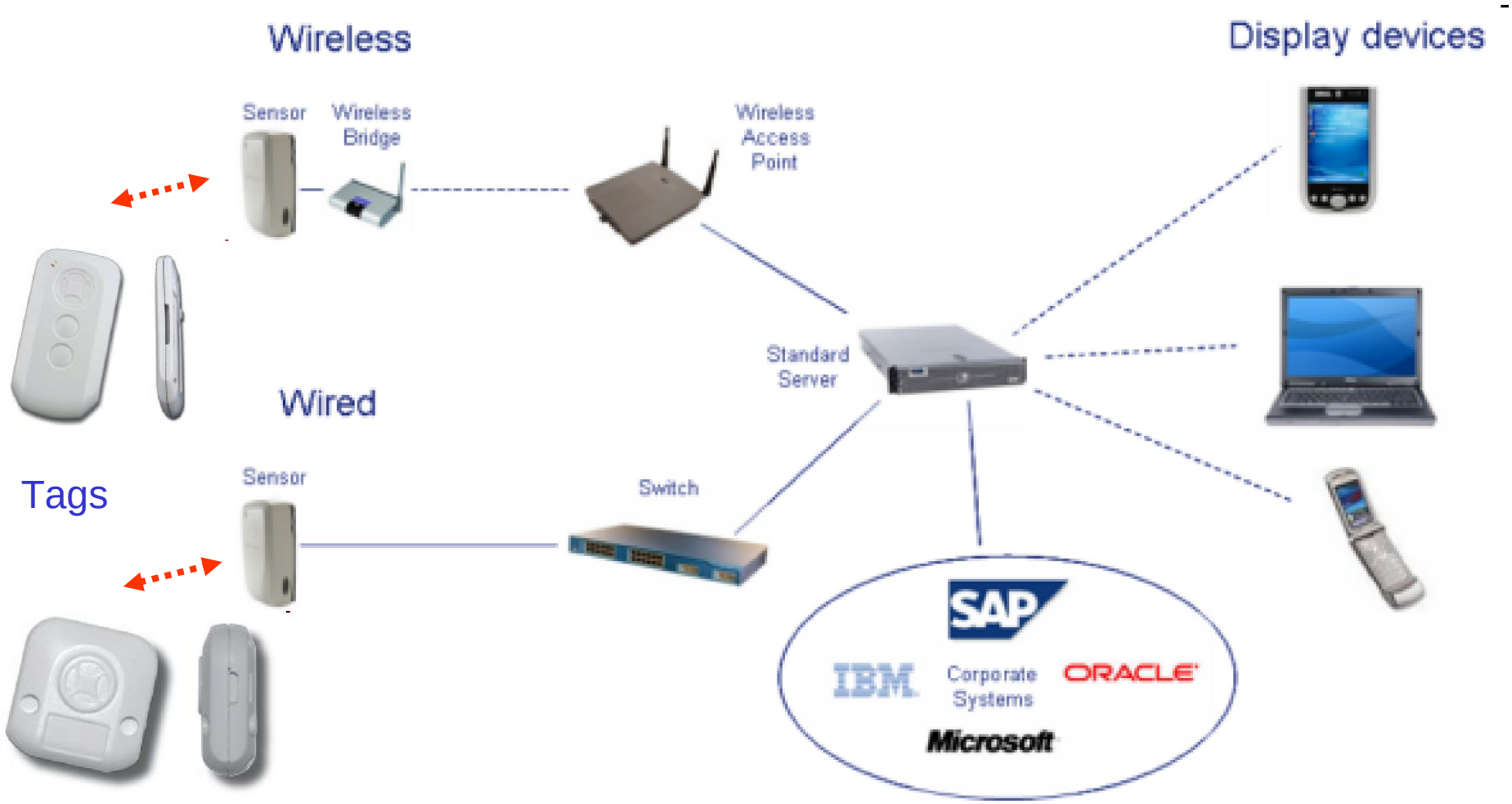


2.4.3 Indoor – Positioning Technologies

- Chokepoint based



2.5 Indoor – RTLS Systems (System Overview)



2.5.1 Indoor – RTLS System (active RFID & GPS)

RFID-Reader (fix)

