RFID 2018-2028:
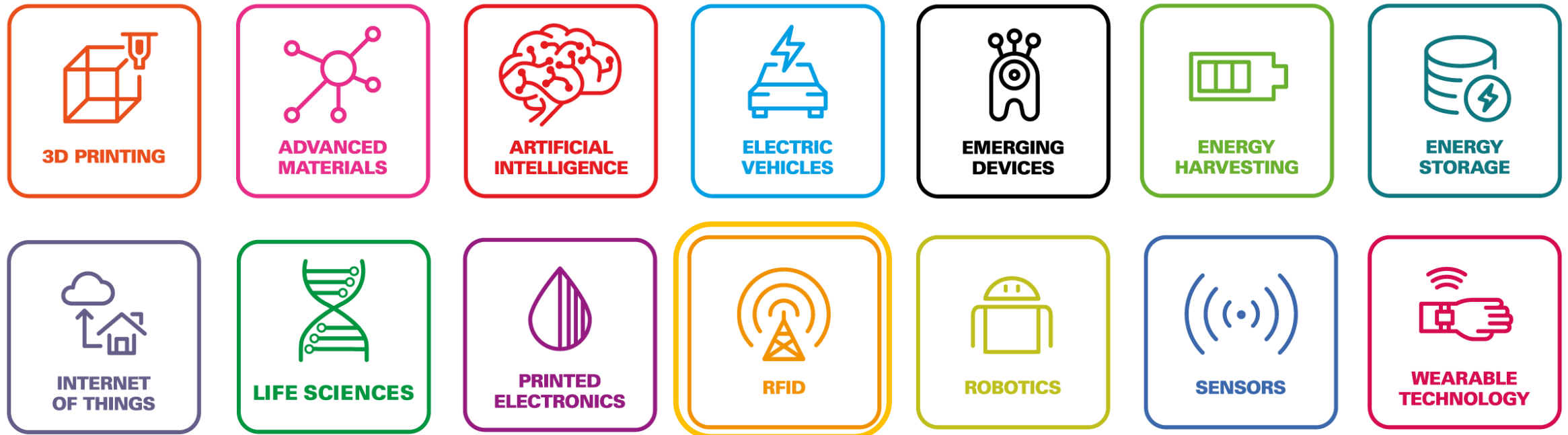
RAIN and NFC Market Status, Outlook and Innovations

Raghu Das, CEO

IDTechEx.com / r.das@IDTechEx.com

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RFID Forecasts, Players and Opportunities

The complete analysis of the global RFID industry

By Raghu Das

IDTechEx Research
Covering the Entire RFID Market

- RFID Forecasts, Players and Opportunities
- Forecasts by application, technology, territory, value chain and more

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The most comprehensive research into RFID markets:
- Over 30 applications assessed and forecast
- Historic and forecast sales
- Value chain and key suppliers
- Technology progression and trends

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What is RFID

Source: RAIN RFID Alliance

- RFID is a wireless technology that connects billions of things

- Enables consumers and businesses to engage, identify, locate, transact and authenticate

- RFID is an enabling set of technologies – not just a single product

Types of RFID	Main Options	Highest volume uses to date	No. of tags sold in 2017
Passive RFID (no battery)	• HF (13.56MHz) – includes **NFC** • UHF (~900MHz) – **RAIN** • LF (~125KHz)	HF / **NFC** – payments/transit UHF / **RAIN** – apparel tagging	Over **16 billion**
Battery assisted passive, Active RFID & RTLS (with battery)	• Point to point • Real Time Location Systems RTLS • Several frequency choices	Car toll tags, manufacturing, medical	Over **150 million**

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RFID helps in many different ways
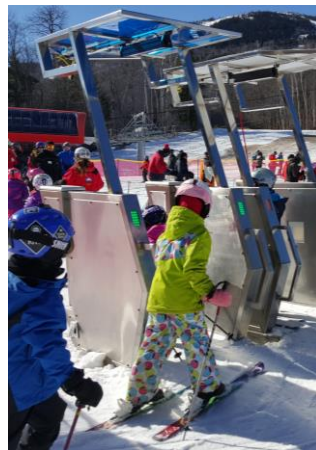
- RFID is an established technology in some sectors - **$11.1 Billion market in 2017** - but still with huge growth potential

- It is already more pervasive than many realise

- RFID improves processes

- RFID increases sales

- RFID makes things more convenient

- And much more …

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# Cumulative sales of all types of RFID tags to 2018 (millions)

Application	Number (millions)	Biggest markets by number of tags
Medical / Healthcare	1481	
Retail apparel	26350	1 – mostly RAIN
Retail consumer goods	740	
Books	2095	7 – mostly HF/NFC
Assets, Parts, Post	4726	4 – mostly RAIN
Smartcards / Payment key fobs	20897	2 – mostly HF/NFC
Smart tickets	5890	3 – mostly HFNFC
Air baggage	796	
Conveyances / Pallets / Cases / Rollcages	4045	5 – mostly RAIN
Animals (Livestock and Pets)	2946	6 – mostly LF
People (excludes other sectors)	207.9	
Vehicles (incl. car clickers)	1530	8 – LF and RAIN
Passports / Secure documents	1034	
Leisure	466	
Other NFC applications	1100	
Other tag applications	1725	
Total	**76,644**	

- **ALL FREQUENCIES shown,** passive and active, labels, fobs and cards

- RFID is used in very diverse, unrelated applications, addressing different problems

