Stand und Potenziale der RFID-Systeme

Workshop am 29.04.2006
Berlin-Adlershof

Halle 7, Stand 304

Transponder Roadshow 2006

GEBHARDT Fördertechnik sieht große Vorteile beim Fördern und Sortieren mit Hilfe von RFID

IBM feilt an verbraucherfreundlichen RFID-Chips

Infos zum Thema RFID-Chips bei der WM

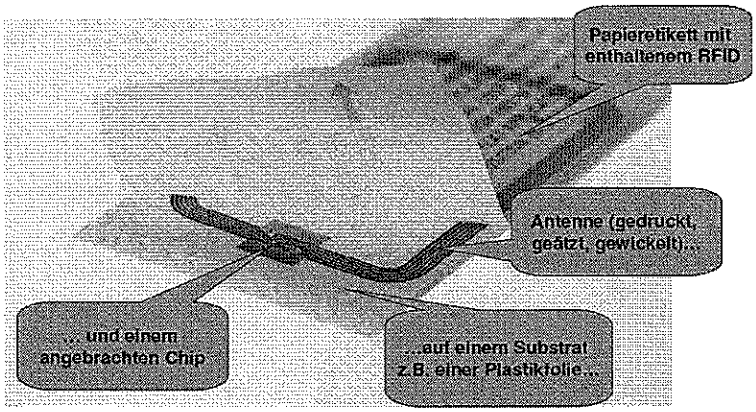
RFID: Funk-Chips als Modegag

Modetrends aus den USA

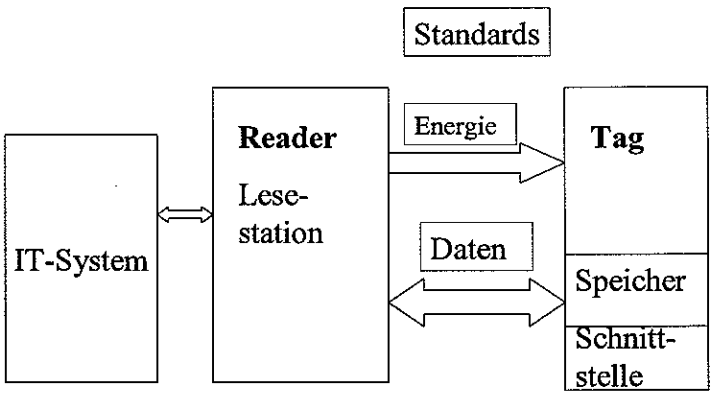
RFID: Der Schnüffel-Chip im Joghurtbecher

"Keine Anonymität mehr mit RFID-Chips"

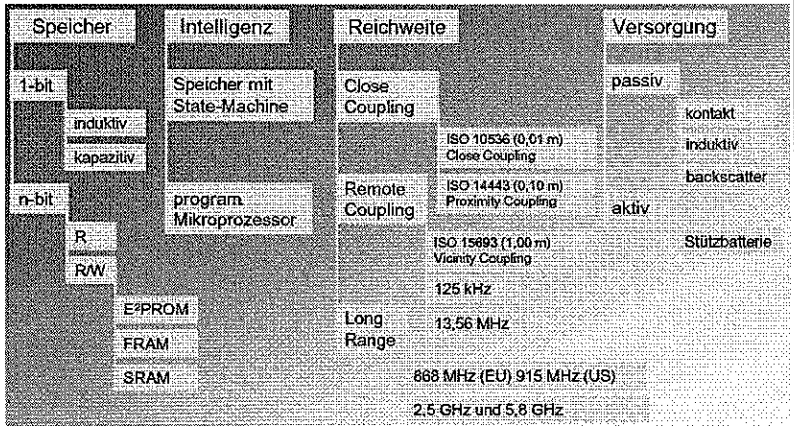
RFID-Tag-Transponder



Grundkonzept



Klassenbildung



Aktiv - Passiv

Energieversorgung

passiv: Versorgung durch Reader, Kommunikation über das „Versorgungsfeld“

semipassiv: Batterieversorgt nach einem Aufwecksignal, Kommunikation über backscattering

