World standard requirements for

Biometric System on Cards (BSoC)

- Capital Markets Day – NEXT Biometrics
- 18 October 2016, Hotel Continental, Oslo, Norway
- By Mr. LIN, Yih

1) Director, Digital Applied Research and Technology Pte Ltd, Singapore

2) Convenor, ISO/IEC JTC1 SC17 WG11 “Biometrics”

ISO/IEC 19795-7

ISO/IEC 14443-4

ISO/IEC 7816-1

ISO/IEC 18328-2

ISO/IEC 14443-3

ISO/IEC 7810

ISO/IEC 7816-11

ISO/IEC 7816-4

ISO/IEC 19794-2

Standards are very boring

I will try to make this session interesting

ISO/IEC 24787

ISO/IEC 17839-1

ISO/IEC 17839-3

ISO/IEC 17839-2

ISO/IEC TR 30117

ISO/IEC 18584

ISO/IEC 7816-3

About myself

- Born and raised in Singapore, age 60 (2016)
- 3 degrees from MIT USA (Bachelor 1980, Master 1983, Engineer 1983), all in Electrical Engineering and Computer Science; 1 year at UIUC (1977-78)
- Joined Singapore Ministry of Defence in 1983; Founded DART in 1985, family owned, wife also MIT alumni (with Bachelor from UMIST UK)
- Company is a system integrator, with extensive experience in computer security, smart card, biometrics, and other technology areas; eligible to bid Singapore government tenders at SG$3 million financial category
- All Company staff are Singaporean, security cleared, typically 15 engineers

MIT Tech Talk
17 Dec 1980
(age 24)

Student Team Develops 'Intelligent' Control Device

Three MIT graduate students, studying in the Product Development Workshop (Course 6.933), a new program that trains electrical engineers to meet critical industrial needs by designing practical new products, have teamed up with Data Technology, Inc., a Woburn, Mass., high-technology company, to develop a low-cost "intelligent" system for the digital semi-automatic control of machine tools.

The control system is the first new product to come from the workshop, which has been offered as a graduate course since September.

The development, accomplished in just three months, is expected to put the cost-cutting benefits of digital control within the price reach of thousands of companies. Total numerical control systems cost in the neighborhood of $15,000 to $30,000 per machine tool because of the expensive servomechanisms they require as well as the modifications to the machine tool and the cost of data processing and software.

The system developed at MIT, which makes use of a shaft position encoder being produced by Data Technology, is an interactive one that requires data input from a human operator who obtains the information from drawings of the part being machined.

The new course that brought the MIT graduate students and Data Technology together is one of the activities developed as a result of a gift to MIT by Bernard M. Gordon, an MIT alumnus who is chairman of the board and chief executive officer of Analogic Corporation of Wakefield. Mr. Gordon, who has maintained close ties with MIT since receiving the SB and SM degrees in 1948, has established a fund to be used to introduce the realism of solving industrial product development problems into the training of electrical engineers. The fund currently supports two part-time holders of the Bernard Marshall Gordon Professorship in Engineering Innovation and Practice in the Department of Electrical Engineering and Computer Science.

FIRST PRODUCT from MIT's new Product Development Workshop (Course 6.933) a low-cost control system for machine tools, is displayed by the three graduate students who tackled the project and Stanley R. Rich, left, adjunct professor and one of two holders of the Bernard Marshall Gordon Professorship in Engineering Innovation and Practice in the Department of Electrical Engineering and Computer Science. From the left, the students are: Ricardo E. Velez of De Lluvia, Mexico, Mark P. Obremski of Salem, Mass., and Yih Lin of Singapore.

The faculty members involved with the Product Development Workshop are Stanley R. Rich, an adjunct professor, and William F. Schreiber, a professor of electrical engineering. They are presently the joint holders of the Bernard Marshall Gordon Professorship.

A key element of the workshop is the involvement of companies like Data Technology.

"Problems of product development are suggested by companies that cooperate with the program," said Professor Rich, whose career has emphasized new product development in the fields of ultrasonics, electrostatics, electromechanical systems and components. "Data Technology had its shaft position encoder and management conceived of a product with which the machine tool operator could determine two or three axes of position. The company brought the idea to us and three graduate students, Mark P. Obremski of Salem, Ricardo E. Velez of De Lluvia, Mexico, and Yih Lin of Singapore, set to work."

Guided by Professors Rich and Schreiber, the students conceived of a system to accomplish Data Technology's goal and proposed it to the company.

J.K. Livingstone, board chairman of Data Technology, which manaufactures graphic systems, encoders and readouts, said he was highly pleased with the work of the MIT students and their faculty directors.

"We never expected to have something so promising in such a short time," Mr. Livingstone said. His company now will engineer the working MIT laboratory model into a product it will manufacture and market at its Woburn plant.

Professors Rich and Schreiber said the Data Technology project is the first to be developed and demonstrated through the new MIT program.

"The workshop focuses on teaching the role of the engineer in technology-based enterprises," Professor Rich said. "We want to make project engineers out of each engineer by exposing them to the group dynamics of technology-based companies, teaching them critical path evaluation and planning, patent law, market research, overall financial management as it relates to proposed new products, and by involving them in the decisions that have to be made in a company before plans for a new product can proceed."

Data Technology and the other companies involved in the workshop have agreed to make key information available to the MIT faculty members and their students. The MIT professors and students have agreed to treat as highly confidential such information as corporate profit margins, the production costs being aimed for, the potential market the product is intended to reach and the proprietary aspect of processes and techniques developed by the companies.

"This is a first for MIT," Professor Rich said, "in that we have combined teaching in these areas while creating a basis for a product. Our goal is to have the workshop function like the research and development arm of a company, to have the students learn the inner dynamics of a company and to interface with its top management."