- Room for different technologies

- Total of ~16.7 Billion tags sold in 2017

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Retail

- 2 to 20% sales boost without increasing stock levels
- Reduction in out of stocks
- 96% improvement in labor productivity
- Over 98% inventory accuracy results

- Global ongoing roll-out for tagging apparel due to proven benefits
- Expanded from apparel to items including luxury goods, jewellery, furnishings and other high value, high complexity mix items
- Anti counterfeiting and anti theft are also driving adoption of RFID in retail
- Many are focussing on increasing sales through better customer service/engagement

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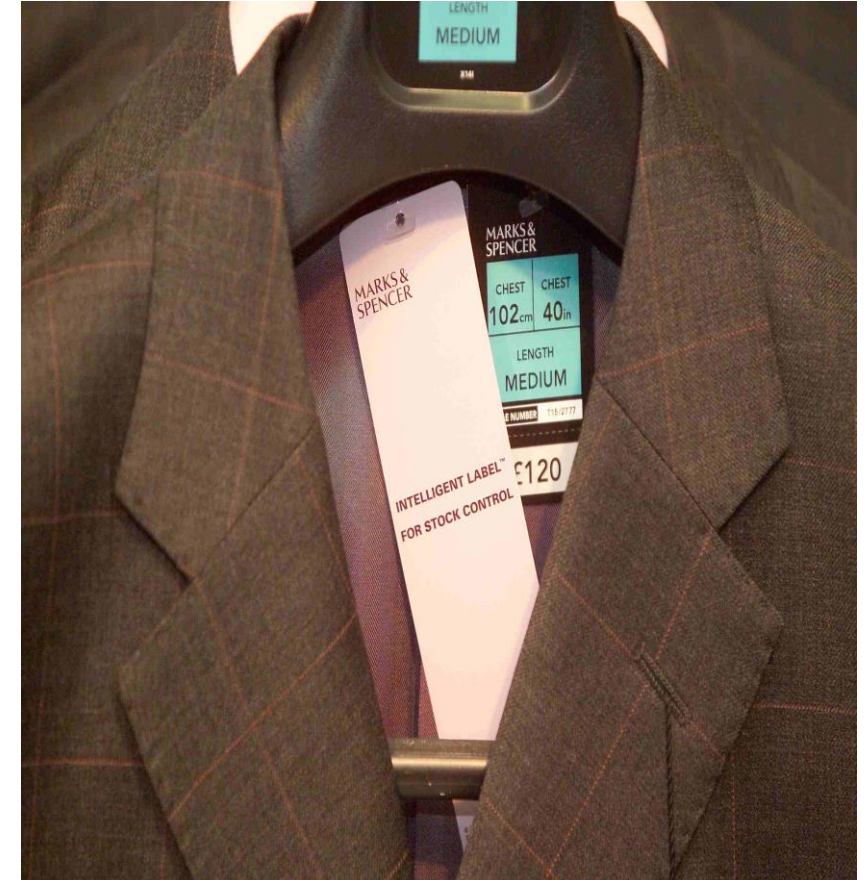
Over 100 Retailers Using RAIN RFID and Growing

7&i Holdings	C&A	Gardeur	Liverpool	Sears
Acne Studios	Calcedonia	Gerry Weber	lululemon	Seidensticker
Adidas	Carrefour	Gottfried Schmidt	Macy's	Suit Supply
Adler	celio	H&M	Marc O'Polo	Target
AEON	Chicos	Hailan	Marks & Spencer	TESCO
American Apparel	Club21	Hudson Bay	Max Mara	TK Maxx
American Eagle	Dazzle	Hugo Boss	Mood of Norway	Tommy Hilfiger
AZ Modell	Decathlon	Intersport	Mersmann Design	Under Armour
Beams	Decks	JBC	Nespresso	UNIQLO
Beaumanoir	Dilliards	JC Penney	Old Navy	Urban Outfitters
Bed Bath Beyond	Dior	Kohl's	Oxylane	VandeVelde
Bel & Bo	Elie Tahari	Komono	Pepe Jeans	Veritas
Boboli	Etam	L'Oreal	Ralph Lauren	VF
Bon-Ton Stores	Fast Retailing	Lacoste	Rebecca Minkoff	Vivienne Westwood
Brascol	G-Star	Levis	River Island	Zara

Source: RAIN RFID Alliance

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Tracking Logistics Containers and Parts

- Return on investment can be 12 months or less. Johnson Controls (pictured) tagged approx. 1 million containers, taking 6 months

- Better location knowledge and utilization of containers and parts. Saves manual labour (such as barcode scanning). Identified and improved bottlenecks.

- Mercedes Benz are using RFID on parts for Sprinter vans: "The goal is to digitally connect up to 40 parts with the production system via RFID in the next few years"

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Healthcare

- Inventory including patient samples, medicines and consumables to reduce manual tracking and error, reduce shrinkage and enable higher visibility
- Adhering to safety and regulatory compliance standards
- Medical research institute reduced shrinkage of expired products and write-offs by 70%
- Medical device company eliminated 15,000 hours of time spent manually reconciling inventory, per year
- Dental company tracks implants and dental tissues across 31 sites in real-time, with automated billing and replenishment
- Hospital increased workflow efficiency by 52% and has less than 1% error rate in tracking implanted products
- Dental solutions provider increased revenue by 168% and products sold by 264% in one year

RFID enclosures and mobile solutions for automated inventory management

Governments Propel RFID

From public transit to electronic toll systems…

Reduce congestion, automate payment collection, faster / more convenient for the user

… to Anti-counterfeiting

In South Korea, customs law requires that all whisky being sold locally carry RFID. This prevents tax evasion by some establishments that underreport purchases and sales, and stops fake products from circulating in the market.

