http://www.news.com/

Privacy advocates call for RFID regulation

By Alorie Gilbert
http://news.com.com/Privacy+advocates+call+for+RFID+regulation/2100-1029_3-5065388.html

Story last modified Mon Aug 18 20:40:00 PDT 2003

SACRAMENTO, Calif.--A handful of technology and consumer privacy experts testifying at a California Senate hearing Monday called for regulation of a controversial technology designed to wirelessly monitor everything from clothing to currency.

The hearing, presided over by state Sen. Debra Bowen, focused on an emerging area of technology that's known as radio frequency identification (RFID). Retailers and manufacturers in the United States and Europe, including Wal-Mart Stores, have begun testing RFID systems, which use millions of special sensors to automatically detect the movement of merchandise in stores and monitor inventory in warehouses.

Proponents hail the technology as the next-generation bar code, allowing merchants and manufacturers to operate more efficiently and cut down on theft.

Privacy activists worry, however, that the unchecked use of RFID could end up trampling consumer privacy by allowing retailers to gather unprecedented amounts of information about activity in their stores and link it to customer information databases. They also worry about the possibility that companies, governments and would-be thieves might be able to monitor people's personal belongings, embedded with tiny RFID microchips, after they are purchased.

"How would you like it if, for instance, one day you realized your underwear was reporting on your whereabouts?" said Bowen, posing a hypothetical RFID scenario.

One witness at Monday's hearing said that failing to impose conditions on the use of RFID technology could lead to a world not unlike the fictional society portrayed in Steven Spielberg's science-fiction thriller "Minority Report." In that movie, set in 2054, iris scanning technology allows billboards to recognize people and display personalized ads that called out their names. It also allows law enforcement authorities to track people's whereabouts". ……

Personopplysningsloven

Kapittel III. Informasjon om behandling av personopplysninger

§ 2. *Definisjoner*

I denne loven forstås med:

1) personopplysning: opplysninger og vurderinger som kan knyttes til en enkeltperson,
2) behandling av personopplysninger: enhver bruk av personopplysninger, som f.eks. innsamling, registrering, sammenstilling, lagring og utlevering eller en kombinasjon av slike bruksmåter,
3) personregister: registre, fortegnelser m.v. der personopplysninger er lagret systematisk slik at opplysninger om den enkelte kan finnes igjen,
4) behandlingsansvarlig: den som bestemmer formålet med behandlingen av personopplysninger og hvilke hjelpemidler som skal brukes,
5) databehandler: den som behandler personopplysninger på vegne av den behandlingsansvarlige,
6) registrert: den som en personopplysning kan knyttes til,
7) samtykke: en frivillig, uttrykkelig og informert erklæring fra den registrerte om at han eller hun godtar behandling av opplysninger om seg selv,
8) sensitive personopplysninger: opplysninger om
   a) rasemessig eller etnisk bakgrunn, eller politisk, filosofisk eller religiøs oppfatning,
   b) at en person har vært mistenkt, siktet, tiltalt eller dømt for en straffbar handling,
   c) helseforhold,
   d) seksuelle forhold,
   e) medlemskap i fagforeninger.

§ 18. *Rett til innsyn*

Enhver som ber om det, skal få vite hva slags behandling av personopplysninger en behandlingsansvarlig foretar, og kan kreve å få følgende informasjon om en bestemt type behandling:

a) navn og adresse på den behandlingsansvarlige og dennes eventuelle representant,
b) hvem som har det daglige ansvaret for å oppfylle den behandlingsansvarliges plikter,
c) formålet med behandlingen,
d) beskrivelser av hvilke typer personopplysninger som behandles,
e) hvor opplysningene er hentet fra, og
f) om personopplysningene vil bli utlevert, og eventuelt hvem som er mottaker.

Dersom den som ber om innsyn er registrert, skal den behandlingsansvarlige opplyse om

a) hvilke opplysninger om den registrerte som behandles, og

b) sikkerhetstiltakene ved behandlingen så langt innsyn ikke svekker sikkerheten.

Den registrerte kan kreve at den behandlingsansvarlige utdyper informasjonen i første ledd bokstav a - f i den grad dette er nødvendig for at den registrerte skal kunne vareta egne interesser.