Professor Schreiber said the workshop will again be offered in the spring term. A new list of product development problems will be provided by cooperating companies, he said, and students will continue to have available to them a meaningful and useful experience focused on the role of the engineer in technology-based industries.

(1980)

Page 4, Tech Talk, December 17, 1980

My participation in standardisation

- Member of Singapore IT Standards Committee since 1996 (20 years)
- Singapore hosted ISO/IEC JTC1 SC17 (WG8) in 2001, first contact (15 yrs)
- Appointed Convenor, JTC1 SC17 WG11 “application of biometrics to cards and personal identification” in 2005 (11 yrs)
- Participated in JTC1 SC37 “Biometrics” since 2004
- Participated in JTC1 SC27 “IT Security techniques” since 2004
- Represents Singapore in ITU-T SG17 “Security” from 2016
- DART and I2R partnered, submitted smart card with Match-On-Card (MoC) feature to NIST for MINEX II Phase IV in 2010

More about ISO/IEC JTC1 SC17 WG11

- Title: **The application of biometrics to cards and personal identification**
- Scope: Interoperability for interindustry and government applications using personal identification technologies, e.g. biometrics. Excludes generic biometrics as undertaken by SC37
- Formed in 2002, first Convenor Michael Hegenbarth, Germany
- Michael relinquished in 2004, LIN Yih was appointed Convenor in 2005
- Secretary was Garth Mackway Wilson, South Africa, in 2005
- Secretary changed to Raul Sanchez Reillo, Spain, in 2010

Process started - 29 Aug 2005, Lund, Sweden

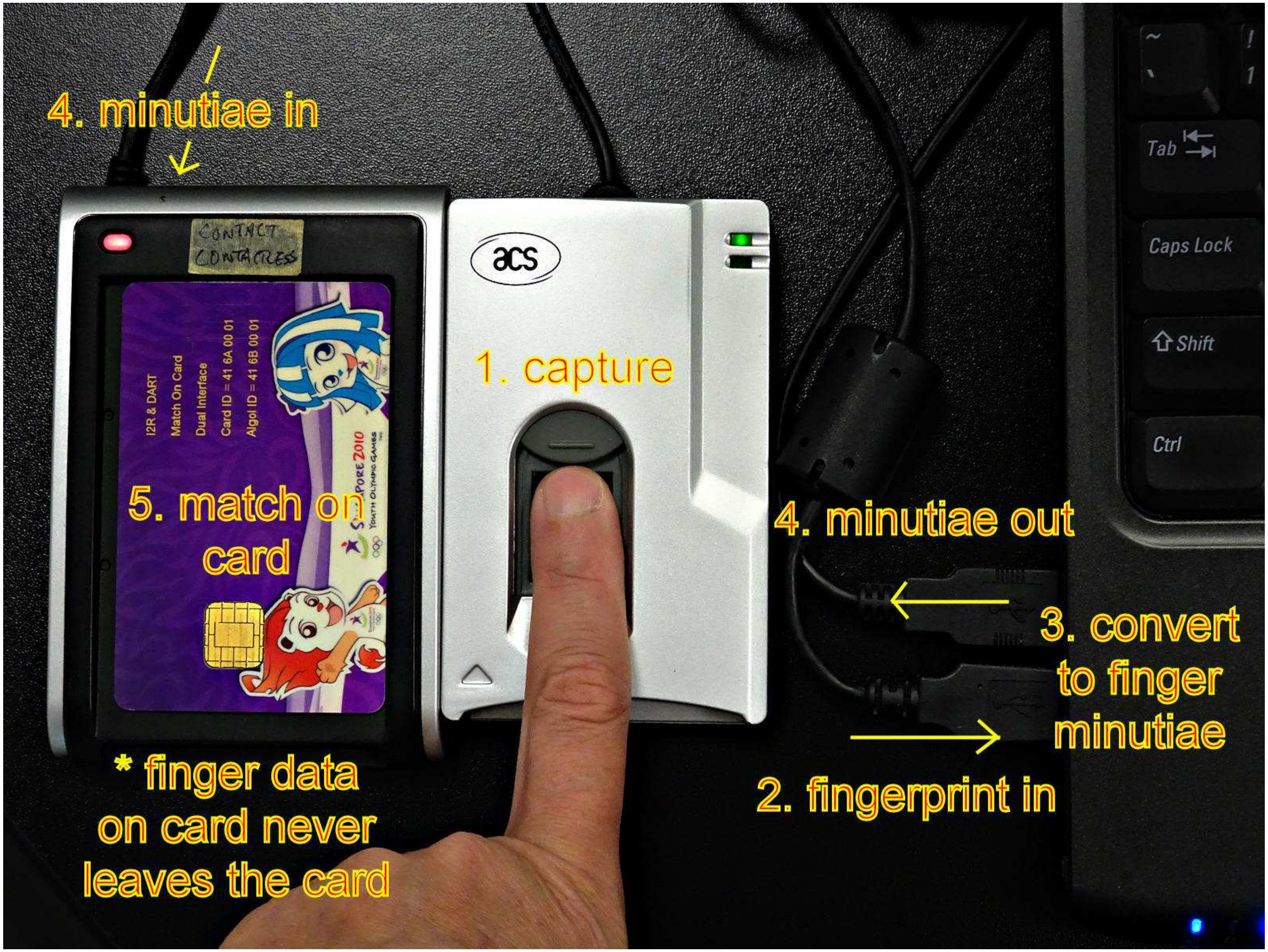
Standards developed in SC17 WG11

- ISO/IEC 24787:2010 - On-card biometric comparison
- ISO/IEC TR 30117:2014 - Guide to on-card biometric comparison standards and applications
- ISO/IEC 18584:2015 - Conformance test requirements for on-card biometric comparison applications
- ISO/IEC 17839-1:2014 - Biometric System-on-Card -- Part 1: Core requirements
- ISO/IEC 17839-2:2015 - Biometric System-on-Card -- Part 2: Physical characteristics
- ISO/IEC 17839-3:2016 - Biometric System-on-Card -- Part 3: Logical information interchange mechanism

What is Match on Card ?