aktiv: batterieversorgte Funkkomponenten

Funktionalität

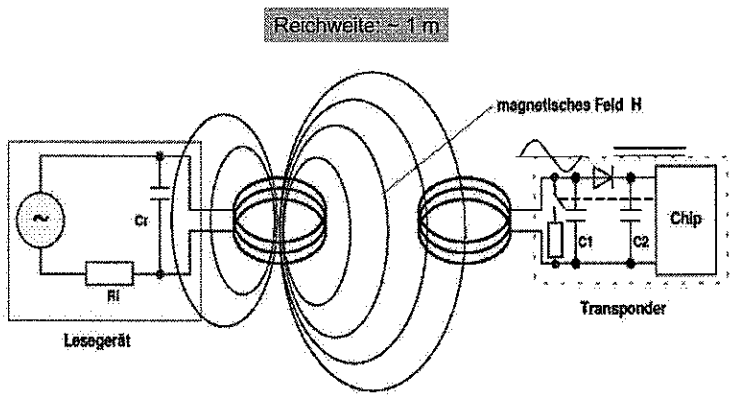
passiv: Eingespeicherte Information wird ausgelesen

aktiv: Auszulesende Information wird jeweils neu gewonnen (Sensorik)

Eingesetzte Frequenzbereiche

Frequency Bands	Antenna Components	Read Range (typical)	Penetration (skin depth)	Orientation (Directionality)	Usability in metal or humid environment	Applications (typical)
Low Frequency (120 to 400) kHz	Coil (> 100 turns) and capacitor	Proximity	Best	Least	Possible	Proximity
Medium Frequency (4 MHz to 24 MHz)	Coil (< 10 turns) and capacitor	Medium	Good	Not much	Possible	Low cost and high volume
High Frequency (>900 MHz)	E-field dipole (a piece of conductor)	Long (> 1 m)	Poor	Very high	Difficult	Line of sight with long range

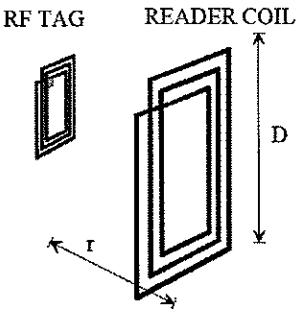
Induktive Kopplung 125kHz-13,56 MHz



Darstellung nach Finkenzeller

Leseabstand induktiv

Read range of an inductive passive RFID tag

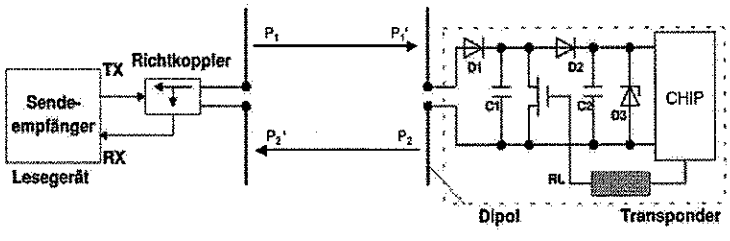


Read range is determined by signal-to-noise-ratio and the field strengths allowed.

In practice $r_{max} \approx D$

Elektromagnetische Kopplung 400 MHz – 6,8 GHz

Reichweite: ~ 10 m



Darstellung nach Finkenzeller

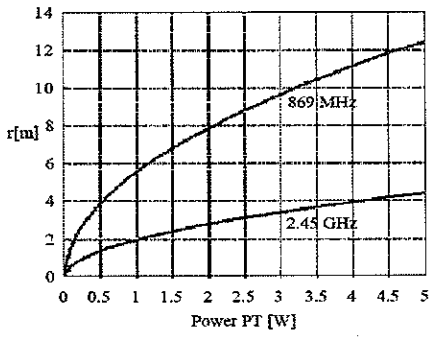
Leseabstand elektromagnetisch

Read range of a passive UHF tag
(power limited)

$$P_r = \left(\frac{\lambda}{4\pi r}\right)^n G_T G_R P_T$$

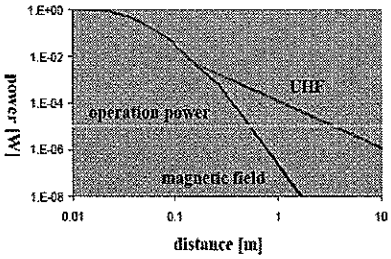
$$r_{max} = \frac{\lambda}{4\pi}\sqrt[n]{\eta G_T G_R P_T / P_R},$$

$\eta = 0.15$
$P_R = 5\ \mu W$
$n = 2$



Gegenüberstellung

Far away, the power transmitted by radio waves decays as $1/r^2$, whereas that of magnetic field as $1/r^6$.