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RFID Provides More Consumer Engagement and Use Data

- In theme parks, NFC provides greater engagement between consumers and exhibits (e.g. personalised interaction, payments, bypassing queues etc) and aids convenience

- Sales increase and engagement continues beyond the theme park visit

- RAIN RFID helped to enable the Coca-Cola Freestyle dispenser, which identifies over 30 cartridges and transmits data of consumption to the company

- Indicates low levels and only accepts genuine cartridges

- Real-time insight into what is happening by geography, what flavours are preferred by each location
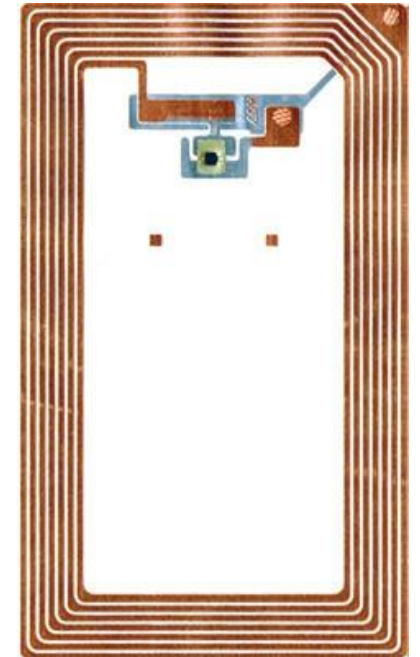
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NFC/HF RFID

(13.56MHz)
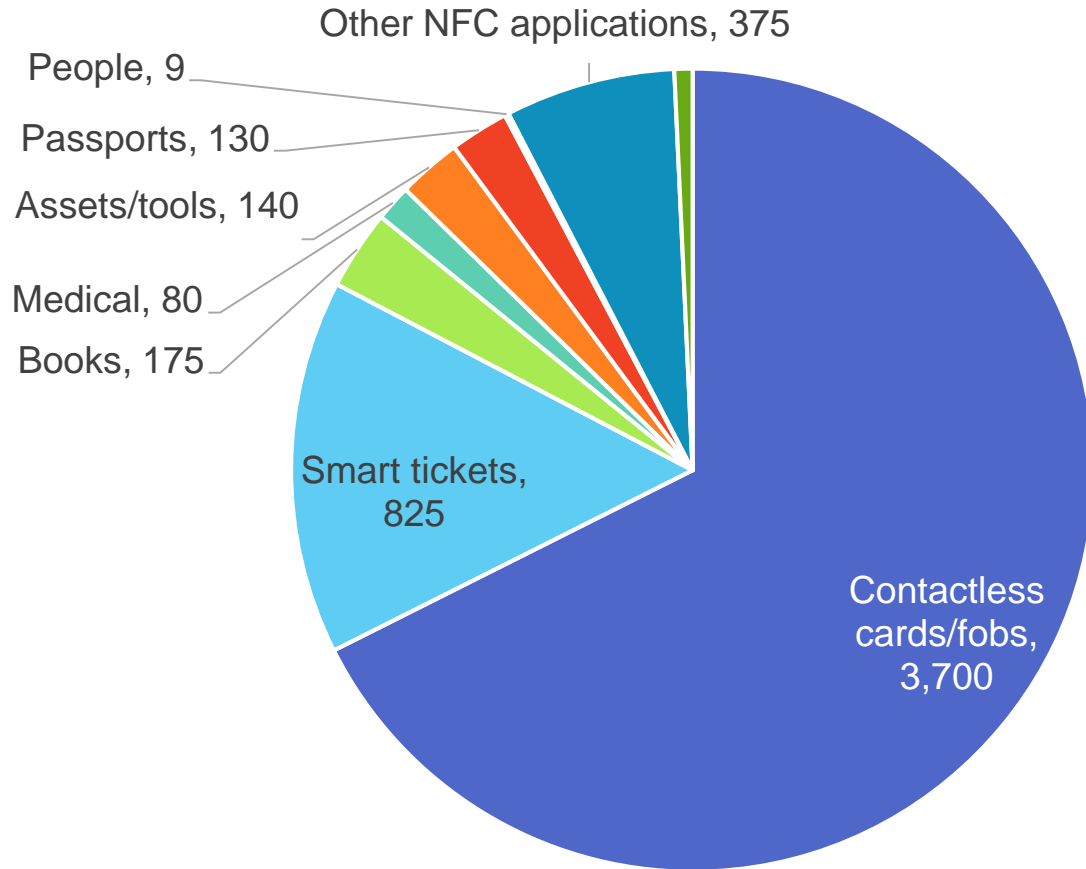**Over 25 billion** tags (contactless cards, fobs and labels) sold to 2018