(also known as “biometric on card comparison”)

Overview of Match on Card (MoC)



ISO/IEC 24787:2010 - On-card biometric comparison

- ISO/IEC 24787:2010 covers topics such as
  - Mandatory retry counter to prevent repeated brute force attack
  - Return of comparison status in a trusted, secured manner
  - Security policies for on-card biometric comparison
  - Commands and rules to permit pre-comparison computations to be done off-card (“work sharing”, useful for Java card implementation)
  - Single storage of biometric data shared by multiple applications
- ISO/IEC 24787:2010 is currently being revised (updated)

ISO/IEC TR 30117:2014 - Guide to on-card biometric comparison standards and applications

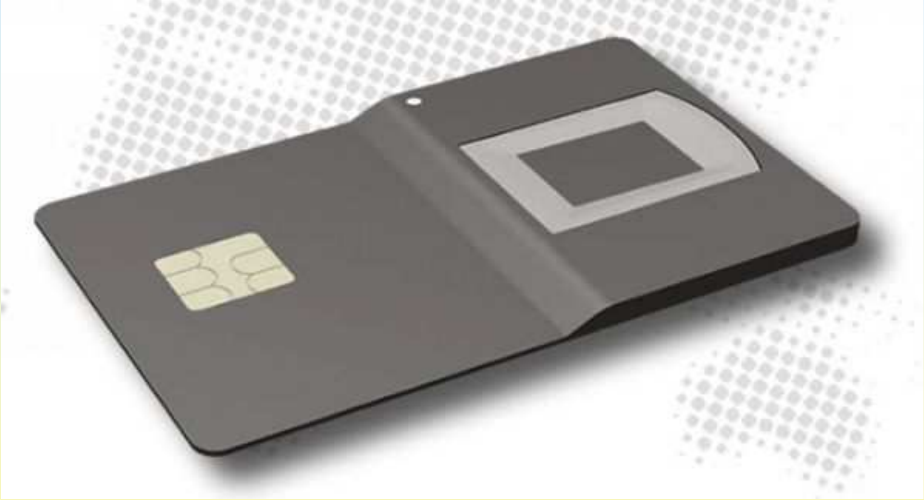
- ISO/IEC TR 30117:2014 summarizes how the international standards, recommendations and technical reports dealing with identification cards, biometrics and/or information security relate to each other with regard to the joint use of biometrics and integrated circuit cards
- Also provides further recommendations and policies needed by developers to integrate applications related to on-card biometric comparison.

ISO/IEC 18584:2015 - Conformance test requirements for on-card biometric comparison applications

- ISO/IEC 18584:2015 establishes
  - Conformance test requirements for using general framework for on-card comparison applications,
  - Conformance test requirements for using work-sharing mechanism for on-card comparison applications, and
  - Conformance test requirements to check accomplishment of security policies for on-card biometric comparison that are specified in ISO/IEC 24787:2010

What is Biometric System On Card ?

Biometric System on Card (BSoC) - prototypes



- Biometric capture, feature extraction, comparison all on the card
- The samples shown here do not conform with ISO/IEC 17839-x

ISO/IEC 17839-1:2014 - Biometric System-on-Card -- Part 1: Core requirements

- Defines two different types of system-on-card: Type S1 and Type S2
- Type S1 (“conventional”)
  - Dimensions (thickness, width and height) in accordance with the ID-1 format as specified in ISO/IEC 7810 (e.g. 0.76mm thick)
  - Card withstands torsion and bending tests specified in ISO/IEC 7816-1
  - Communication Interface may be any of the following:
    - Contact interface as specified in ISO/IEC 7816-3
    - USB interface as specified in ISO/IEC 7816-12
    - Contactless interface as specified in ISO/IEC 14443

ISO/IEC 17839-1:2014 - Biometric System-on-Card -- Part 1: Core requirements

- Type S2 (“new, thicker”)
  - Card ***must be*** 2.5mm thick, more than the one defined in ISO/IEC 7810
  - 2.5mm thick card cannot be inserted into standard card slot by mistake
  - Maximum width and height are within the boundaries of an ISO/IEC 7810 card as specified in ISO/IEC 17839-2
  - Need not conform to the ISO/IEC 7816-1 flexibility requirements
  - Supports ***only*** contactless interface specified in ISO/IEC 14443
- Regardless of S1 or S2, a card with swipe sensor must have some form of feedback mechanism such as LCD display, LED or buzzer

ISO/IEC 17839-2:2015 - Biometric System-on-Card -- Part 2: Physical characteristics

- ISO/IEC 17839-2:2015 covers:
  - The minimum size of an area sensor shall be 169mm^2 (13 × 13 mm or 0,512 × 0,512 in)
  - In the case of a swipe sensor, the effective area of fingerprint capture is bigger than the sensor size. A swipe sensor shall have a minimum width of 13 mm (0.512 in)
- Allows fingerprint sensor, voice microphone, camera for facial image, signature input pad

ISO/IEC 17839-3:2016 - Biometric System-on-Card -- Part 3: Logical information interchange mechanism

- ISO/IEC 17839-3:2016 covers:
  - Commands and data structures
  - Internal Enrollment and External Enrollment
  - Initiation of verification
  - Status feedback
  - Processing time management and extension
  - Capability discovery mechanism