RFID-Reader (mobile)

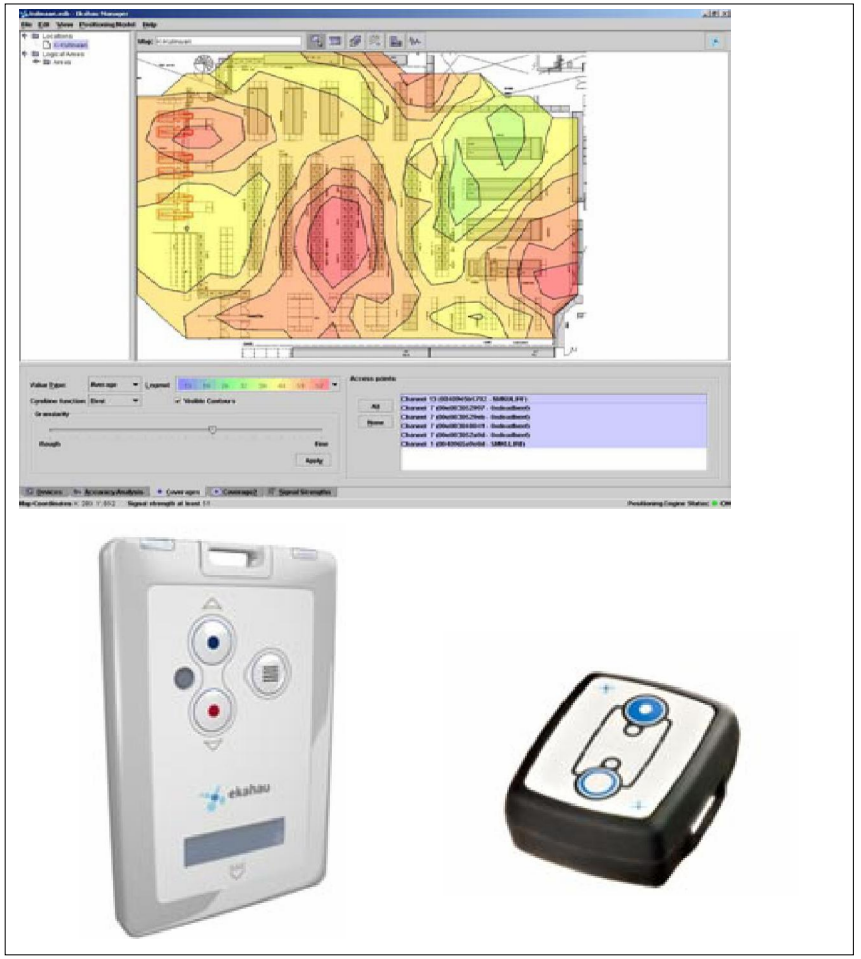
Active RFID Tags

Active-RFID & GPS-Tag

http://www.identecsolutions.com/ilrlongrange.html

2.5.2 Indoor – RTLS System (WLAN-based RFID)

- Access Points = Readers
- Triangulation of WLAN tags
- Radio-Map needed
- Calibration may be needed
- Tag or reader RSSI sensing
- Full WLAN client tags or only 802.11b/g beacon tags
- WLAN ready Laptops / PDAs can be located
- Can leverage existing infrastructure, but…
- Needs high density of APs! (good if already VoIP-enabled WLAN)
- Description see …