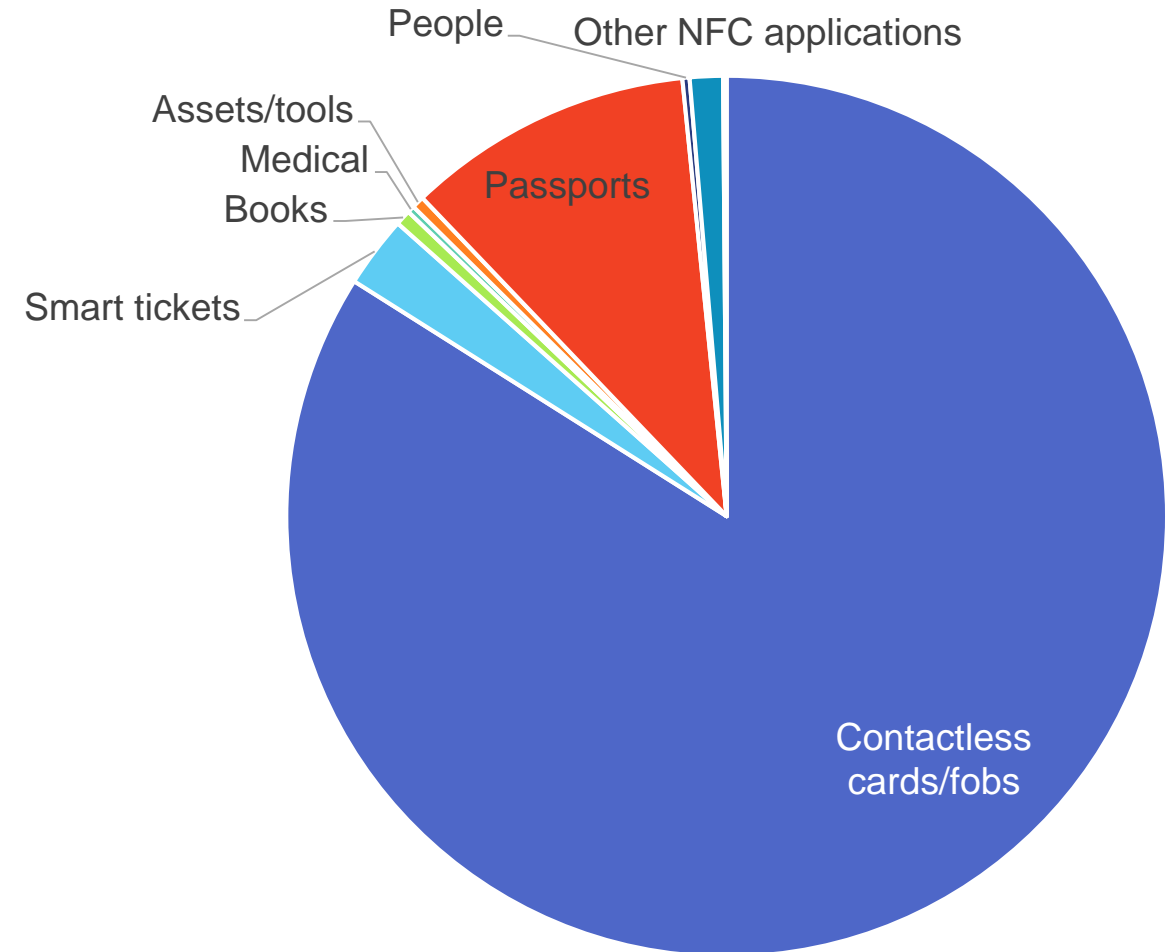| Application maturity	Main applications	Application profile
Mature in many sectors with some standards being set over 15 years ago	• Contactless cards (transit, access, ID, payments) • Tickets • Passports • Books • Data request / share labels	Government driven (transit, ID etc) Consumer orientated (payments, etc)

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2017 NFC/HF RFID Tag Sales (IDTechEx)

Numbers of Units, Millions

- Other NFC applications, 375
- People, 9
- Passports, 130
- Assets/tools, 140
- Medical, 80
- Books, 175
- Smart tickets, 825
- Contactless cards/fobs, 3,700

Value, totalling $3.09 Billion

- People
- Other NFC applications
- Assets/tools
- Medical
- Books
- Passports
- Smart tickets
- Contactless cards/fobs

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NFC/HF RFID Trends

- NFC payments growing, reducing handling of cash

- Large consumer reader network, opened further by Apple last year

- Outside of payments and transit, NFC labels are used in many applications :
  - Highlights are bluetooth pairing, computer games, "remind me" stickers
  - Smart packaging drives strong interest in NFC with more bands in trials and low volume deployments

- More companies focussed on quantifying ROI cases to create new markets

- NFC phones may eventually impact contactless card sales but app saturation outside of payments is a constraint and NFC labels will grow

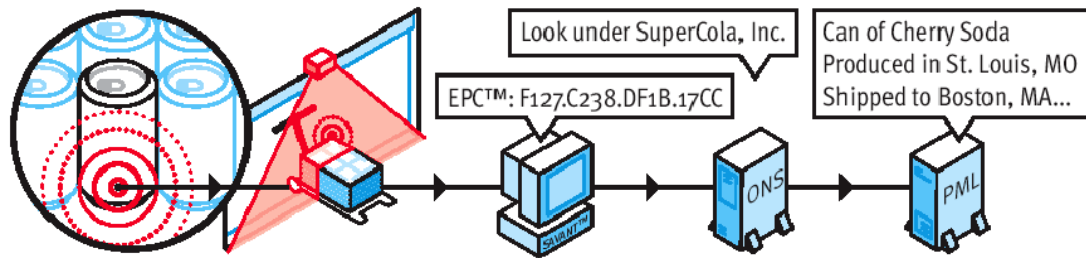Brands are being copied, face more competition and seek to improve consumer engagement

Four Drivers of RAIN RFID

Technology

1. Gen2 standard, common global frequencies

Interoperability, multiple sourcing

2. Performance

- Tag sensitivity has improved by ~10% / year on average

- Improvement in performance opens more opportunities

Confidence

3. Established value chain

- Streamlined value chain with established global players

- Consistent growth

- Reliable, low cost hardware

4. High confidence from industry (retailers, brands, airlines, manufacturers, automotive etc)

- "Cookie cutter" roll-out for some applications (apparel, asset management etc)