Summary and conclusion

- Biometric Match on Card and Sensor on Card prevents sensitive data (e.g. fingerprint) from leaving the card
- Demand has been around for decades, and technology continues to grow and improve
- Standards are available to ensure – interoperability, confidence in products and services, etc.
- Although the context here is "card", the technology can be applied to other form factors – key chain, wrist band, other wearable devices with secure element capability

THE END

THANK YOU

Q&A

NEXT FINGERPRINT TECHNOLOGY & COMPETITIVE POSITIONING

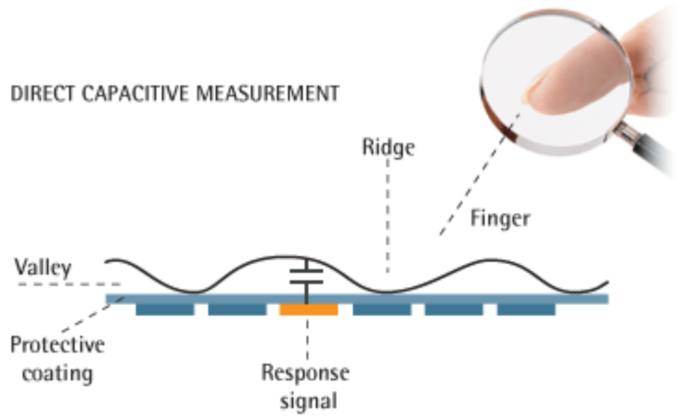
DR ROBERT MÜLLER

Overview

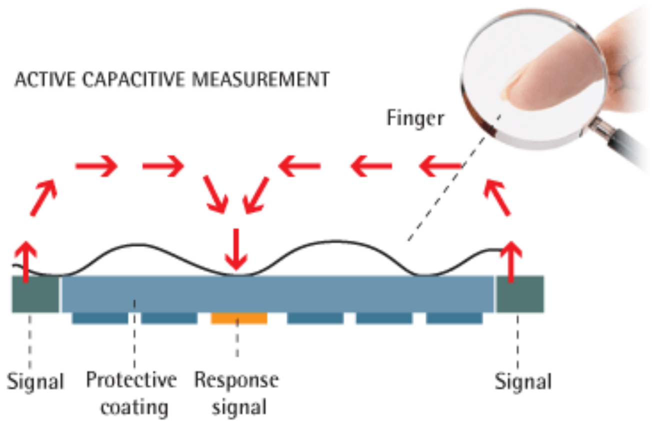
- Competing sensor technologies
- NEXT technology
- Strategic positioning
- Manufacturing
- Focus segments

Competing sensor technologies

Competing sensor technologies - Capacitive



- Measure capacitance using skin as dielectricum
- Larger format sensors are not offered at acceptable pricing



- Inject electrical signal from perimeter, measure response
- Superior to direct capacitive
- Larger format sensors are not offered at acceptable pricing

Synaptics

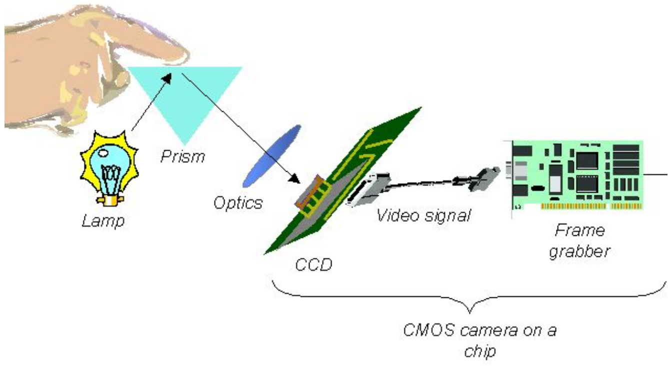
FINGERPRINTS

egistec

IDEX THE ID OF YOU

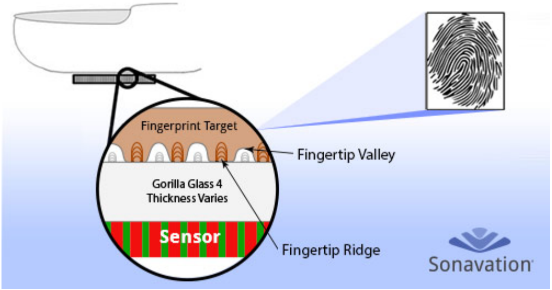
5-6 NEW
CHINESE

Optical & Ultrasound



Optical

- Frustrated Total Internal Reflection generates image
- Quality sensors require good optics and calibration
- Too bulky for smart cards, smartphone or portable devices



Ultrasound

- Generate ultrasonic pulse, measure response
- Complex hardware
- Focused at smart phones by Qualcomm
- Not relevant for smart cards

QUALCOMM

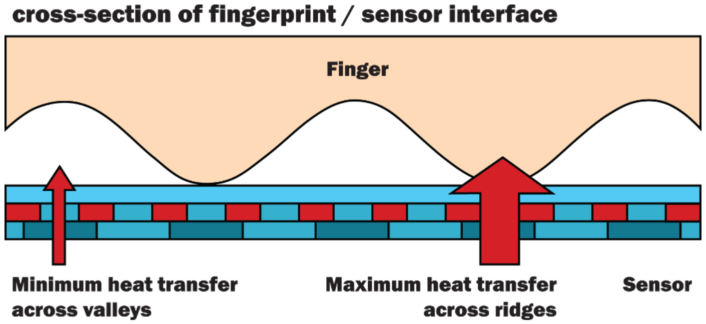
The NEXT Active Thermal™ sensor technology

