



# Enabling billion unit IoT play using FDSOI

# Global Presence



**Santa Clara, CA**



**Boulder, CO**



**India**



**China**

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# Market Focus

Power Management  
Engine Control  
Drivetrain Control  
Suspension Control  
Display Systems  
Infotainment

## Automotive



## Data Storage

Disk Controller  
SSD Controller  
High-Speed Interfaces  
Firmware



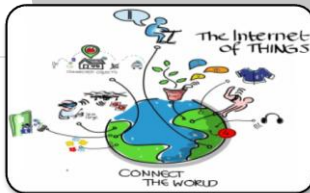
Cell Phones  
Tablets  
Machine to Machine

## Mobile

Synapse  
Product Design  
Experience

## IoT

Wireless Protocols  
3GPP LTE  
RF & Baseband ASICs  
Gateways  
L2/L3 Controller  
Application SW



## Consumer

Smart TV Solutions  
Set Top Box  
DVR



## Networking

Routers and Switches  
Security  
High-Speed Data

**ZERO Respins  
On 35 SOCs**

# 35 Complex SoCs

- ❑ **Turnkey Projects (100% Synapse Design)**
  - ❑ 10 devices
  
- ❑ **Synapse as Primary Design Team (>50% from Synapse Design)**
  - ❑ 14 devices
  
- ❑ **Resource Augmentation**
  - ❑ 11 devices

## Technologies

14nm FinFET, 16nm TSMC, 28FDSOI, 28HPM, 28HPL, 28SLP, 28nm, 40nm, 45nm, 55nm, 130nm

- Speeds up to 2GHz
- Die size > 700 sq. mm
- Gate Counts > 150M

Our highly skilled teams guarantee release time and cost of ownership for SOC derivatives and embedded firmware are among the best in industry

# Synapse FDSOI Experience

- ❑ Executed the first FDSOI project in 2011
- ❑ Worked directly with ST's Central R&D of FDSOI
- ❑ Executed 4 FDSOI projects
- ❑ 50+ Expert FDSOI Design Team
  
- ❑ Successfully utilized and skilled in
  - ❑ Back Biasing (forward FBB)
  - ❑ DVFS (Dynamic Voltage/Frequency Scaling) & VID
  - ❑ ARM Hardening, Power Integrity, IP Design
  
- ❑ Current FDSOI Projects
  - ❑ Full-COT Flow: 1 Project (Architecture to GDS, Extreme LP)
  - ❑ RTL to GDS: 2 Projects

# IoT market size

- 50 billion connected devices by 2020
- Earth population is 7.5 billion and growing
- 6 connected devices per human being

# How to enable Billion units?

- Cost – almost free
- Battery life – multiple year
- Very small footprint - disposable
- Worldwide connectivity

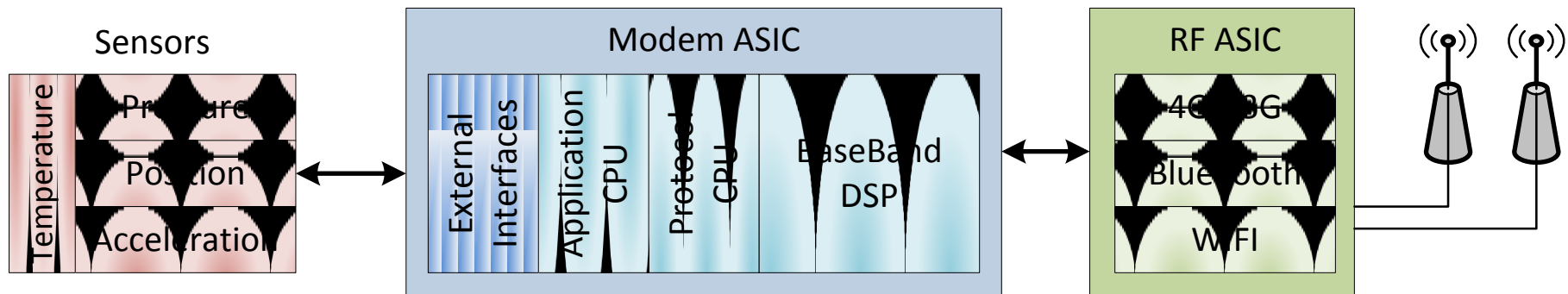
# What do we mean?

- Cost
  - Size and wafer cost – sub \$5 for finished product
- Multi year battery life
  - Average consumption should be less than 100uW
- Form factor
  - Module has to be inconspicuous (compact & lightweight)
- Worldwide
  - LTE is available



# Solution

- Develop a full-LTE chipset dedicated for IoT
  - Smart Architecture
  - Process technology for extreme low power
  - Efficient Software & Firmware
  - LTE compliance



# The requirements

- Extreme low leakage when in standby mode
  - Always ON block with state retention is necessary
- High CPU MIPS needed in active mode
  - LTE Signal Processing and protocol stack demand clocks in excess of 300 MHz
  - Low execution latency needed
  - Reduce dynamic power

# Technology options

- 40nm LP
- 28nm Bulk
- 28FDSOI

# Technology Options

- **Use 40nm LP**
  - Most widely used process
  - Low mask cost
- **BUT**
  - Did not meet performance
  - High dynamic power
  - Vdd range is limited
  - Large die size

# Technology Options

- **Use 28LP Bulk**
  - High Performance
  - Small Die
  - Low Dynamic Power
- **BUT**
  - High standby power
  - Limited low Vdd operation

# Technology Options

- **Use 28FDSOI**

- High Performance
- Small Die
- Low Dynamic Power
- Very Low standby Power
- Wider Vdd range

- **BUT**

- No well known products in market

# Advantages of 28FDSOI

- Standby Power
  - Leakage is very low.
  - Dedicated retention memories, able to retain data at very low V<sub>dd</sub>
  - Even RVT cells are usable down to 0.6/0.7V
  - Able to achieve < 10uW standby power with all AON logic/memories operational

# Advantages of 28FDSOI

- Dynamic power – logic
  - Extremely wide usable V<sub>dd</sub> range
    - 0.6V – 1.1V
    - Allows for wide choice of DVFS scenarios to optimize dynamic power
- Dynamic power - memories
  - Memories with embedded switches allow fine grain power optimization
  - Even dense memories meet the performance with very well controlled leakage



# Advantages of 28FDSOI

- Timing
  - With 40LP couldn't meet timing even with LVT cells in overdrive voltage
  - With 28nm Bulk
    - Meet Timing requirements
    - But did not meet Standby mode power requirements
  - In 28FDSOI, closed timing (without back-bias) at 0.8v without having to use short channel cells
    - In standby mode, we are working at 0.6v and meet standby power requirements

# 28FDSOI

**We believe FDSOI is the sweet spot for battery operated IOT devices**

- Mid Range Performance [Clock Speed 300MHz-700MHz]
- Extremely Low Standby Power
- Low Cost Product

# 22FDSOI

- 30% further power reduction due to technology
- Integrated solution chips will save power
- Even Smaller module size
- Similar cost

# Synapse Team

## □ Expert Team

- **14/16nm FinFET [TSMC/GF/Samsung]**
- **28 CMOS [TSMC/GF/Samsung]**
- **28FDSOI, 14FDSOI**
- **ARM/Core Hardening**

## □ Latest Device Tapeout

- **FinFET 16/14nm: 5 Tapeout [Test Chip]**
- **28nm: 20+ Device, 16+ in Production**
- **40nm: 32+ Device, 24+ in Production**
- **28FDSOI: 4 Tapeouts [Executing 3 New Device]**