UHF vs. inductive

- **Longer read range**
- **Small antenna (50 mm @869 MHz, 20 mm @2.45 GHz.**
- **Mobile-phone-size reader**
- **Reading independent of direction and orientation.**
- **Interrogation field can be focused.**
- **Faster communication**
- **UHF tag works on metal (patch antenna)**

Anwendungsprobleme

Reflexionen an Metalloberflächen (Dosen, Gitterkörbe, Autos ...)

Abhilfe: Richtantennen, Arrays, Isolation der Tags, Anhänger

Wasser ist „undurchsichtig“

Abhilfe: induktive Kopplung aber geringere Reichweite

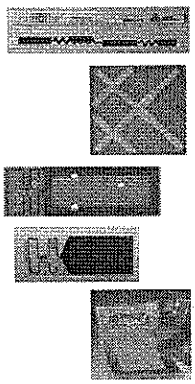
International unterschiedliche Frequenzen, Sendeleistungen,

Überreichweiten

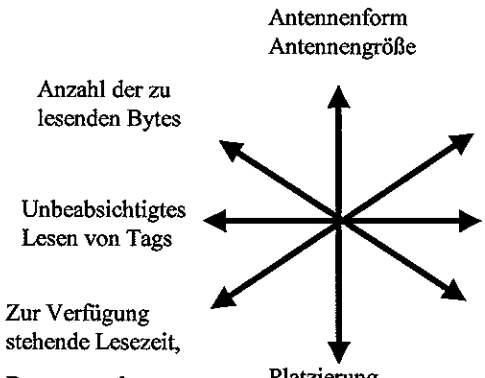
Anwendungsangepasste Realisierungen

Different Tags for Difficult Things.

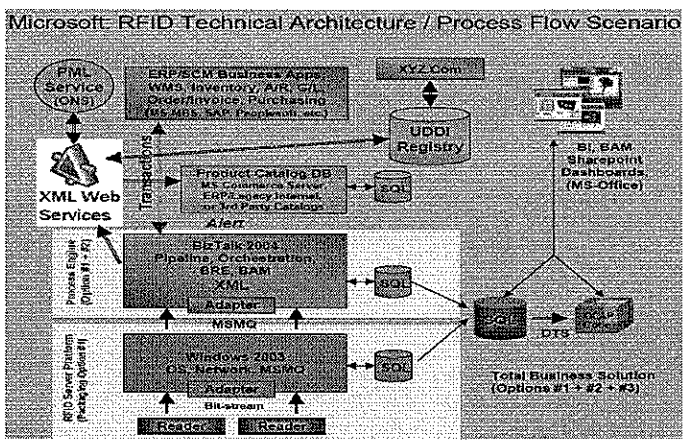
- Tags differ in antenna design and substrate:
  - **Standard** tag with dipole antenna: good performance on easy materials.
  - **Folded** dipole antenna: overcomes reading angle problems.
  - Ferrit **coated** substrates: eliminates reflections from metallic surfaces and detuning effects.
  - **Stand-off** tags: tags with foamed plastic element as distance piece enhances performanes in mutiple situations.
  - **Frequency tolerance**: tags with higher tolerance to frequency detuning are available but have lower overall performance.
  - **RF sensitivity**: minimal threshhold of signal strength that the tag needs to operate
  - **Isotropy of RF sensitivity**: ability to operate the tag at the minimum threshhold of signal strength regardless of the orientation of the tag



