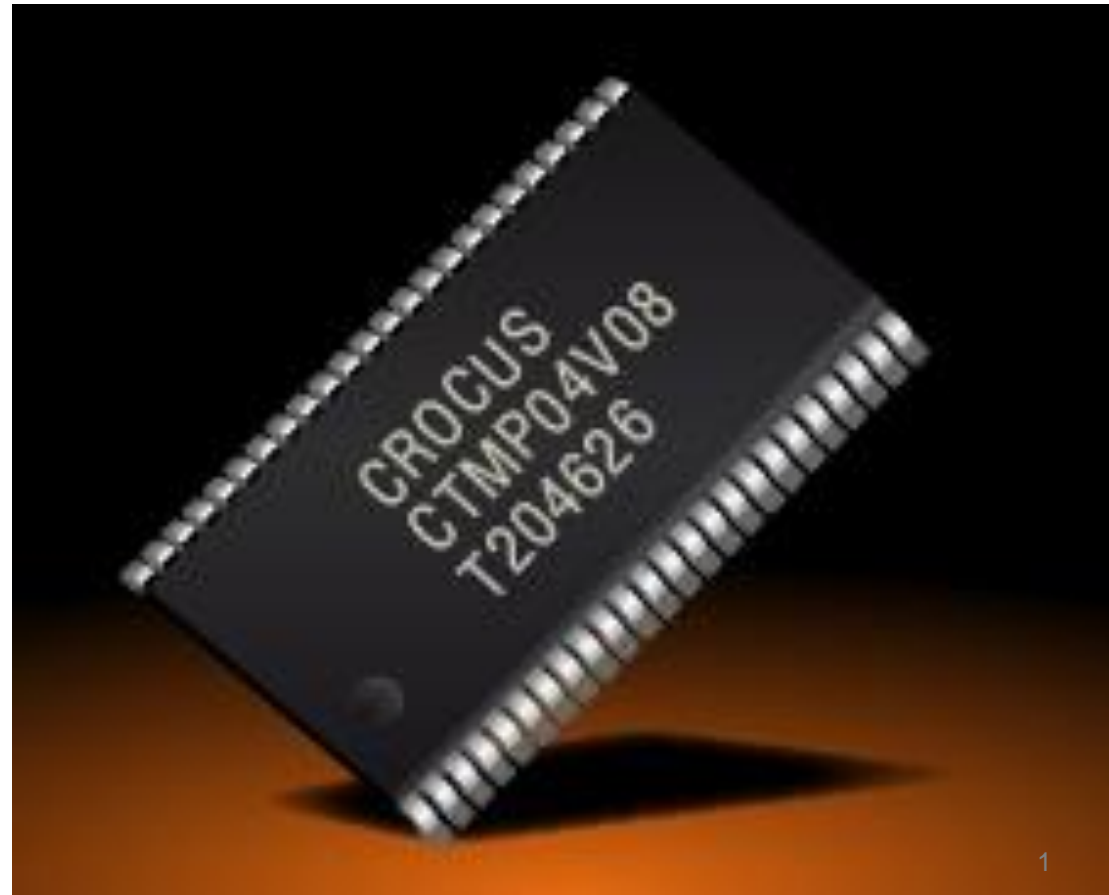
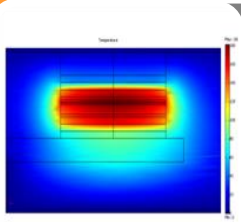