Retten til informasjon etter annet og tredje ledd gjelder ikke dersom personopplysningene behandles utelukkende for historiske, statistiske eller vitenskapelige formål og behandlingen ikke får noen direkte betydning for den registrerte.

§ 19. *Informasjonsplikt når det samles inn opplysninger fra den registrerte*

Når det samles inn personopplysninger fra den registrerte selv, skal den behandlingsansvarlige av eget tiltak først informere den registrerte om

a) navn og adresse på den behandlingsansvarlige og dennes eventuelle representant,

b) formålet med behandlingen,

c) opplysningene vil bli utlevert, og eventuelt hvem som er mottaker,

d) det er frivillig å gi fra seg opplysningene, og

e) annet som gjør den registrerte i stand til å bruke sine rettigheter etter loven her på best mulig måte, som f.eks. informasjon om retten til å kreve innsyn, jf. § 18, og retten til å kreve retting, jf. § 27 og § 28.

Varsling er ikke påkrevd dersom det er på det rene at den registrerte allerede kjenner til informasjonen i første ledd.

§ 20. *Informasjonsplikt når det samles inn opplysninger fra andre enn den registrerte*

En behandlingsansvarlig som samler inn personopplysninger fra andre enn den registrerte selv, skal av eget tiltak informere den registrerte om hvilke opplysninger som samles inn og gi informasjon som nevnt i § 19 første ledd så snart opplysningene er innhentet. Dersom formålet med innsamling av opplysningene er å gi dem videre til andre, kan den behandlingsansvarlige vente med å varsle den registrerte til utleveringen skjer.

Den registrerte har ikke krav på varsel etter første ledd dersom

a) innsamlingen eller formidlingen av opplysningene er uttrykkelig fastsatt i lov,

b) varsling er umulig eller uforholdsmessig vanskelig, eller

c) det er på det rene at den registrerte allerede kjenner til informasjonen varslet skal inneholde.

Når varsling unnlates med hjemmel i bokstav b, skal informasjonen likevel gis senest når det gjøres en henvendelse til den registrerte på grunnlag av opplysningene.

§ 21. *Informasjonsplikt ved bruk av personprofiler*

Når noen henvender seg til eller treffer avgjørelser som retter seg mot den registrerte på grunnlag av personprofiler som er ment å beskrive atferd, preferanser, evner eller behov, f eks som ledd i markedsføringsvirksomhet, skal den behandlingsansvarlige informere den registrerte om

a) hvem som er behandlingsansvarlig,

b) hvilke opplysningstyper som er anvendt, og

c) hvor opplysningene er hentet fra.

Deksel som går på nett

Publisert: 03 november 2004
Av Marius S. Eltervåg

Verdens første ferdige NFC-produkt er et nytt deksel til 3220 laget av Nokia, som rett og slett er et vanlig deksel utstyrt med innebygget radio-teknologi.

Under Nokia Mobility Conference i Monaco presenterte Nokia et deksel med støtte for teknologien NFC (Near Field Communication). Denne teknologien åpner for at man ved å berøre spesielle RFID (Radio Frequency Identification)-brikker med telefonen vil få tilgang til forskjellige tjenester.

NFC-teknologien er spådd å bli flittig brukt innenfor reklamebransjen i fremtiden. Hvis man for eksempel plasserer en RFID-brikke i en reklameplakat for en film, vil mobilbrukere med NFC-deksel kunne berøre plakaten med telefonen, for så å automatisk bli koblet opp mot hjemmesiden til filmprodusenten. Der vil man kunne lese filmanmeldelser og se trailere og lignende.

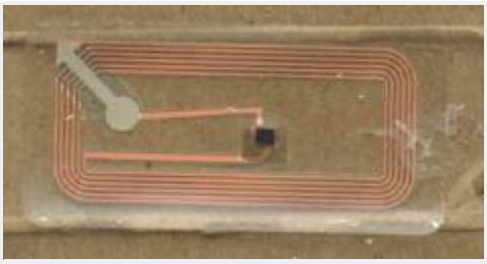
Teknologien kan imidlertid brukes til mye mer enn å gi enkel tilgang til internett-sider. Man kan for eksempel programmere brikkene slik at telefonene som berører dem ringer opp et spesielt telefonnummer. I fremtiden vil man også kunne bruke NFC-teknologi til å betale togbilletter og lignende, kun ved å holde telefonen inntil billettautomaten.