The core technology

Area sensor technology – Thermal conductivity vs Capacitive sensing

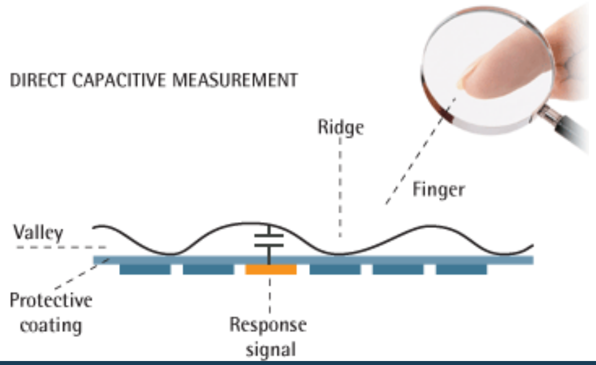
Active Thermal – Heat conductivity

A heat pulse is generated and a response measured by every pixel


cross-section of fingerprint / sensor interface

Capacitive sensing

An electrical radio frequency signal is generated and response is measured by every pixel



Players

NEXT BIOMETRICS

Players

Synaptics

FINGERPRINTS

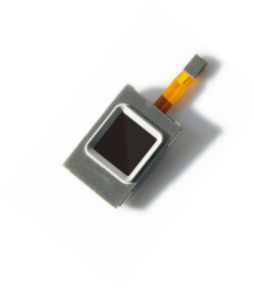
egistec

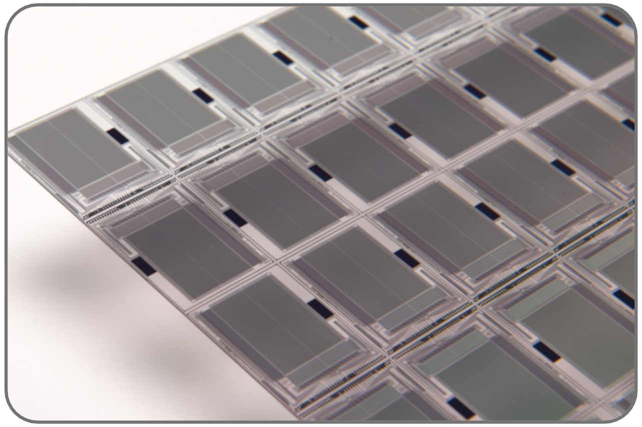
IDEX THE ID OF YOU

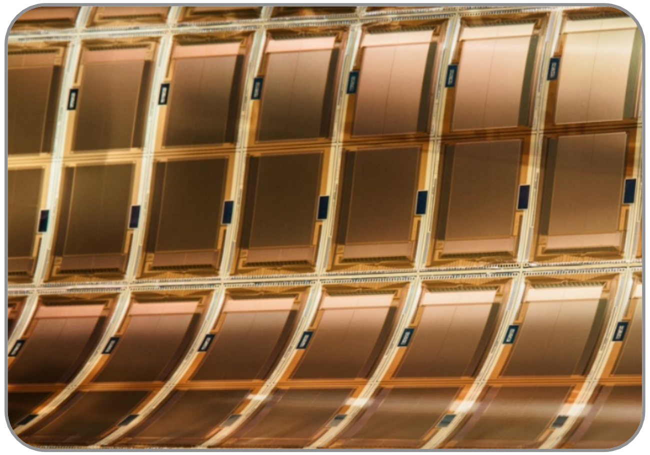
5-6 NEW CHINESE

Market changing cost levels and product formats

LTPS Manufacture at Rigid & Flexible substrates → 840 sensors per sheet







The Active Thermal Principle, patented and owned by NEXT, is based on transfer of heat from sensor into finger ridges and valleys

The unique simplicity of the NEXT Active Thermal pixel designs allows for mass production in standard high quality display fabs

Facilitating mass production at a lower costs plus access to both rigid and flexible product formats

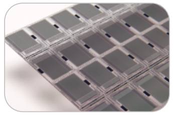
5 strong and significant competitive advantages

Rigid & Flexible

- Adaptable to both rigid and flexible or shaped substrates

Significantly lower costs

- 70% lower production cost vs same sized silicon area sensor modules



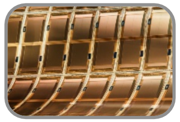
Uncompromised security & convenience

- Company not forced to compromise on sensor size in order to stay competitive

For close to 100% of a population

Scalable

- Scalable to 10's & 100'eds of millions of sensors



Strong IP

- Strong IP - protected by a range of patents & trade secrets
- Strength vs crowded capacitive space

Competitive positioning

Key requirements per market segment

Disqualifying if not met

Smart Cards

Fundamental requirements

-To serve close to 100% of pop
- At high security & convenience
= Large sensor size - Area format

-Physical flexibility
-Acceptable cost level
-Reader compliance

NEXT-enabled & Traditional markets

Fundamental requirements

-To serve close to 100% of pop
- At high security & convenience
= Large sensor size – Area format

-Acceptable cost level

Notebooks & Tablets

Fundamental requirements

-Large/medium size
-Acceptable cost level

Smartphones

Fundamental requirements

-Small size
-Attractive design
-Low cost

Key requirements per market segment

	Smart Cards	**NEXT-enabled & Traditional markets**	**Notebooks & Tablets**	**Smartphones**
				
Disqualifying if not met	**Fundamental requirements** -To serve close to 100% of pop - At high security & convenience = Large sensor size - Area format -Physical flexibility -Acceptable cost level -Reader compliance	**Fundamental requirements** -To serve close to 100% of pop - At high security & convenience = Large sensor size – Area format -Acceptable cost level	**Fundamental requirements** -Large/medium size -Acceptable cost level	**Fundamental requirements** -Small size -Attractive design -Low cost
May be important	**Important requirements** -ISO compliance -Clean IP -Acceptable system speed	**Important requirements** -System speed -Small total format -Clean IP	**Important requirements** -Attractive design -Color variations -Clean IP -System speed	**Important requirements** -Under glass ? -Acceptable system speed -Color variations
Likely not important	**Nice to have** -Color variations	**Nice to have** -Color variations	**Nice to have** -Color variations	