# Crocus MRAM Technology

*Advancing  
Memory  
Applications*

*Lj. Ristic*





## Technology:

Magnetic Logic Unit (MLU™)  
> 150 patents  
> Memory blocks, Logic, Analog



## R&D Partners:

IBM JDA – Yorktown  
CEA - Grenoble



## Product Focus

Smartcards/Secure MCU  
Technology licensing/NRE  
High value MRAM & Sensors



## Manufacturing Partners:

Crocus Nano Electronics  
Tower Jazz  
SMIC



## Investors:

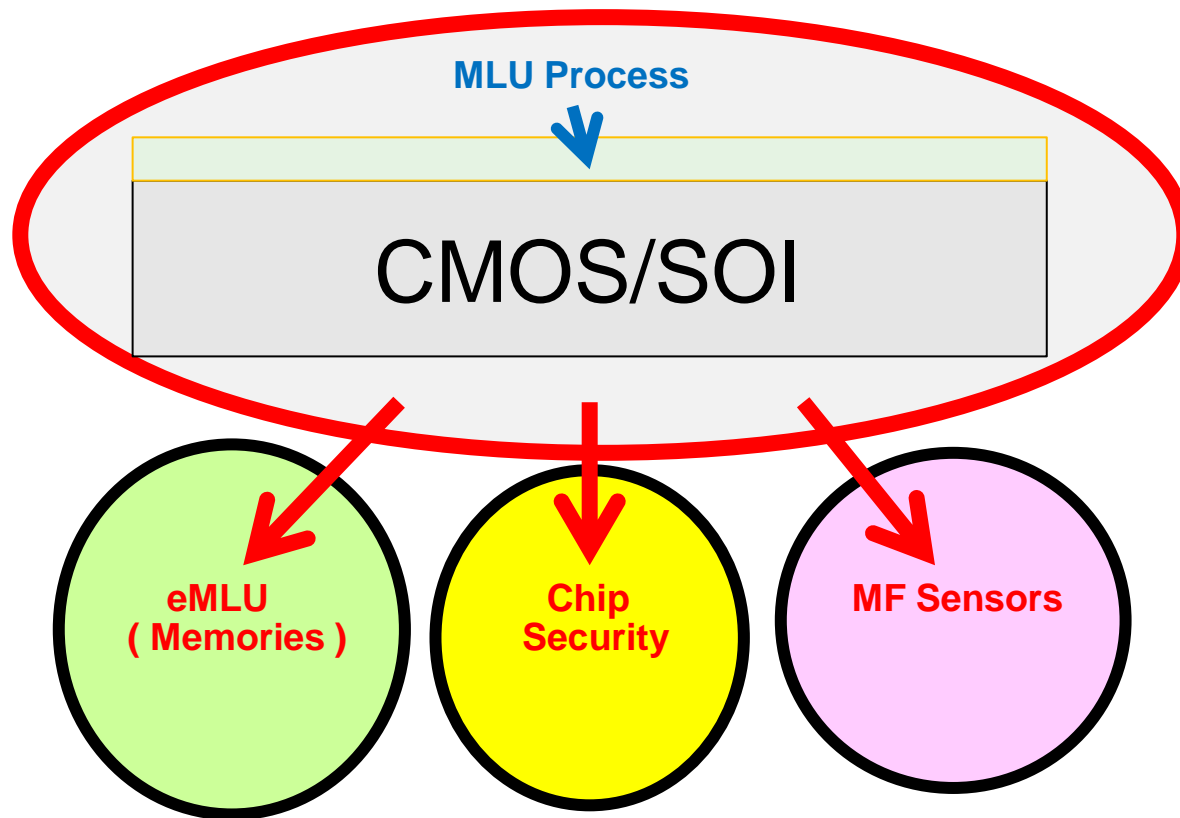
\$170M cash raised  
Committed **Revenue Plan** Syndicate



## Strong team:

60 Employees  
»200 Associated Employees

# MLU – Platform Enabler for Multiple Markets





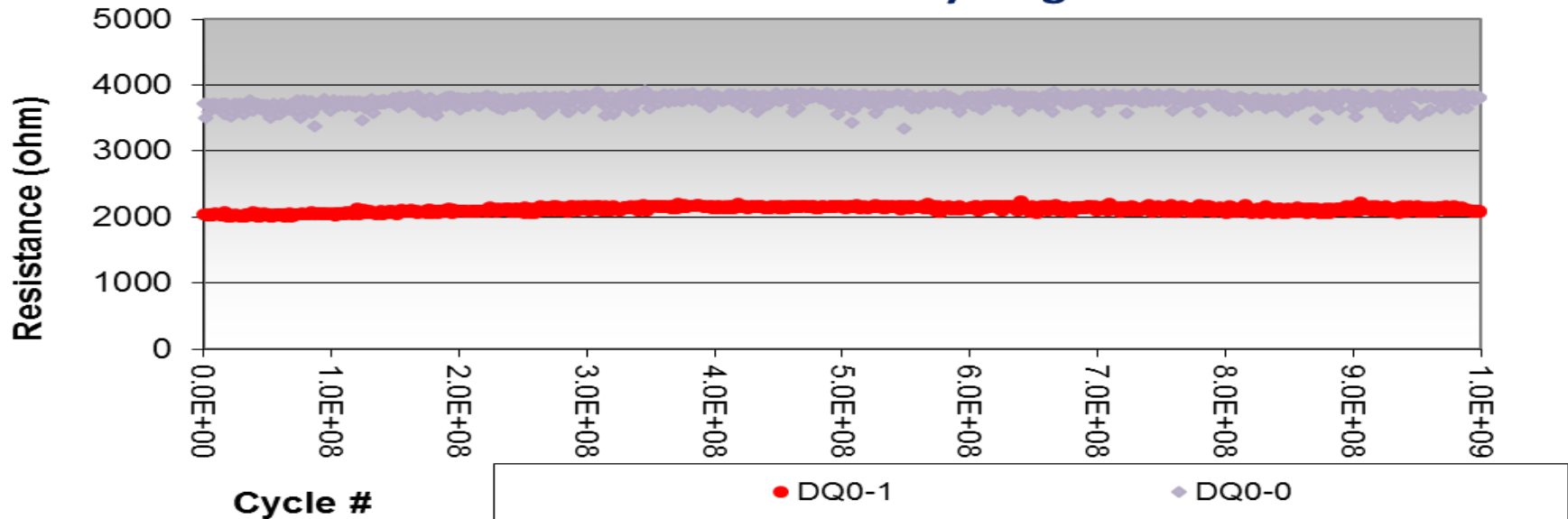
# Crocus eMLU vs eFlash: Benchmark @ 65 nm