Allgemeine Einflussfaktoren auf das Leseergebnis

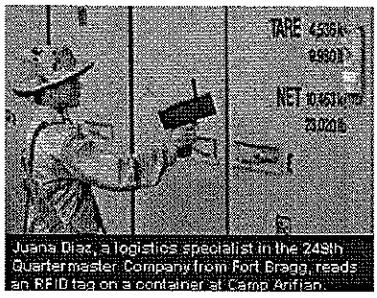


Integration in die IT-Prozesse



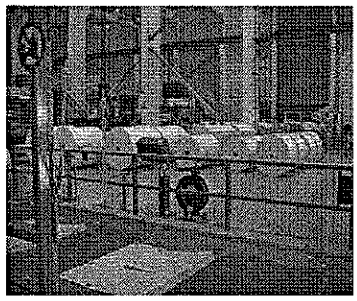
Anwendungen in der Logistik

Extensive use of RFID in logistics



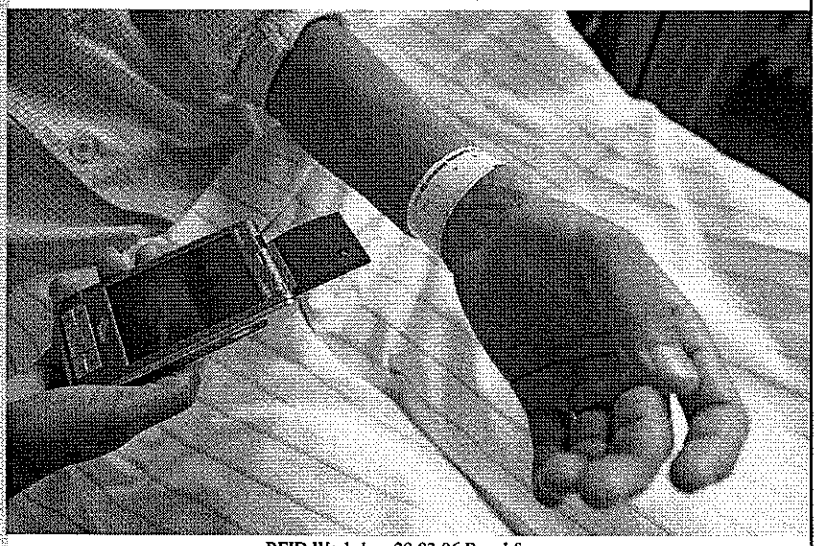
Juana Diaz, a logistics specialist in the 249th Quartermaster Company from Fort Bragg, reads an RFID tag on a container at Camp Arifjan.

Hand-held RFID reader being used in Kuwait, April 2003.



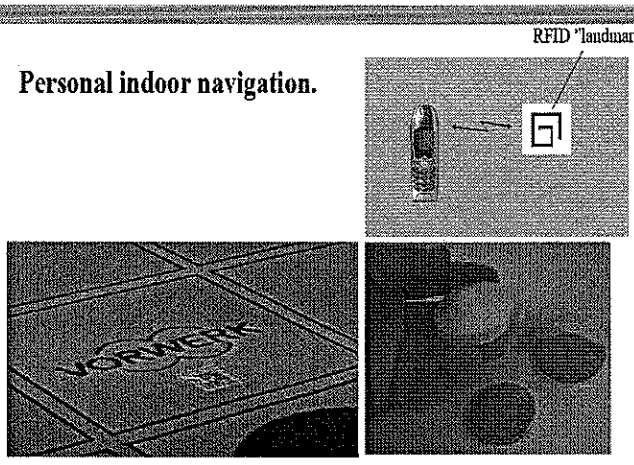
Palomar RFID system for paper rolls.

Anwendung im Gesundheitswesen



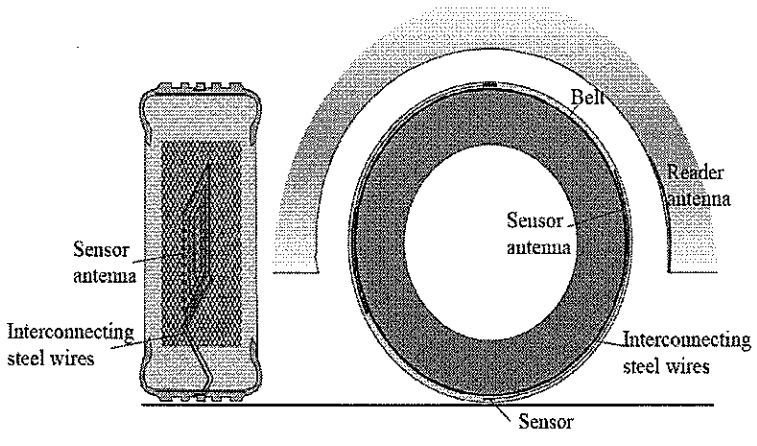
Anwendung zur Ortung/Navigation

Personal indoor navigation.



Anwendung zu Messung

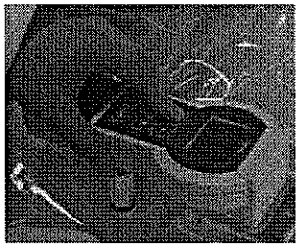
Scheme of 13.56 MHz Wireless Tyre Sensor System



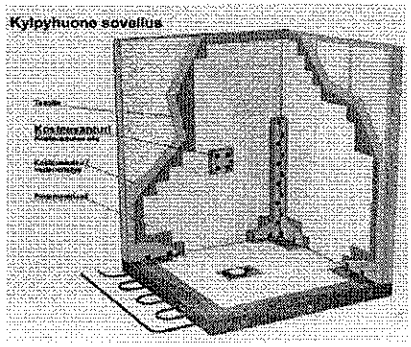
NEW DEVELOPMENTS IN RFID SENSORS

Measurements in buildings and constructions

- **Temperature, moisture, CO_2,...**
- **Fatigue of steel construction**



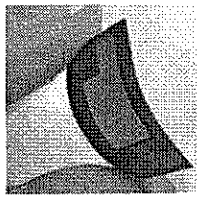
Wireless moisture sensor system by Vigilan Oy.