Strategic focus – Competition

Smart Cards

LARGE SENSORS ONLY

NEXT

SMALL/MEDIUM

IDEX, FPC

NEXT-enabled markets

LARGE SENSORS ONLY

NEXT

Notebooks & Tablets

SMALL

SYNAPTICS
FPC
EGISTEC

LARGER

NEXT

Smartphones

SMALL

SYNAPTICS
FPC
(APPLE)

GOODIX
IDEX
EGISTEC
SILEAD
FOCALTECH
MD
Chipone
MicroArray
Pixir.
QUALCOMM
Vkansee
Holtek

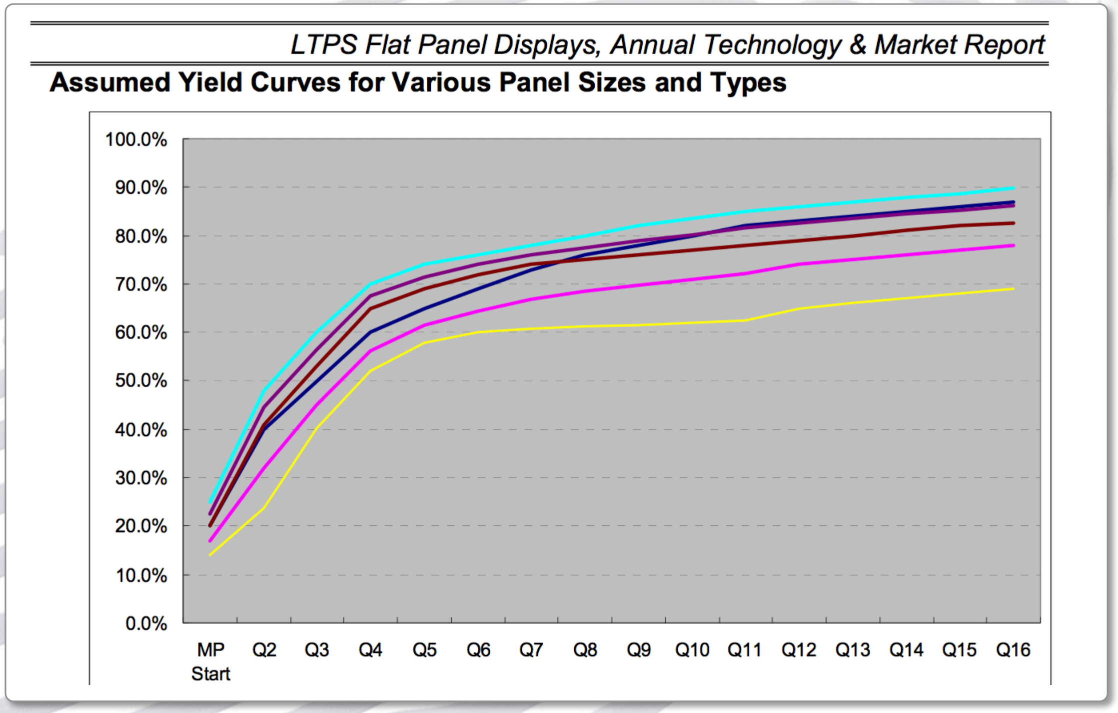
LARGER

NEXT

NEXT keeps its unique competitive positioning

Manufacturability
/
Credibility of logistics

Cost down : Yield Gen 1 vs Gen 2 sensors



LTPS Flat Panel Displays, Annual Technology & Market Report

Assumed Yield Curves for Various Panel Sizes and Types

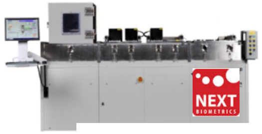
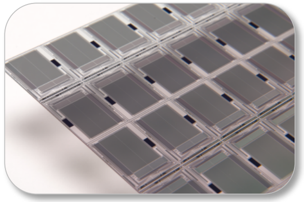
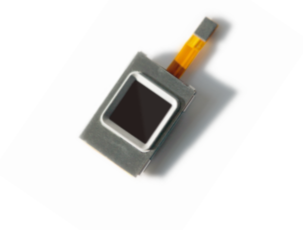
NEXT GEN I SENSOR :

YIELDS REALIZED IN FIRST Q1 and Q2-16
(THE FIRST HIGH VOLUME QUARTER)
WERE BELOW FORECASTED TARGETS

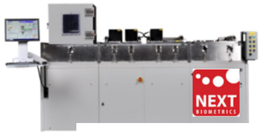
NEXT GEN II SENSOR :

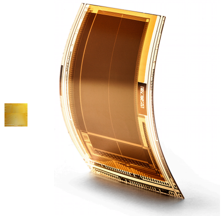
YIELDS REALIZED IN JUNE-AUGUST
(WITH EFFECT FROM LATE Q3)
ARE ABOVE FORECASTED LEVELS..