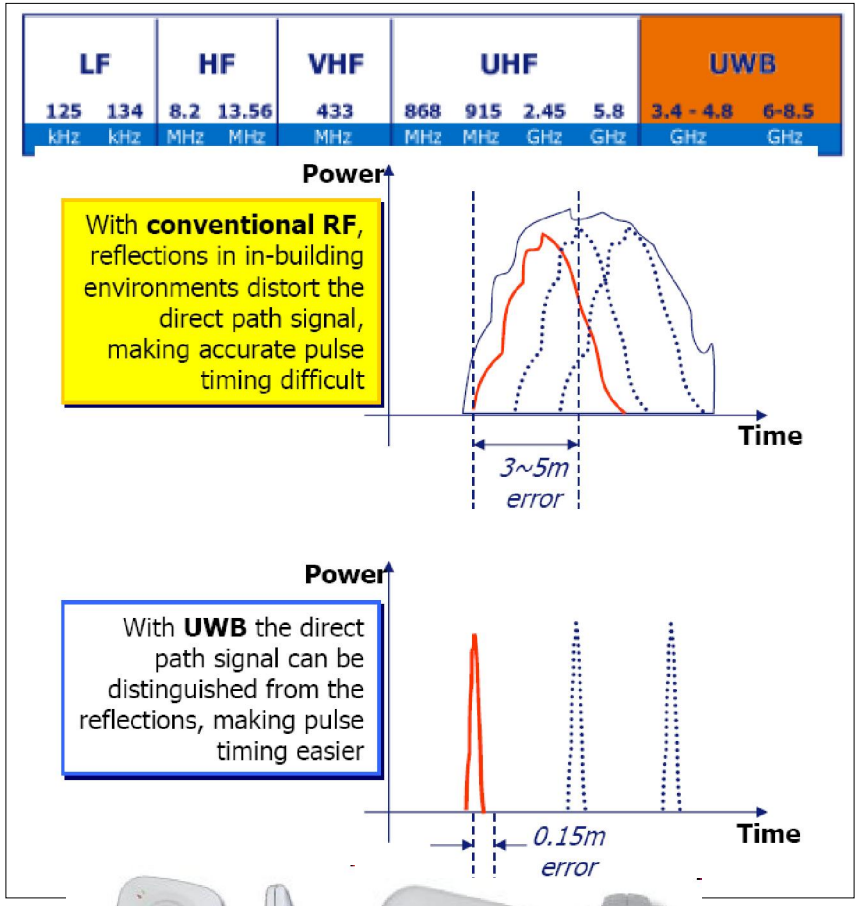


http://www.ekahau.com/?id=1012

2.5.3 Indoor – RTLS System (UWB)

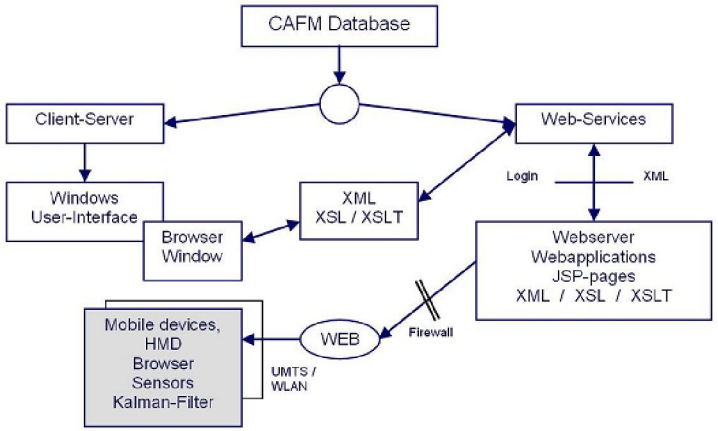
- Ultra Wide Band technology
- Wide spectrum, short pulses
- Precision up to 15cm in 3D!
- Very new technology (just been approved in EU in 2007 and CH in 2008)
- Combined TDoA and SS
- Sensors connected with timing cable
- Usually 4 sensors needed for one « cell »
- Localization with
  2 sensors à 30cm
  3 sensors à 15cm
- Demo see …