- Excellent understanding of RFID solution value – leveraging RFID to fix problems

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IDTechEx RAIN RFID Forecast, Inlays/Tags Sold, Value, Millions
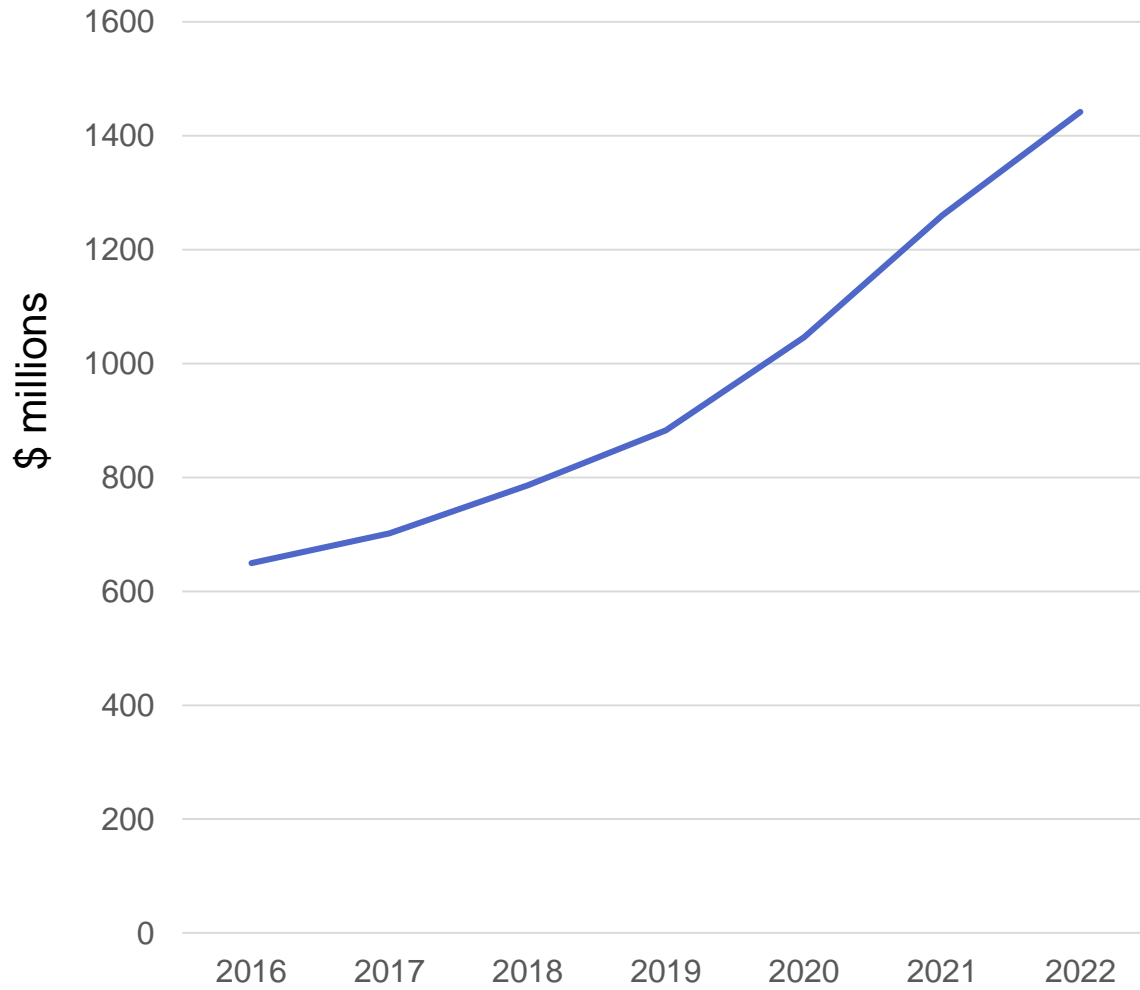
- IC sales in 2016 were 10.6 Billion units, we anticipate 2017 figures to be between 12.2 – 12.6 Billion (to be finalized)

- We expect 15 to 20% growth in 2018 (unit numbers)

- Ongoing new deployments in apparel (estimated TAM for apparel is 80 Bn units a year for top retailers) plus volume in healthcare, logistics, automotive (a long tail)

- $649 Million value for tags in 2016 rising to $1442 Million in 2022.