Parameter		eFlash	eMLU Gen3
<b>WRITE</b>	Prog time (us)	5	<0.1
	Current (mA)	4	3
	Write Energy/bit (pJ)	1000	<10
	Erase Energy/bit (pJ)	14000	n/a
<b>READ</b>	Read time (ns)	50	<30
	Current (mA)	2	2
	Energy/bit (pJ)	6	5
<b>Cell Size</b>	Per cell (um <sup>2</sup> )	0.072	0.068
<b>Block Size</b>	32Mb (mm <sup>2</sup> )	12	8
<b>Extra Mask layers</b>	# of reticles	7	2
<b>Test cost</b>	P/E cycle μs	1000	0.1
<b>Endurance</b>	Cycles	400K	> 10**12

# MLU Endurance

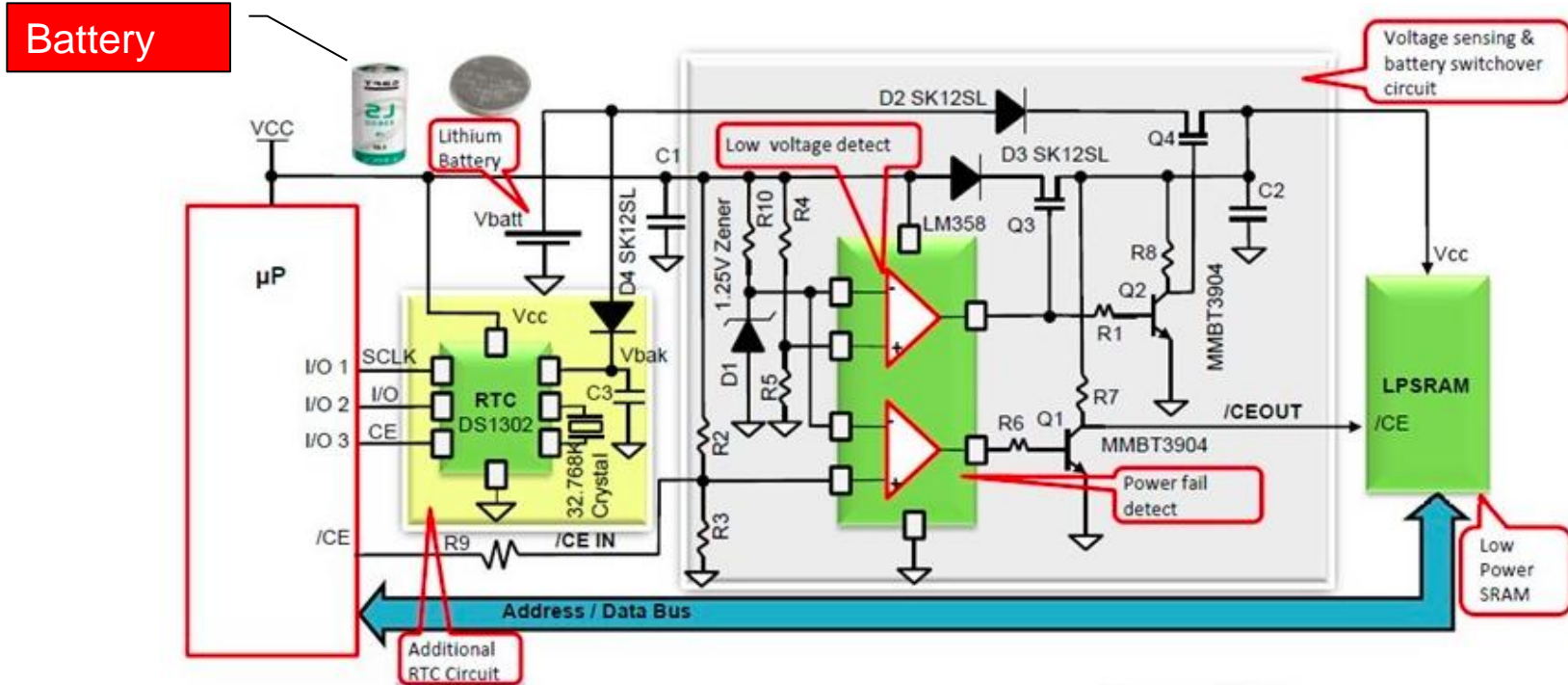
- Measurement of  $R_{LOW}$  and  $R_{HIGH}$  over 100B cycles