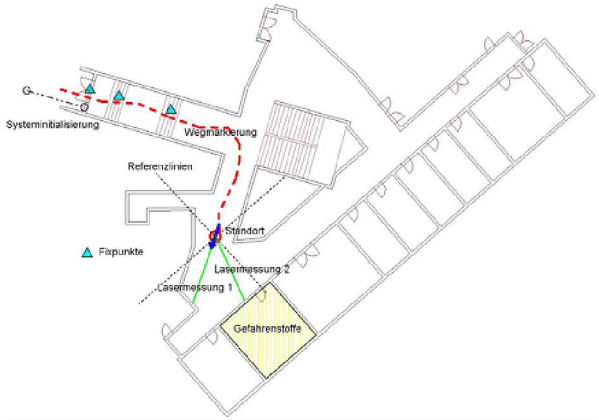
  http://www.ubisense.net



2.5.4 Indoor-RTLS Systems (e-INS)

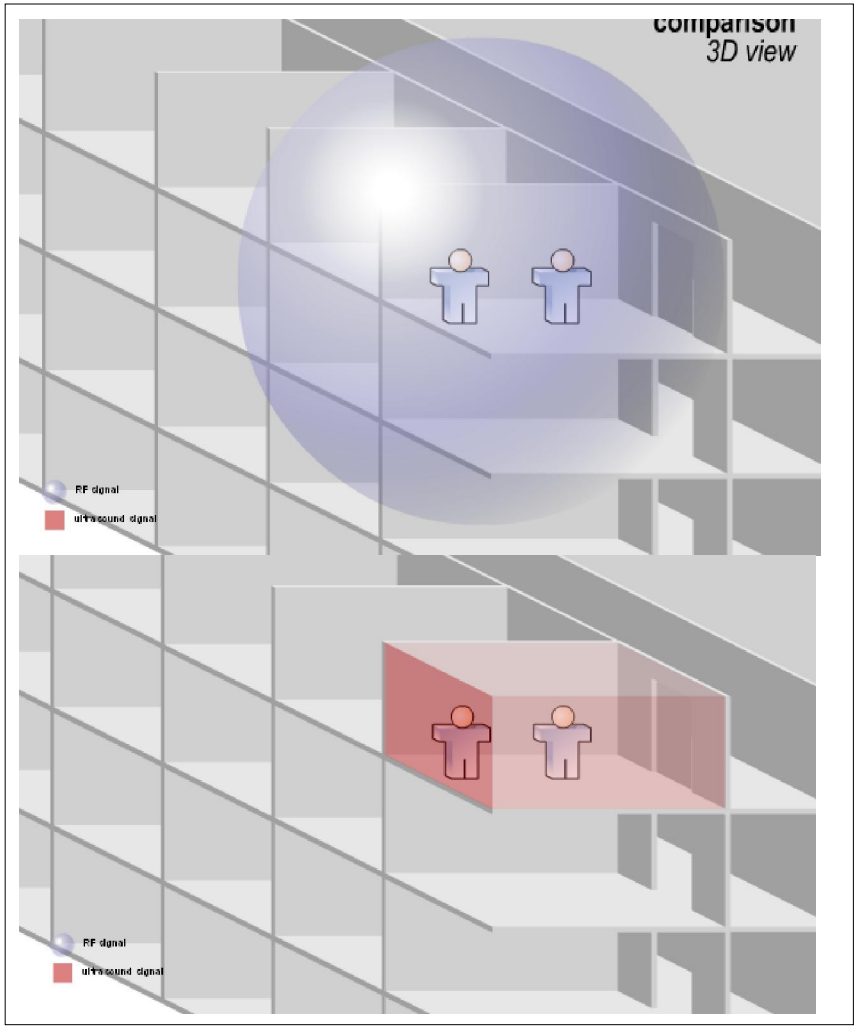
- Electronic-Inertia-Navigation-System (analogue airborne Nav.)
- Precision up to ~5m in 3D !
- Very new technology: based on e-INS HW and …
- SW from Bauinformatik@TU Graz
- Autonomouse, autarc System as CADMS
- Localisation via Refernce-Point + Inertia Vector
- Disadvantage: needs GPS-Synchronisation or Building Plans