- For value (shown), growth by numbers slightly offset by price reduction

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RFID Readers: 2017 Market

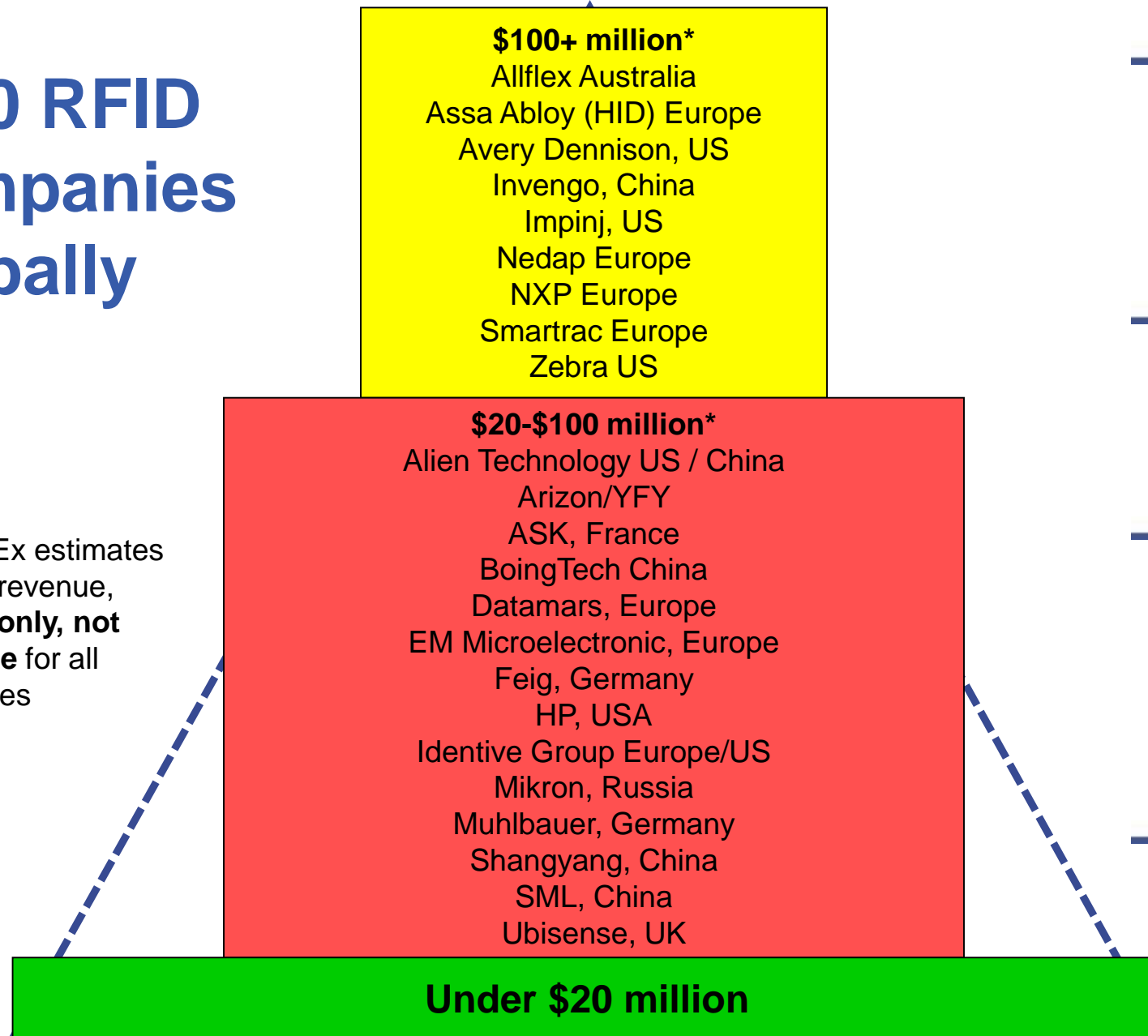| Reader type / Freq.	2017 number (millions)	2017 value ($millions)
RAIN (portal, handheld, modules)	0.6	660
NFC/HF and LF	15	2070
LF Vehicle	62	118
NFC cellphones and other consumer elec.	1,000	N/A

- Huge NFC reader infrastructure, predominantly for payments but being leveraged by other applications

- Eventual adoption of RAIN readers in cellphones creating B2C engagement?

- Rise of mobile robots that can integrate RFID for higher productivity

~800 RFID Companies Globally

*IDTechEx estimates of RFID revenue, **sample only, not complete** for all companies

$100+ million*
Allflex Australia
Assa Abloy (HID) Europe
Avery Dennison, US
Invengo, China
Impinj, US
Nedap Europe
NXP Europe
Smartrac Europe
Zebra US

$20-$100 million*
Alien Technology US / China
Arizon/YFY
ASK, France
BoingTech China
Datamars, Europe
EM Microelectronic, Europe
Feig, Germany
HP, USA
Identive Group Europe/US
Mikron, Russia
Muhlbauer, Germany
Shangyang, China
SML, China
Ubisense, UK

Under $20 million

- Highest RFID revenue companies typically feature focussed integrators / solution providers and the largest IC suppliers

- Typically the most successful integrators / solution providers focus on one or two verticals

- The middle of the value chain (i.e. horizontal tag production) can be lower margin so companies differentiate through customization for applications

- Horizontal suppliers created pull through demand by working directly with end users in the markets

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Trends by territory

Strong RAIN, NFC

Many in high volume roll-out (RAIN)

Strong supplier base

Retail apparel	
Person ID & payment	
Other	
By Value Chain (by company HQ)	
Tags	
Readers	
Integration	

Strong RAIN, NFC

Many in high volume roll-out (RAIN)

Strong supplier base (but more localised by country/ fragmented)

Retail apparel	
Person ID & payment	
Other	
By Value Chain (by company HQ)	
Tags	
Readers	
Integration	

Strong NFC, RAIN

Many in trials, some high volume roll-out (RAIN)

Most RFID manufacturing capacity

Retail apparel	
Person ID & payment	
Other	
By Value Chain (by company HQ)	
Tags	
Readers	
Integration	

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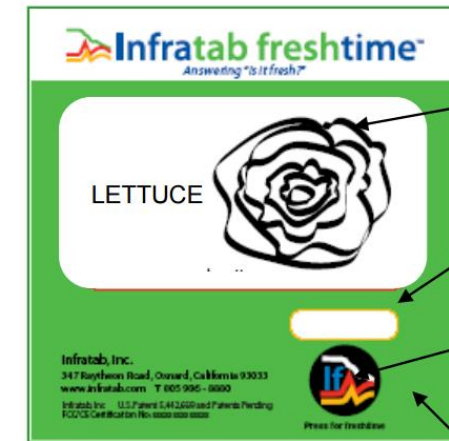
RFID with Sensors Disrupts the Data Logger Market