Dekselet er foreløpig bare laget til Nokia 3220, og blir levert med fire tomme brikker hvor man kan lagre sine favorittjenester for å alltid ha rask tilgang til disse. Vil man kopiere tjenester fra andre NFC-kompatible enheter kan man enkelt og greit holde disse ved siden av hverandre. Rekkevidden er på knappe fem cm.

Dekselet kommer på det europeiske markedet i løpet av første kvartal neste år. Prisen vil ligge på mellom 1500 og 2000 kroner, så det spørs om det er verdt investeringen - ihvertfall før teknologien får skikkelig fotfeste.

WHAT IS RFID?

RFID stands for **R**adio **F**requency **ID**entification, a technology that uses tiny computer chips smaller than a grain of sand to **track items at a distance**. RFID "spy chips" have been hidden in the packaging of Gillette razor products and in other products you might buy at a local Wal-Mart, Target, or Tesco - and they are already being used to spy on people.



Above: Magnified image of actual tag found in Gillette Mach3 razor blades.

Each tiny chip is hooked up to an antenna that picks up electromagnetic energy beamed at it from a reader device. When it picks up the energy, the chip sends back its **unique identification number** to the reader device, allowing the item to be remotely identified. Spy chips can beam back information anywhere from a couple of inches to up to 20 or 30 feet away.

Some of the world's largest product manufacturers have been plotting behind closed doors since 1999 to develop and commercialize this technology. If they are not opposed, their plan is to use these remote-readable spy chips **to replace the bar code**.

RFID tags are NOT an "improved bar code" as the proponents of the technology would like you to believe. **RFID technology differs from bar codes in three important ways**:

1. With today's bar code technology, every can of Coke has the same UPC or bar code number as every other can (a can of Coke in Toronto has the same number as a can of Coke in Topeka). With RFID, each individual can of Coke would have a unique ID number which **could be linked to the person buying it** when they scan a credit card or a frequent shopper card (i.e., an "item registration system").

2. Unlike a bar code, these chips **can be read from a distance, right through your clothes, wallet, backpack or purse** -- without your knowledge or consent -- by anybody with the right reader device. In a way, it gives strangers x-ray vision powers to spy on you, to identify both you and the things you're wearing and carrying.

3. Unlike the bar code, RFID **could be bad for your health**. RFID supporters envision a world where RFID reader devices are everywhere - in stores, in floors, in doorways, on airplanes -- even in the refrigerators and medicine cabinets of our own homes. In such a world, we and our children would be **continually bombarded with electromagnetic energy**. Researchers do not know the long-term health effects of chronic exposure to the energy emitted by these reader devices.

Many huge corporations, including Philip Morris, Procter and Gamble, and Wal-Mart, have begun experimenting with RFID spy chip technology. **Gillette is leading the**

pack, and recently placed an order for up to **500 million RFID tags** from a company called "Alien Technology" (we kid you not). These big companies envision a day when every single product on the face of the planet is tracked with RFID spy chips!

As consumers we have no way of knowing which packages contain these chips. While some chips are visible inside a package (see our pictures of Gillette spy chips), **RFID chips can be well hidden**. For example they can be sewn into the seams of clothes, sandwiched between layers of cardboard, molded into plastic or rubber, and integrated into consumer package design.

This technology is rapidly evolving and becoming more sophisticated. Now RFID spy chips can even be printed, meaning **the dot on a printed letter "i" could be used to track you**. In addition, the tell-tale copper antennas commonly seen attached to RFID chips can now be printed with conductive ink, making them **nearly imperceptible**. Companies are even experimenting with making the product packages themselves serve as antennas.

As you can see, it could soon be virtually impossible for a consumer to know whether a product or package contains an RFID spy chip. For this reason, CASPIAN (the creator of this web site) is proposing federal labeling legislation, the RFID Right to Know Act, which would require complete disclosures on any consumer products containing RFID devices.

We believe the public has an absolute right to know when they are interacting with technology that could affect their health and privacy.

Don't you?

Join us. Let's fight this battle before big corporations track our every move.

Fight Back!

http://whatis.com

From Wikipedia, the free encyclopedia.