3. Tomorrow‘s RTLS Systems (combined technologies)

- Infrared RTLS
  - Room localisation possible
  - Think « TV remote control »
- Ultrasound RTLS
  - Room localisation possible
  - Think « bat »
- GPS assisted RTLS
  - Get data from GPS
  - Combine with local RTLS
  - Get precise localisation on open fields (airport)
- Distance measurement RTLS
  - Think « radar » with active RFID



Organisations

AIM Global	www.aimglobal.org
AIM D/A/CH	www.aim-d.de
EU-RFID …	http://www.rfidconsultation.eu/
European GS1 ….	http://www.gs1.org/
European EPC Global …	http://www.epcglobalinc.org/about/about.html
ISO ….	http://www.iso.org/iso/en/ISOOnline.frontpage
CEN …..	http://www.cenorm.be/cenorm/index.htm
ETSI …..	http://www.etsi.org/home.htm
AutoID …..	http://www.autoidlabs.org/aboutthelabs.html
RFID-Consultation	http://www.rfidconsultation.eu/menu/rfid-directory/db/
RFIDnet Bern GmbH	www.rfidnet.ch
Odette	www.odette.org
AIAG	www.aiag.org
Oasis	www.oasis.org
AutoID Labs	www.autoidlabs.org

Publications

RFID-Journal	www.rfidjournal.com
RFID-Update	www.rfidupdate.com
RFID-Exchange	www.rfidexchange.com
RFID im Blick	www.rfidimblick.de
RFID Solutions Online	www.rfidsolutionsonline.com
RFID Gazette	www.rfidgazette.org
RFID IDtechx	www.idtechx.com
Info RFID Deutschland	http://www.info-rfid.de
RFID Ready	www.rfid-ready.de
RFID ABC	www.rfidabc.de

Portals

RFID-Portal Link	http://www.rfidlinks.de/

Portals

http://www.aimglobal.org

- AIM Inc.:
  is the global trade association for the Automatic Identification and Data Capture (AIDC) industry. Covering technologies such as barcode, rfid, card technologies (magnetic stripe, smart card, contactless card, optical card), radio frequency data communications (RFDC), biometrics, and electronic article surveillance (EAS).
-
- http://www.rfidbusiness.org
- The International RFID Business Association (RFIDba) is an International, Not-for profit, Vendor neutral, Educational, Trade Association. The RFIDba is focused on serving the needs of End Users who have a real need for educational programs that will help them in achieving a successful deployment and implementation of RFID technologies in their business.
-
- http://www.epcglobalinc.org
- EPCglobal:
  is leading the development of industry - driven standards for the EPC to support the use of RRID in today´s fast-moving, information rich, trading networks. A subscriber-driven organisation comprised of industry leaders and organisations focused on creating global standards for the EPCglobal Network.
-
- http://www.rfidsolutionsonline.com
- RFID Solutions Online:
  provides its readers with news and insight into RFID Solutions News and information.
-
- http://www.rfidresellers.com
- IT Backbones is an innovative network of websites that spans the global IT industry to provide latest news and vital sourcing information directly to your browser, absolutely free of charge.
-
- http://www.rfidaa.org
- RFID Australia:
  RFID Action Australia is an industry cluster which will assist in the development of expertise and experience with RFID within Victorian companies.

Portals

- http://www.rfidnederland.nl
- RFID Nedderland:
  Dutsh RFID Plattform.

- http://www.rfididensbank.dk
- RFID Vidensbank:
  Siden der samler viden om RFID i Danmark.

- http://www.rfidtribe.com
- RFID Tribe:
  a global organization with local chapters, is a rapidly growing forum for radio frequency identification. RFID Tribe has members in over 50 countries and in more than 300 companies.

- http://www.rfid-chips.net
- rfid-chips.net
- Wissenswertes rund um die Übertragung von Identifikationsmerkmalen via Funk (Radio Frequency IDentification / RFID) – einer Schlüsseltechnologie der Zukunft. rfid-chips.net ist ein redaktionelles Angebot der Kommunikationsagentur Schrader.

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Thank you for your attention

Merci pour votre attention

Danke für Ihre Aufmerksamkeit

Spaciba / Kiitos / Gracias / Grazie / Toda Raba