Data Logger Market

- Temperature data logging is most popular
- Logger costs $15 to $100, often reused
- Highlight excursions in transportation / use
- Large market for analytics, calibration etc.
- Little innovation

RFID Sensors

Source: Infratab

EPC Gen2 RFID tag

RFID Antenna

Red/green LED (display)
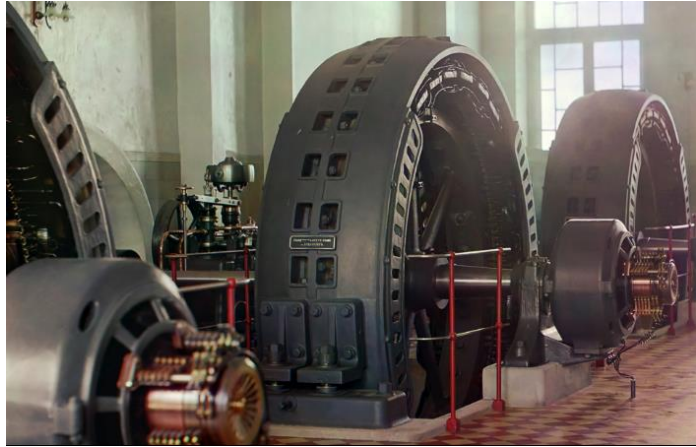
Button to start, check status

Temperature sensor, Lettuce shelf life profile

Alerts

Histogram

Log

- RFID ICs with I2C connection or dedicated sensor ICs
- Leverage standardized NFC or RAIN readers
- Lowers data logger and system infrastructure cost
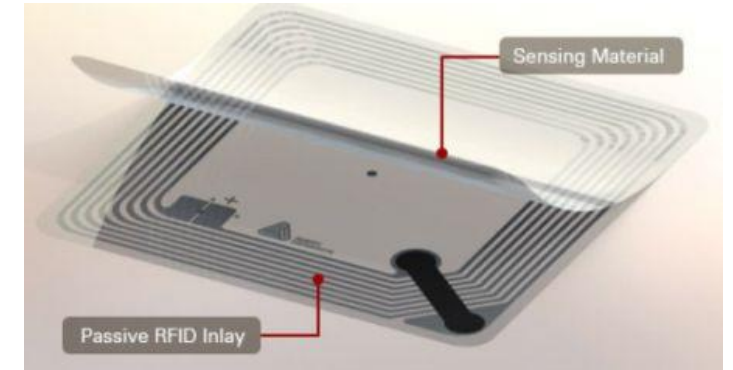
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Passive RFID Sensor Labels

Predictive Maintenance from a digital twin: e.g Hotspot monitoring

High temperatures is one of the biggest threats to motor & generator life cycle.

Moisture Detection

Detecting leaks in hybrid/EV structures in the manufacturing process

Detection of gases and toxic compounds

Sensing film changes conductivity with the parameter it is sensing.

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RFID ICs with Large Area Printed Sensors

Printed and flexible electronics enables large area and relatively low cost sensor systems