An RFID tag used for electronic toll collection

Radio frequency identification (**RFID**) is a method of remotely storing and retrieving data using devices called **RFID tags/transponders**. An RFID tag is a small object, such as an adhesive sticker, that can be attached to or incorporated into a product. RFID tags contain antennas to enable them to receive and respond to radio-frequency queries from an RFID transceiver.

http://www.asicnw.com/rfid_tags.htm

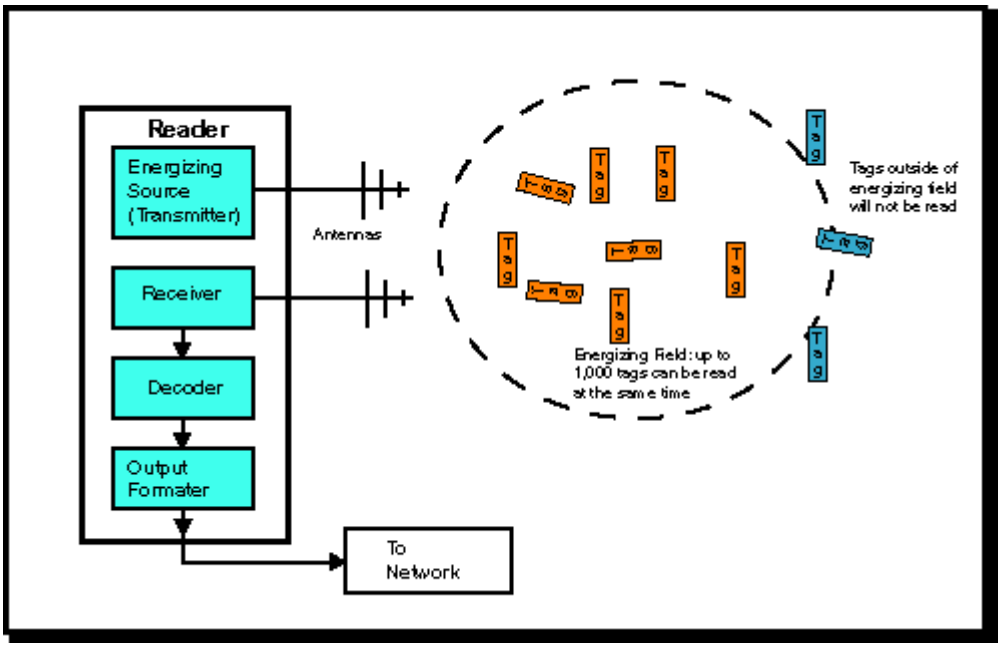
The System

A basic RFID systems consists of the reader and multiple RFID tags, which are more properly called transponders. Individual transponders are attached to any number of assets that are to be tracked such as:

- shirts in retail clothing supply chains
- blood pumps in hospitals
- cows in a livestock operation
- uniforms in a commercial laundry service

Each transponder can have a unique code or part number permanently stored in its memory. When a transponder or group of transponders is placed in proximity to a reader (approximately 15 feet), the data contained in the transponder's memory can be transferred to the reader and then usually on to a computer network system and database.

Components of an RFID System



More Details

The exact number of transponders that can be read simultaneously is a function of the protocol being used in the system. Some protocols can handle only a single transponder. Other protocols, such as the one ANW recommends, can handle up to 1,000 transponders at the same time.

The ANW recommended protocol allows transponders within the reader field to have the same or different part numbers. If several transponders have the same part number, the reader will report the total number of transponders with the same serial number.

Some protocols allow sending data to and from the transponder. These are called Read/Write. Other protocols are Read Only, which means that data can only be transferred

from the transponder to the reader. In a Read Only system, the data that the transponder sends is preloaded into the transponder, usually as a part of the manufacturing process.

The ANW recommended protocol can be Read Only; or if enable, can allow for loading or changing the transponder memory through an RF link at the ANW factory or in the field.

Transponders

Transponders are divided into two basic types. The first (contact) requires an electrical connection to transfer the data. The second (contactless) requires no physical electrical connections. ANW uses the contactless type.

Contactless types can be further divided into two categories. The first type is an inductively coupled transponder. The second is a radio frequency (RF) type. ANW uses radio frequency (RF) transponders.

The advantage of a radio frequency transponder using our recommended protocol is that the transponder can be read over distances of 15 feet. An inductively coupled transponder can typically be read only from a few inches.