Neue Konzepte zur Energieversorgung

Power for RFID tag

- **Thin film batteries**
- **Energy scavenging**
  - **Light**
  - **Building vibrations**
  - **Radio waves**
  - **Temperature difference**



Infinite Power's flexible, thin-film batteries, which can be less than 5 millimeters thick, put out four volts and have a capacity of about 200 micro-amp hours per square centimeter.

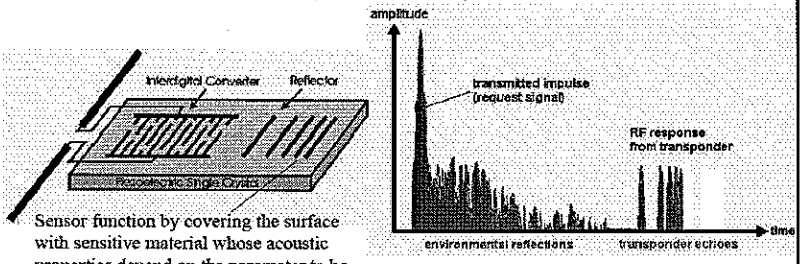
Infinite Power has developed several methods for recharging the battery by collecting ambient energy. These including taking advantage of changes in temperature, vibrations, or motion. The batteries can also be recharged directly from a power source or using RF energy. They are currently being used in smart cards, micro-electronic and medical applications.

The cost of the batteries is typically $1 to $10 depending on volume and the application. *Infinite Power* is not trying to compete with button cell batteries, which cost about 15 cents. Instead, it is focusing on applications where the battery's unique properties are needed. Those properties include a long operational life and the battery's ability to function normally at temperatures ranging from -50 to 120 degrees Celsius.

One potential application is a tire pressure and temperature sensor.

Neue Prinzipien

RFID based on surface acoustic wave (SAW RFID)



Sensor function by covering the surface with sensitive material whose acoustic properties depend on the parameter to be measured.

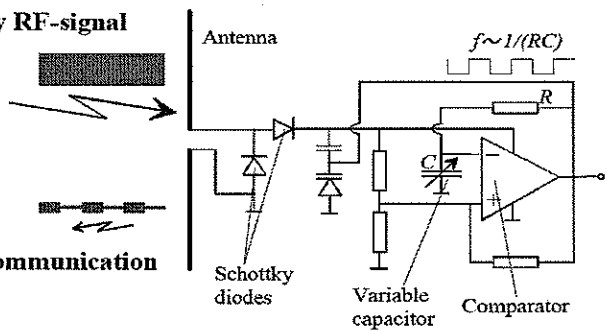
The "memory" content of the SAW RFID chip cannot be changed after manufacturing.

Neue Sensorkonzepte

Measurement of capacitance with relaxation oscillator
A simple wireless sensor

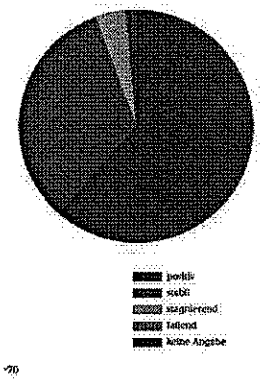
Powering by RF-signal

Back scatter communication

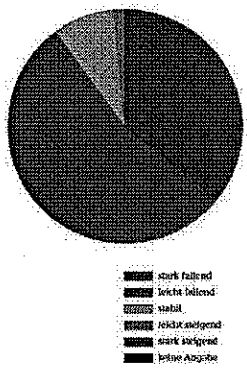


Optimistische Zukunft

Allgemeine Marktentwicklung von RFID-System in Deutschland für den Zeitraum 2005 - 2010



Preisentwicklung für RFID-Systeme bis zum Jahr 2010



*n=70

IZT 2004

RFID Workshop 29.03.06 Rauchfuss
TFH Berlin

25