Rainbow Rev. D Die 2000M Cycling "0" & "1"



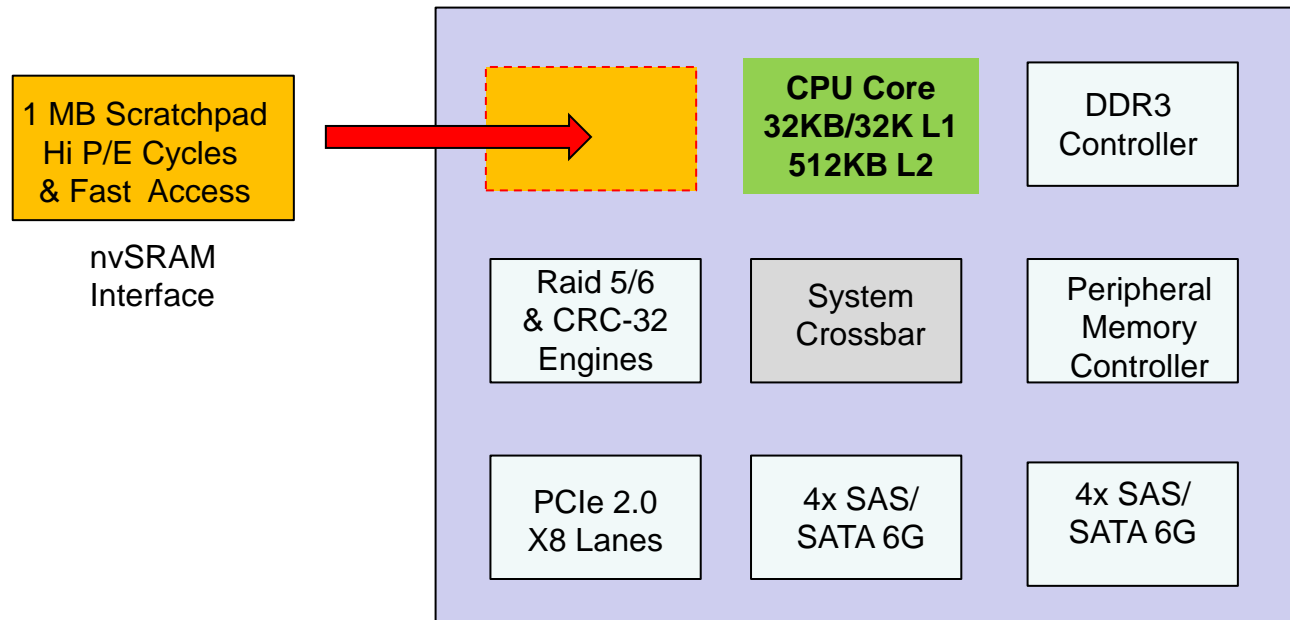
# Non-Volatile RAM

- BBSRAM is an SRAM memory that is backed up with a battery to preserve data in the event of a power failure



- nvSRAM is a combination of an SRAM memory cell and a non-volatile cell that acts as a backup to the SRAM cell.