On Track → Mass production capacity expansion of rigid modules

	Sensor	Sensor coating	ASIC	Module & Assembly
	INNOLUX INNOLUX CORPORATION		tsmc XFAB MIXED-SIGNAL FOUNDRY EXPERTS	3 ISO-9000 APPROVED PARTNERS
Component				
Capacity April 2016	**“Unlimited“ capacity**	**1 mill units per month**	**“Unlimited “ capacity**	**0,5 mill per month**
Scalability		8-9 months lead time for extra coating machines		Scalable with 3-6 months notice

On Track → Mass production capacity expansion of flexible sensors

	Sensor	Sensor coating	ASIC
	INNOLUX INNOLUX CORPORATION		tsmc XFAB MIXED-SIGNAL FOUNDRY EXPERTS
Component			
Capacity H1 2017	- **Target 2 mill / month**	- **1-3 mill units per month (new tool)**	- **“Unlimited” capacity**
Scalability	- 2018 .. 10 mill/ month	- 8-9 months leadtime for extra coating machines	



chipset

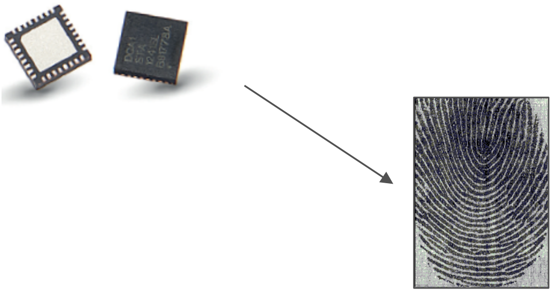
FINAL REMARKS & BUSINESS UPDATE

TORE ETHOLM-IDSØE / CEO

Business Update – Generation II ASIC

“A2”

Generation 2
ASICs



- **“A2”**
  - **Second Generation Asic Project**

STATUS & MILESTONES

- **First silicon received Mid August**
- **First image retrieved Early September**
- **Now 2/3 through the testing process**
- **Validation → Module build → Mass production in H1-17**
- **First shipments to start late in Q2-17**

FINANCIAL IMPACT

- **A MAJOR cost down**
  - **Significant reduction of module BOM**
  - **Significant ASIC cost down (vs Gen 1)**

Business Update – First Smartcard Customer

First Major Smartcard Deal

- **First Customer → Their first project**
  - **Part of their contract for initial order for 650 000 cards**
  - **Prototype Card w rigid sensor successfully demonstrated**
  - **NEXT to deliver initial production volumes in Q4-16 (rigid)**
  - **NEXT customer to ship first card volumes in Q1-17 (rigid)**
  - **Volumes of flexible sensor cards to be shipped from Q3-17**

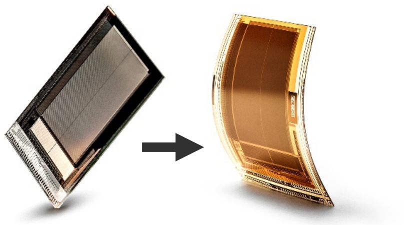
- **First Customer → New leads**
  - **In process with new project leads**
  - **Impact targeted H2-2017**

Business Update - Flexible sensor mass production

Smartcards

Transition to Mass Production

- **Transition to mass production of flexible sensors**
  - **Step 1 - Rigid sensor → Step 2 – Transfer to flexible**
  - **Significant joint Innolux project**
  - **Process not trivial - Making targeted progress every month**
  - **On Track for MP within end of Q2-17**



Smart Card industry mandatory requirements

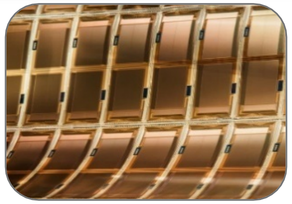
As defined by leading smart card industry projects

I
Technology/ Performance

- **FRR <1% at FAR 1:10 000**
- **Full compatibility with all the ISO standards below**
  - ISO/IEC 17839, Biometric System-on-Card
  - ISO/IEC 7810, Physical characteristics
  - ISO/IEC 10373, Test methods
  - 8 other partially overlapping ISO standards

II
Scalability

- **Access to credible, high volume production processes**
- **Strong and credible partners**
- **Ability to ramp up production to millions and 10's of millions units per month**

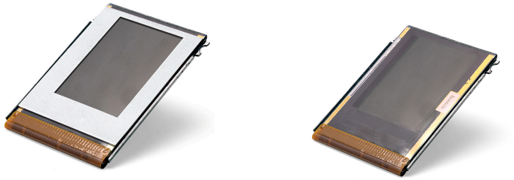


III
Cost

- **Cost levels compatible with the value proposition of the targeted volume markets**

Business Update - NEXT Enabled

Status ..
Focus on major volume opportunites based on the 2023-series



- bezel less design
- SPI or USB interface
- comprehensive SDK
- multi-platform
- ingress protection

Key Fobs

Smart Home Concepts

Remote controls

Internet of Things

Tokens

Portable hard drives

Built to develop and serve a wide range of new NEXT-enabled volume markets

Business Update - Dell

Status

- NEXT sensors now sold in 12 different notebooks & tablets
- Volume shipments since April 2016
- Most models are using full sized 12x17 mm sensors

NEXT →

COMMITTED TO
CREDIBLE DOCUMENTION OF
TRUE PERFORMANCE

New round of Madrid Tests

Q4-16
-
Q1-17

- **Further improved NEXT performance**
  - **Improved Gen-2 sensors**
  - **Improved algorithms**
  - **Uncompromised size = 201 mm2**
- **Enhanced selection of reference products**
  - **Large, ISO-compliant sized sensor**
  - **Smaller formats ?**

NEXT INVITES ALL LEADING COMPETITORS TO SUBMIT SENSORS AND ALGORITHMS FOR TRUE MASS MARKET REALISTIC COMPARATIVE VOLUME TESTING