Strain sensor system for structural health monitoring

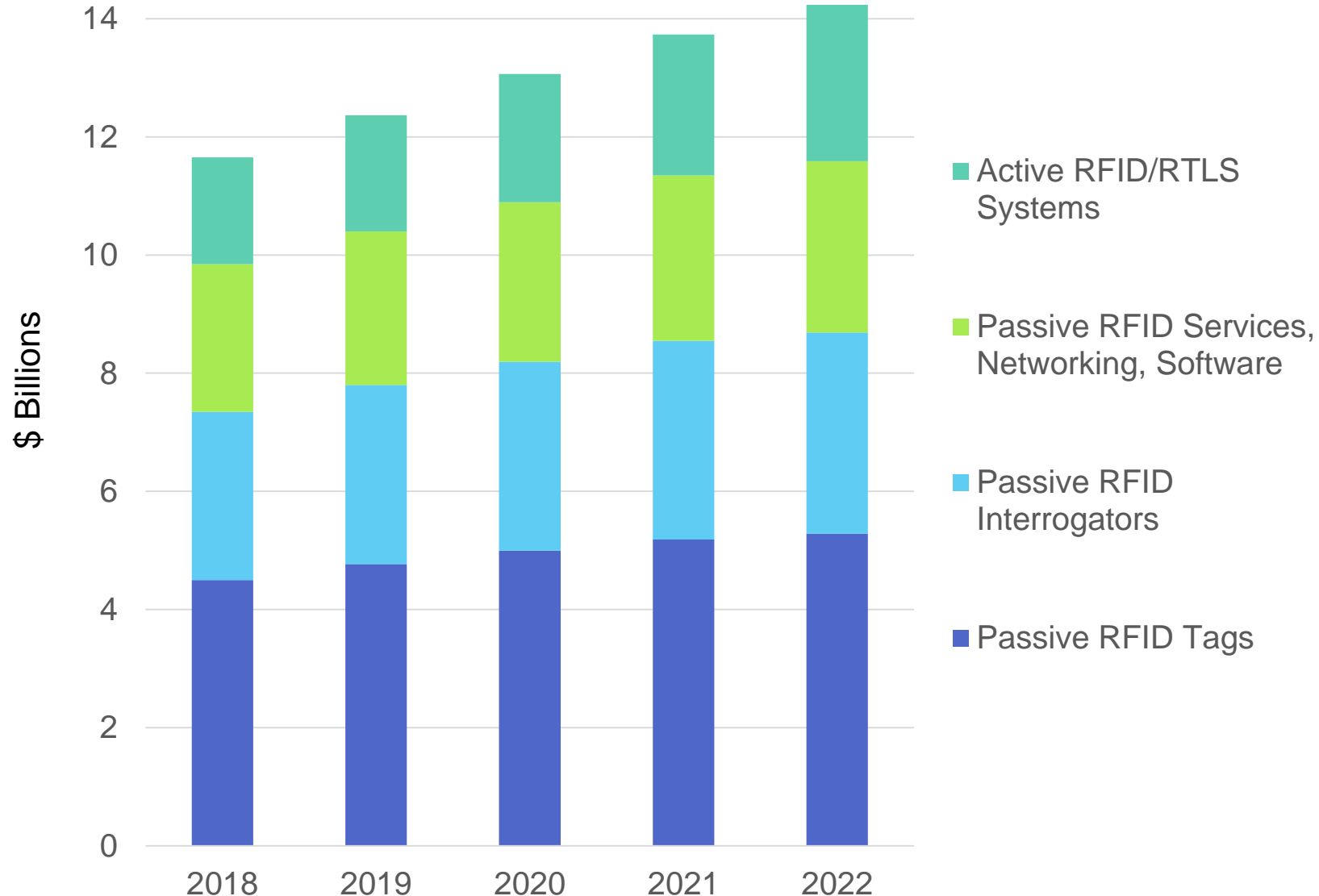Printed component
Si-CMOS component

Source: Xerox Parc
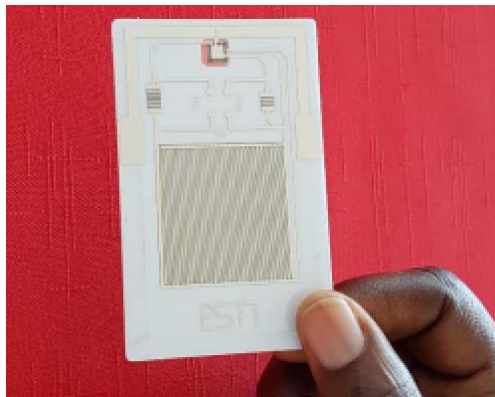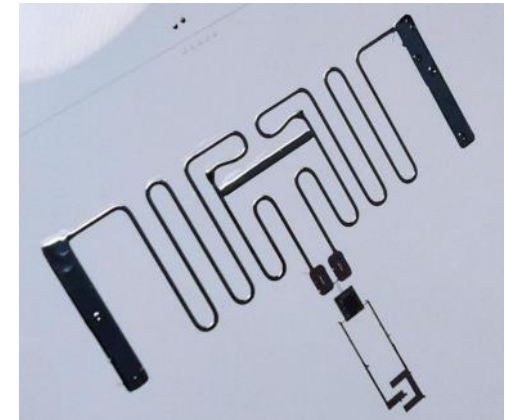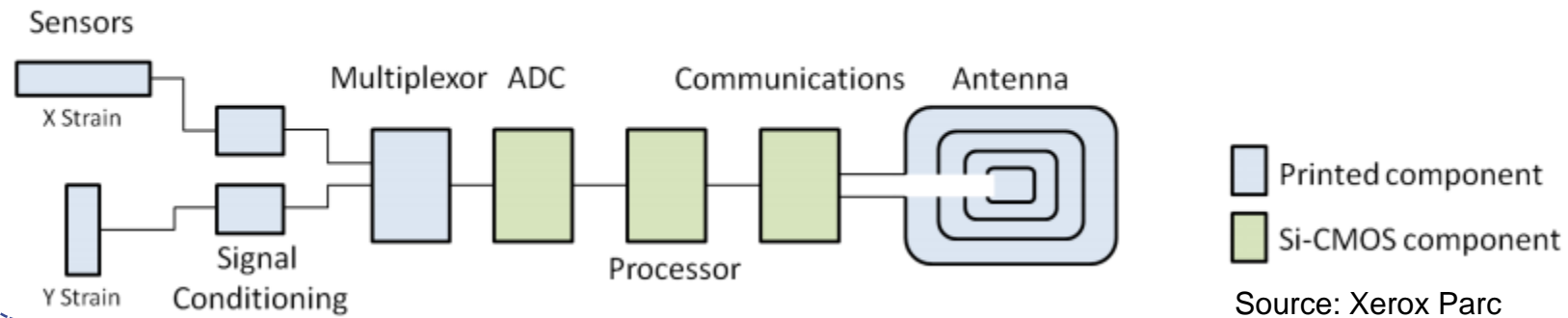
- Printed temperature sensor with passive RAIN RFID IC or NFC IC
- Large areas of printed temperature sensors enable thermographic mapping

Source: PST Sensors

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IDTechEx RFID Outlook

$ Billions

Active RFID/RTLS Systems

Passive RFID Services, Networking, Software

Passive RFID Interrogators

Passive RFID Tags

2018 2019 2020 2021 2022

— RFID has a large TAM, despite being one of the highest volume electronic devices ever made: large growth potential.

— Growth in existing applications through wider deployment

— Many rapidly growing sectors (healthcare, non apparel retail, baggage, automotive…) with billion+ tag volume applications establishing

— Businesses adopt RFID to become more competitive

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