Passive RFID

RFID transponders can be further divided into two categories. The first is active RFID which has a battery in the transponder. The second is passive RFID, which means that the transponder has no power source of battery of its own. In passive RFID, the transponder picks up energy from the Reader's RF field. The Reader contains a transmitter as well as a receiver.

Advantages to Passive RFID are:

- Lower cost because there are no batteries
- Simpler to assemble
- An infinite life for all practical purposes

To summarize, ANW manufactures passive RFID transponders

http://news.com.com/2102-1029_3-5065388.html?tag=st.util.print

Privacy advocates call for RFID regulation

By Alorie Gilbert
http://news.com.com/Privacy+advocates+call+for+RFID+regulation/2100-1029_3-5065388.html

Story last modified Mon Aug 18 20:40:00 PDT 2003

SACRAMENTO, Calif.--A handful of technology and consumer privacy experts testifying at a California Senate hearing Monday called for regulation of a controversial technology designed to wirelessly monitor everything from clothing to currency.

The hearing, presided over by state Sen. Debra Bowen, focused on an emerging area of technology that's known as radio frequency identification (RFID). Retailers and manufacturers in the United States and Europe, including Wal-Mart Stores, have begun testing RFID systems, which use millions of special sensors to automatically detect the movement of merchandise in stores and monitor inventory in warehouses.

Proponents hail the technology as the next-generation bar code, allowing merchants and manufacturers to operate more efficiently and cut down on theft.

Privacy activists worry, however, that the unchecked use of RFID could end up trampling consumer privacy by allowing retailers to gather unprecedented amounts of information about activity in their stores and link it to customer information databases. They also worry about the possibility that companies, governments and would-be thieves might be able to monitor people's personal belongings, embedded with tiny RFID microchips, after they are purchased.

"How would you like it if, for instance, one day you realized your underwear was reporting on your whereabouts?" said Bowen, posing a hypothetical RFID scenario.

One witness at Monday's hearing said that failing to impose conditions on the use of RFID technology could lead to a world not unlike the fictional society portrayed in Steven Spielberg's science-fiction thriller "Minority Report." In that movie, set in 2054, iris scanning technology allows billboards to recognize people and display personalized ads that called out their names. It also allows law enforcement authorities to track people's whereabouts.

"There has been scant scrutiny by policymakers on RFID and pervasive computing," said Beth Givens, director of the Privacy Rights Clearinghouse, a nonprofit consumer advocacy group based in San Diego. "This hearing is an important first step."

Givens urged Bowen to lead a study of RFID and its "profound privacy and civil liberties implications." She suggested that RFID be subjected to a set of fair-use guidelines. For instance, companies should be required to inform consumers about products containing RFID chips by clearly labeling them, Givens said. Consumers should also have the right to permanently disable the chips upon purchasing such goods, she said. And companies ought to provide consumers with the information collected about them via RFID tracking systems upon consumers' request, Givens added.

Other witnesses, including a representative from the consumer privacy group Electronic Frontier Foundation and a researcher from University of California at Los Angeles, also called for limits on the use of RFID and a technology assessment by policymakers. "It's possible to set up these systems so that there is no privacy anywhere," said Greg Pottie, an electrical engineering professor at UCLA.

"The time is right for an assessment of this technology," said Pottie, who is involved in the Center for Embedded Networked Sensing, a research project based at UCLA that's funded by the National Science Foundation.

Katherine Albrecht, a vehement opponent of RFID technology, went further and suggested a moratorium on the commercial use of RFID technology until legal guidelines are set. Albrecht, who also testified Monday, is the head of Consumers Against Supermarket Privacy Invasion and Numbering. "I would personally like to see (RFID) go away," she said.

Dan Mullen, head of the trade group Association for Automatic Identification and Data Capture Technologies, tried to temper the discussion, testifying that mass adoption of RFID chips for tracking merchandise in stores has yet to take off and may never do so. "There has to be a business case to put an RFID chip on a can of Coke," Mullen said. "When it comes down to it, there may not be a business case for anyone to do that."

Bowen said that the introduction of legislation to control the use of RFID is "possible," but that she's not at the bill stage yet. Even if she were to draft a bill, it would not be her goal to outlaw RFID, she said. Bowen herself uses a special pet-tracking chip that uses RFID to keep tabs on her cats.

"Is the goal of this hearing is to restrict the use of the technology? No," Bowen said. "It's not our goal to create legislation that says this technology could never be used. It's to gain a better understanding."