# SATA/PCIe SoC Controller

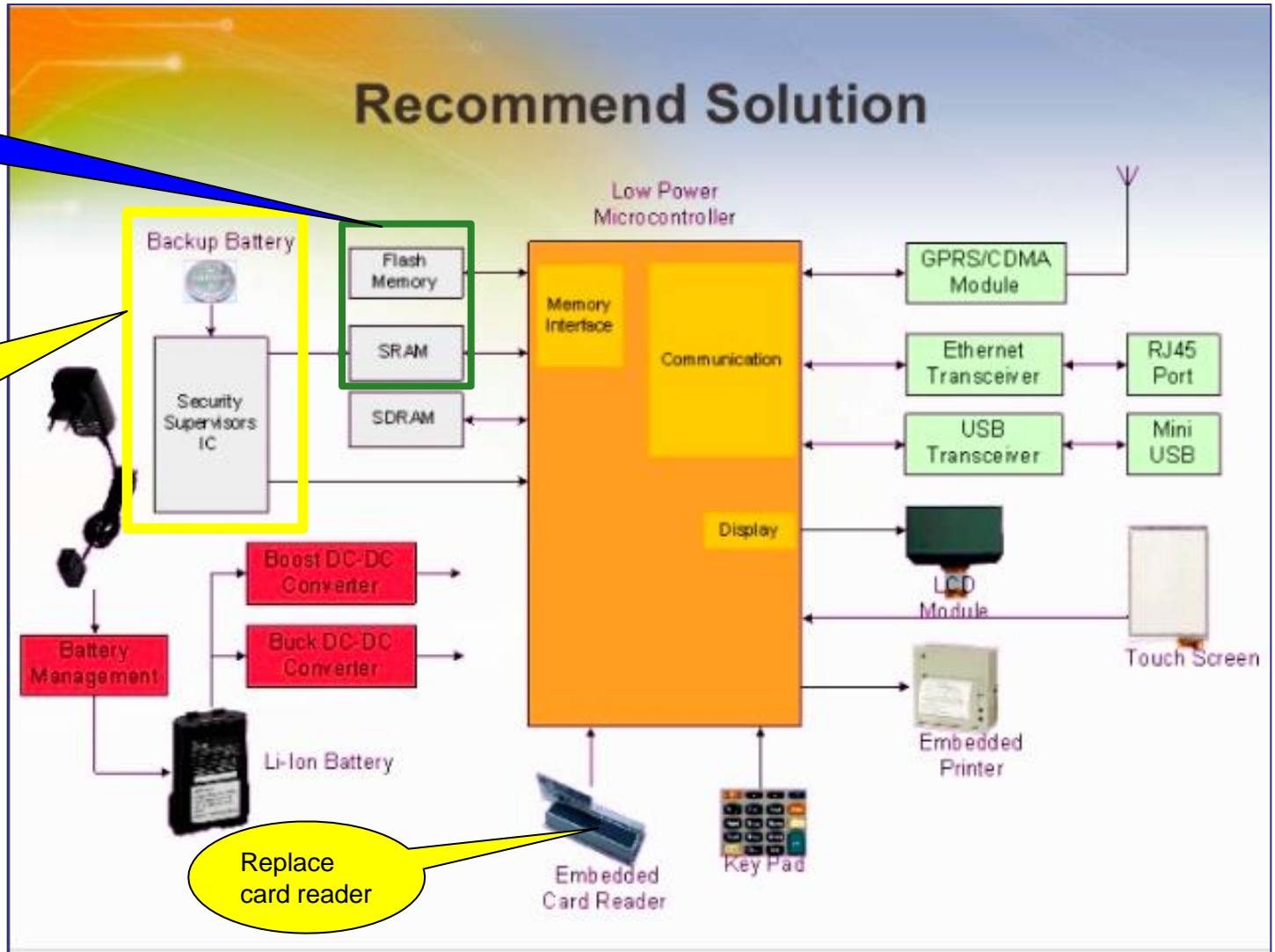


## Block Diagram

- nvSRAM currently is not on the controller chip
- Next Gen Controllers will include scratchpad