CRITICAL REMINDER

MASS MARKET APPLICATIONS
&
RELEVANT TESTING REGIMES

Relevant user group testing

Major Worlds Markets

	Testing Regimes	Sensing area = 100 mm²	Sensing area = 148 mm²	Sensing area = 201 mm²
TYPICAL INHOUSE CUSTOMER TESTS	**Inhouse tests (typical)** - Limited number of prints collected - Limited number of individuals - Ages 20-60 years - Indoor, clean, office worker environment - Normally poor methodology	ESTIMATED BY NEXT **FRR 3-4%** Such tests are not credible in mass market implementation context	ESTIMATED BY NEXT **FRR 1-1.2%** Such tests are not credible in mass market implementation context	ESTIMATED BY NEXT **FRR 0.4-0.5%** Such tests are not credible in mass market implementation context
	The Madrid Tests - 3 x 60 000 prints collected - 600 individuals - Representative part of population - Ages 20 to 65 (80% less than 30) - Indoor, clean environment - ISO Best Practices methodology - **Western world user group relevant test**	**SIMULATED MADRID** **FRR 4.75-6.72%** CONDITIONS/RESULTS - Capacitive silicon sensor - High Quality algorithms - Simulation by cropping - Full enrollment (stitching) - Not ISO BSoC Compliant - FRRs at 1/ 10,000 FAR	DOCUMENTED-MADRID **FRR 1.54%** CONDITIONS/RESULTS : - Capacitive silicon sensor - High Quality algorithms - Rigid only - Not ISO BSoC compliant - FRRs at 1/ 10,000 FAR	DOCUMENTED-MADRID **FRR 0.63%** CONDITIONS/RESULTS : - 201 mm² sensor - NEXT Active Thermal™ sensor - High Quality algorithms - ISO BSoC compliant - FRRs at 1/10,000 FAR

Relevant user group testing

Major Worlds Markets

	Testing Regimes	Sensing area = 100 mm^2	Sensing area = 148 mm^2	Sensing area = 201 mm^2
TYPICAL INHOUSE CUSTOMER TESTS	**Inhouse tests (typical)** - Limited number of prints collected - Limited number of individuals - Ages 20-60 years - Indoor, clean, office worker environment - Normally poor methodology	ESTIMATED BY NEXT **FRR 3-4%** Such tests are not credible in mass market implementation context	ESTIMATED BY NEXT **FRR 1-1.2%** Such tests are not credible in mass market implementation context	ESTIMATED BY NEXT **FRR 0.4-0.5%** Such tests are not credible in mass market implementation context
UNIVERSIDAD CARLOS III DE MADRID	**The Madrid Tests** - 3 x 60 000 prints collected - 600 individuals - Representative part of population - Ages 20 to 65 (80% less than 30) - Indoor, clean environment - ISO Best Practices methodology - **Western world user group relevant test**	SIMULATED MADRID **FRR 4.75-6.72%** CONDITIONS/RESULTS - Capacitive silicon sensor - High Quality algorithms - Simulation by cropping - Full enrollment (stitching) - Not ISO BSoC Compliant - FRRs at 1/ 10,000 FAR - FRR too high for payments	DOCUMENTED-MADRID **FRR 1.54%** CONDITIONS/RESULTS : - Capacitive silicon sensor - High Quality algorithms - Rigid only - Not ISO BSoC compliant - FRRs at 1/ 10,000 FAR	DOCUMENTED-MADRID **FRR 0.63%** CONDITIONS/RESULTS : - 201 mm^2 sensor - NEXT Active Thermal™ sensor - High Quality algorithms - ISO BSoC compliant - FRRs at 1/10,000 FAR
CHALLENGING USER GROUP WORLD MARKETS	**Major Volume World Markets** - Developing country user group - Representative population - Ages children to 80 years - Hot and dry, often dirty outdoor conditions - Quality methodology - **Relevant outdoor – challenging market - user group**	**FRR = VERY HIGH** **NOT APPLICABLE**	**FRR 3-5%** **NOT APPLICABLE**	DOCUMENTED **FRR UNDER 2%** CONDITIONS/RESULTS : - 201 mm^2 sensor - NEXT Active Thermal™ sensor - High Quality algorithm - Interoperable template format - ISO BSoC Compliant - **The only sensor <211 mm2 passing**

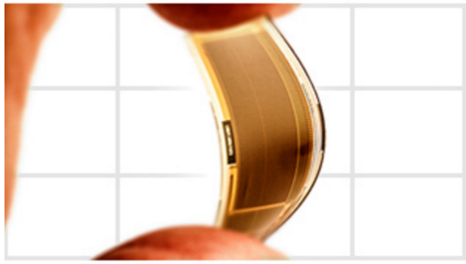
From Madrid to Outdoor, demanding markets

FRR's Increase by 2-3 times

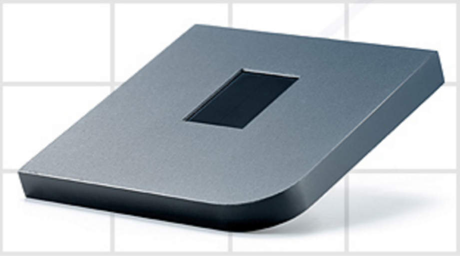
ISO/IEC 17839-2
Minimum
169 mm^2

Q&A

» Product / technology



» The worlds first ISO compliant flexible sensor



» NB-2023-S - The bezel less fingerprint area sensor.

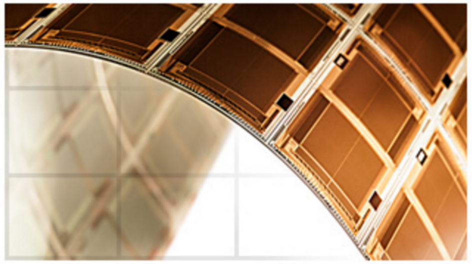
» Key NEXT Advantages

Universidad
Carlos III de Madrid

» The "Madrid Report" - Size is key in quality critical applications

» 5 Major competitive advantages

» Financial / investors



» NEXT Q2-2016 Presentation

» Capital Markets Day