Bowen, who is the chair of the legislative subcommittee on new technologies, has been on the forefront of the antispam legislation movement. An outspoken advocate of consumer privacy, Bowen also helped draft and introduce bills that would regulate face recognition technology, consumer data collected by cable and satellite television companies, and shopper loyalty cards used in grocery chains.

Policymakers in Britain are also starting to ponder the privacy implications of RFID. A member of Britain's Parliament recently submitted a motion for debate on the regulation of RFID devices when the government returns from its summer recess next month.

Major retailers are just beginning to experiment with RFID. Tesco, a United Kingdom-based supermarket chain, has begun selling Gillette razors with RFID chips embedded in them in a trial run of the technology at its Cambridge store, according to reports. Wal-Mart had undertaken a similar test in a Boston-area store but recently decided to cancel the test. Italian clothier Benetton is studying how it wants to use RFID chips.

Instead of introducing RFID to its store shelves, Wal-Mart is urging its top 100 suppliers to start attaching RFID chips to shipments of merchandize they send to the retailer by 2005. And by the end of 2006, the company wants the rest of its suppliers, about 25,000, to begin doing the same, a Wal-Mart representative said. Wal-Mart says the chips will be used only on paletts and cases, not on the goods themselves.

It will confine its use of the chips, for now, to warehouses and distribution centers, keeping them out of its stores and away from consumers.

The retail giant will meet with its suppliers in the fourth quarter to discuss implementation of RFID technology and the issues surrounding the use of the technology.

Though the timetable set by Wal-Mart to install RFID technology may be difficult to keep, it isn't likely a voluntary assignment. Suppliers may have a number of reasons to use RFID other than just to appease the retail giant, according to Peter Coleman, an analyst with securities firm SoundView Technology.

If Wal-Mart, known for its highly efficient business model, is taking RFID seriously, suppliers may want to look into how it can improve their business, according to Coleman.

http://www.rfidsurvival.com/HistoryofRFID.html

Genesis of an Idea: There is an old adage that success has many fathers but failure is an orphan. The development of technology is messy. The potential for an infinite number of things is present, yet the broader human choices determine how technology evolves. There's no clear, text book perfect, or logical progression, and often developments ahead of their time are not recognized until later, if ever. So it was with the development of RFID.

An early, if not the first, work exploring RFID is the landmark paper by Harry Stockman, "*Communication by Means of Reflected Power*", Proceedings of the IRE, pp1196-1204, October 1948. Stockman stated then that "Evidently, considerable research and development work has to be done before the remaining basic problems in reflected-power communication are solved, and before the field of useful applications is explored."
Thirty years would pass before Harry's vision would begin to reach fruition. Other developments were needed: the transistor, the integrated circuit, the microprocessor, development of communication networks, changes in ways of doing business. No small task. Like many things, timing is everything, and the success of RFID would have to wait a while.

A lot has happened in the 53 years since Harry Stockman's work. The 1950s were an era of exploration of RFID techniques following technical developments in radio and radar in the 1930s and 1940s. Several technologies related to RFID were being explored such as the long-range transponder systems of "identification, friend or foe" (IFF) for aircraft. Developments of the 1950s include such works as F. L. Vernon's, "*Application of the microwave homodyne*", and D.B. Harris', "*Radio transmission systems with modulatable passive responder*". The wheels of RFID development were turning.

The History of RFID waves:

- 1940s -- RFID used in WW2 to identify 'friend or foe' aircraft

- 1960s -- Electronic article surveillance used to counter theft – first commercial use of RFID
- 1970s -- Developers, inventors, companies, academic institutions and government develop RFID applications
- 1980s -- Europe deploys RFID for animal tracking, industrial and business applications and payment on toll roads
- 1996 -- ANA (e.centre) board and EAN International plan RFID as the next standard data carrier1998EAN UCC RFID project kicks-off
- 1999 -- EAN and UCC adopt UHF the Auto-ID Center is established to develop the 'internet of things'
- 2000 -- EAN UCC rolls out the GTAG project
- 2002 -- E.centre leads the Home Office Chipping of Goods 'CD.id' project
- 2003 -- EPCglobal joint venture set-up to oversee the rollout of RFID standards worldwide
- 2004 -- First EPCglobal standards are released

To some extent, the History of RFID can be explained in terms of frequency. Frequencies have increased in order to provide the thin low cost tags required for the new, higher volume orders and the multitag reading and fast data transfer and other new requirements.