# POS Terminal

## Recommend Solution



Replace both devices

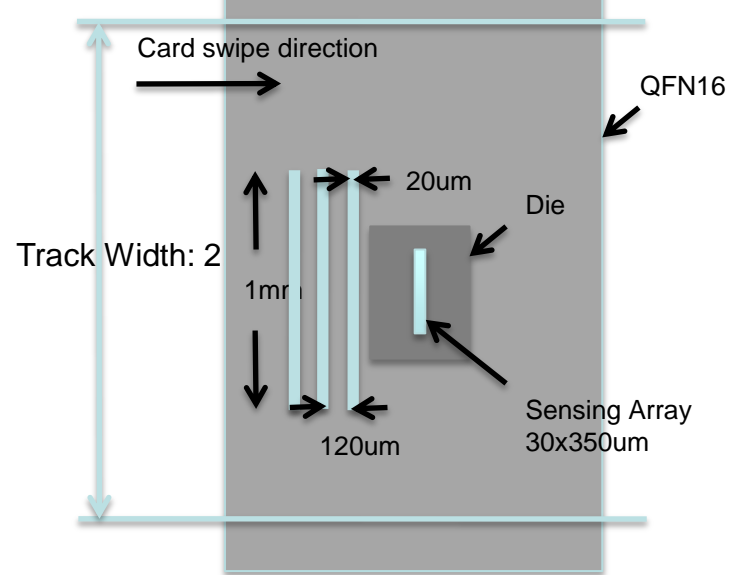
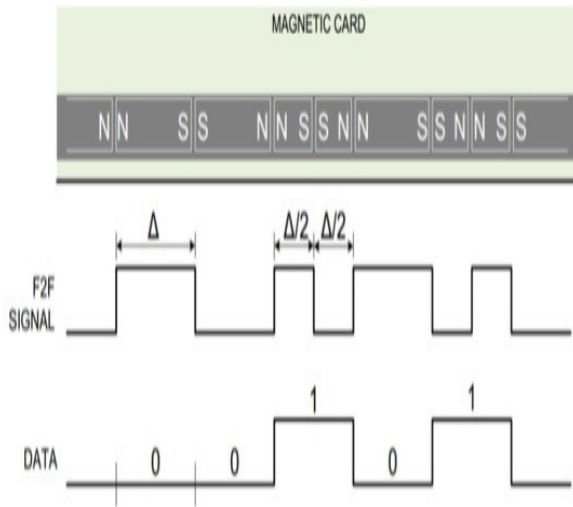
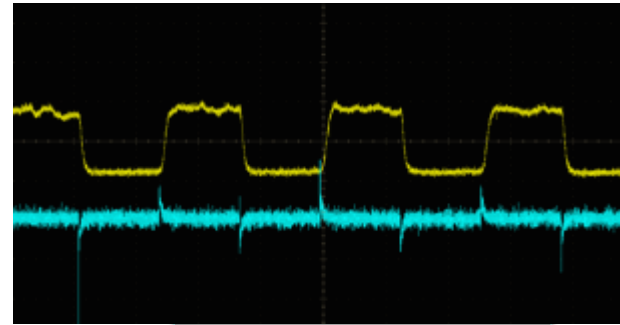
Could also address battery backed data device with Security

Replace card reader



# Magnetic Strip Reading Capabilities

## Application: POS/ATS



## Magnetic Strip Reading Demo Board

# Crocus Prime Focus Chip Security

## NFC and the Travel Experience



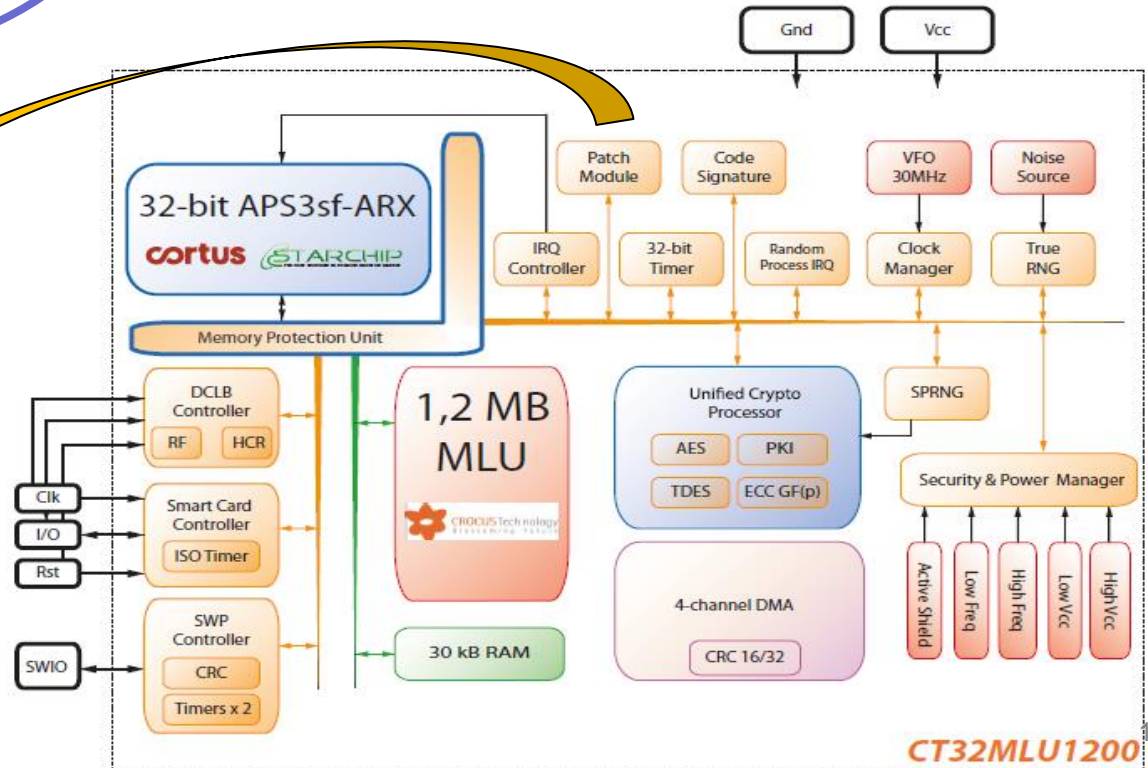
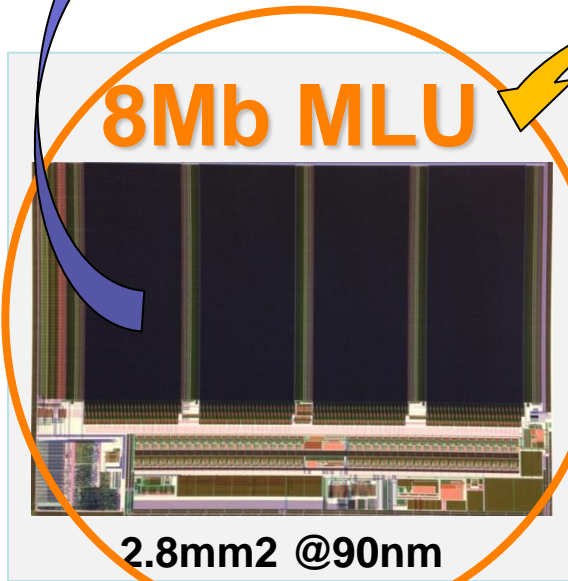
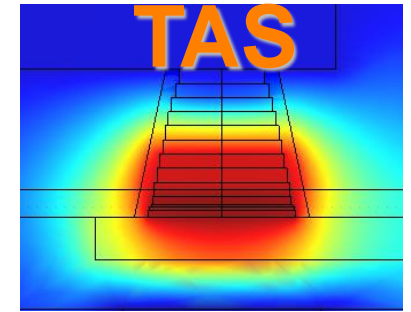
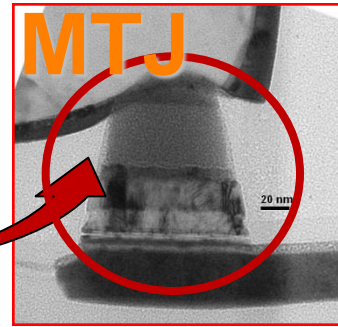
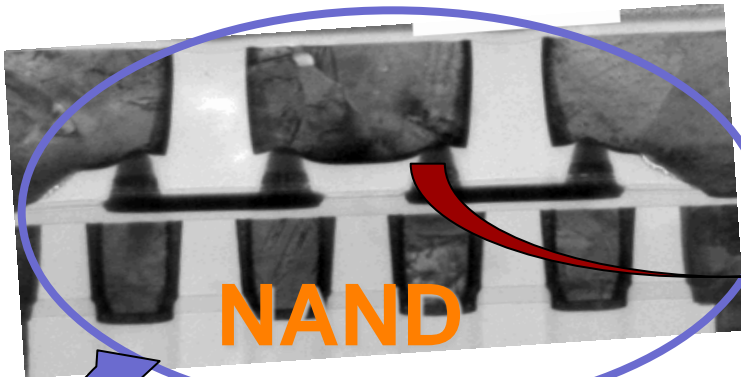
## THE GROWTH OF MOBILE COMMERCE