Let's have a lose look over the History of RFID: Dr. Landt is one of the foremost worldwide authorities on radio frequency identification (RFID), is one of the original five scientists from Los Alamos National Laboratories that developed this technology for the federal government. As TransCore's chief scientist, Landt is responsible for leading the technical developments of radio frequency identification systems. In 1984, Landt was one of the five co-founders of Amtech Corporation and served as vice president of research and development. He served on the Amtech board of directors from May 1989 to August 1998.

Landt has authored more than 60 technical papers and been awarded twelve U.S. Patents. Before joining Amtech, Landt worked for nine years at the Los Alamos National Laboratory in New Mexico. Landt earned a Ph.D. in electrical engineering from Stanford University, a Master of Science degree and a Bachelor of Science degree in electrical engineering from the South Dakota School for Mines and Technology.

RFID (radio frequency identification) is an integral part of our life. RFID increases productivity and convenience. RFID is used for hundreds, if not thousands, of applications such as preventing theft of automobiles, collecting tolls without stopping, managing traffic, gaining entrance to buildings, automating parking, controlling access of vehicles to gated communities, corporate campuses and airports, dispensing goods, providing ski lift access, tracking library books, buying hamburgers, and the growing opportunity to track a wealth of assets in supply chain management.

One can trace the History of RFID back to the beginning of time. Science and religion agree that in the first few moments of creation there was electromagnetic energy. "And God said, 'Let there be light,' and there was light" (Genesis 1). Before light, everything was formless and empty. Before anything else, there was electromagnetic energy.

Scientific thinking summarizes the universe was created in an instant with a Big Bang. Scientists deduce all the four fundamental forces - gravity, electromagnetism, and the strong and weak nuclear forces – were unified. The first form in the universe was electromagnetic energy. During the first few seconds or so of the universe, protons, neutrons and electrons began formation when photons (the quantum element of electromagnetic energy) collided converting energy into mass. The electromagnetic remnant of the Big Bang survives today as a background microwave hiss.

Why is this important, you might wonder? This energy is the source of RFID. It would take more than 14 billion years or so before we came along, discovered how to harness electromagnetic energy in the radio region, and to apply this knowledge to the development of RFID.

The Chinese were probably the first to observe and use magnetic fields in the form of lodestones in the first century BC in the History of RFID. Scientific understanding progressed very slowly after that until about the 1600s. From the 1600s to 1800s was an explosion of observational knowledge of electricity, magnetism and optics accompanied by a growing base of mathematically related observations. And, one of the early and well known pioneers of electricity in the 18th Century was Benjamin Franklin.

The 1800s marked the beginning of the fundamental understanding of electromagnetic energy. Michael Faraday, a noted English experimentalist, proposed in 1846 that both light and radio waves are part of electromagnetic energy. In 1864, James Clerk Maxwell, a Scottish physicist, published his theory on electromagnetic fields and concluded that electric and magnetic energy travel in transverse waves that propagate at a speed equal to that of light. Soon after in 1887, Heinrich Rudolf Hertz, German physicist, confirmed Maxwell's electromagnetic theory and produced and studied electromagnetic waves (radio waves), which he showed are long transverse waves that travel at the speed of light and can be reflected, refracted, and polarized like light. Hertz is credited as the first to transmit and receive radio waves, and his demonstrations were followed quickly by Aleksandr Popov in Russia.

In 1896, Guglielmo Marconi demonstrated the successful transmission of radiotelegraphy across the Atlantic, and the world would never be the same. The radio waves of Hertz, Popov and Marconi were made by spark gap which were suited for telegraphy or dots and dashes.

The Decades of History of RFID:

- *1940 - 1950* Radar refined and used, major World War II development effort.
- RFID invented in 1948.
- *1950 – 1960* Early explorations of RFID technology, laboratory experiments.
- *1960 – 1970* Development of the theory of RFID. Start of applications field trials.
- *1970 – 1980* Explosion of RFID development. Tests of RFID accelerate. Very early adopter implementations of RFID.
- *1980 – 1990* Commercial applications of RFID enter mainstream.
- *1990 – 2000* Emergence of standards. RFID widely deployed. RFID becomes a part of everyday life.