2016  
**\$31 BILLION**

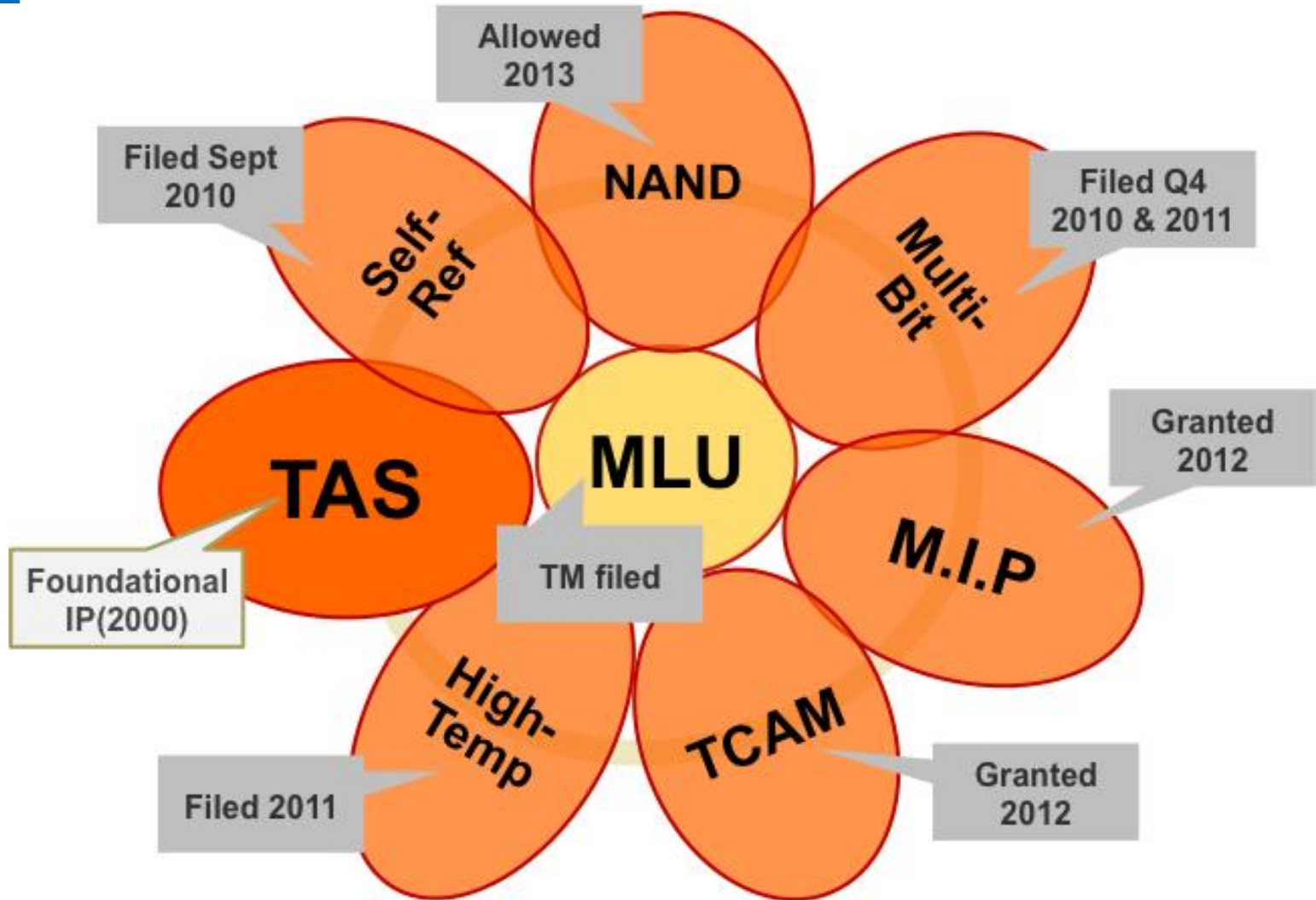
2012  
**\$10 BILLION**

2011  
**\$6 BILLION**

# First smartcard implementation



# Strength of Crocus' IP



# MLU Technology: Value proposition

**Tamper resistant (Security)**  
**High temperature (180° – 240°)**  
**Magnetic sensors**

**Unique  
Features**

**Stability &  
Performance**

**Low power & rugged**  
**Fast read/programming**

**Cost  
Structure**

**Based on basic CMOS**  
**2 additional photo-  
steps**

# Crocus Technology

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