

YOUNGHYUN KIM

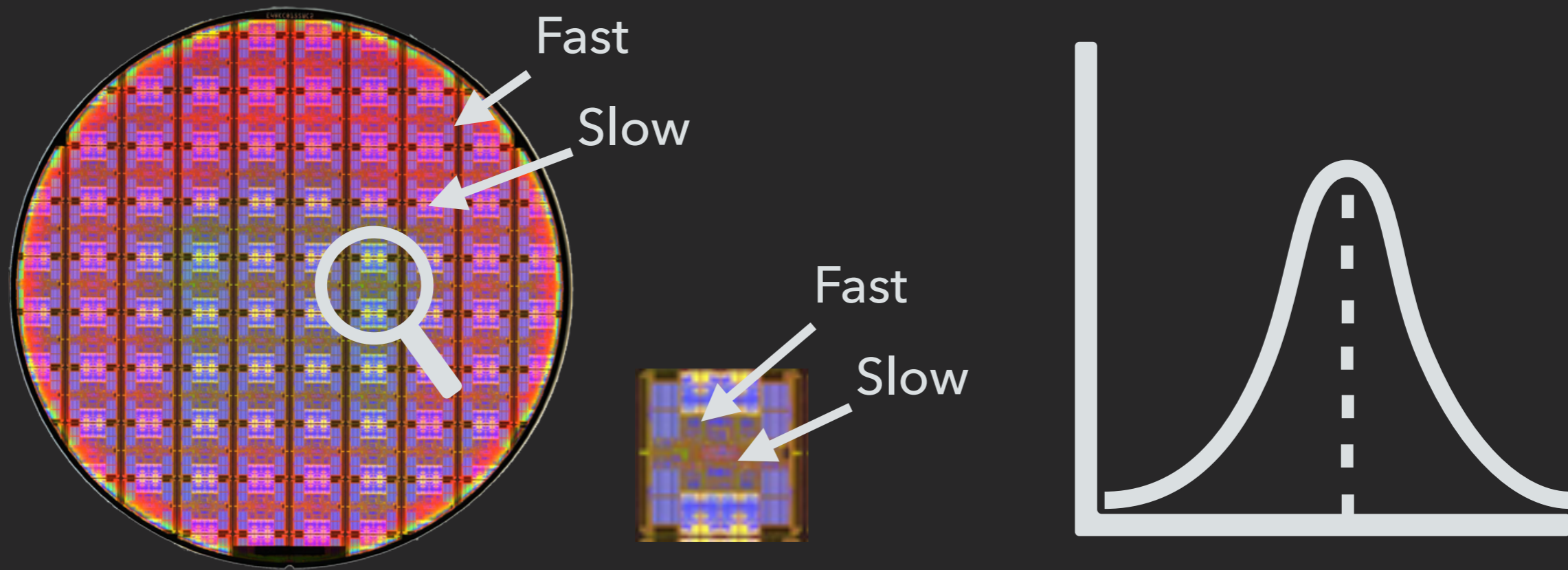
UNIVERSITY OF WISCONSIN–MADISON

MICRO– AND NANO–SENSOR FOR IoT SECURITY

US-KOREA FORUM ON NANOTECHNOLOGY @ NANO KOREA, JULY 13, 2018, ILSAN, KOREA

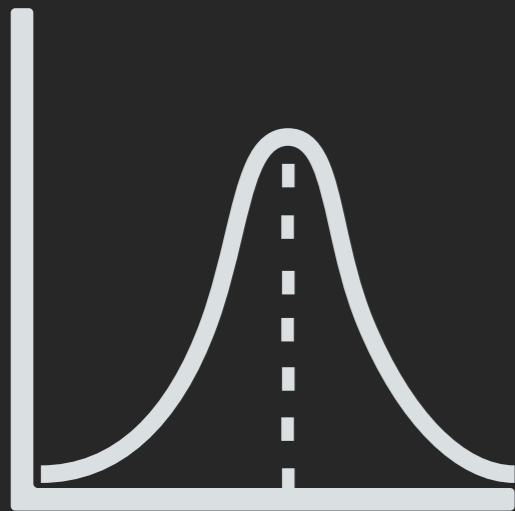
VARIATIONS IN SEMICONDUCTOR MANUFACTURING

2



- ▶ Random variations in semiconductor manufacturing process
 - ▶ Sources: gate oxide thickness, random dopant fluctuations, device geometry
 - ▶ Consequences: variations in performance (speed, sensitivity, etc.)
- ▶ Should be minimized, cannot be eliminated
- ▶ Can we take advantage of it?

PHYSICALLY UNCLONABLE FUNCTIONS (PUF)



Process variation

SRAM

DRAM

RF transmitter

Arbiter chain

Ring oscillator

Unique fingerprint

Reset state

Retention capability

Propagation delay

Phase/magnitude error

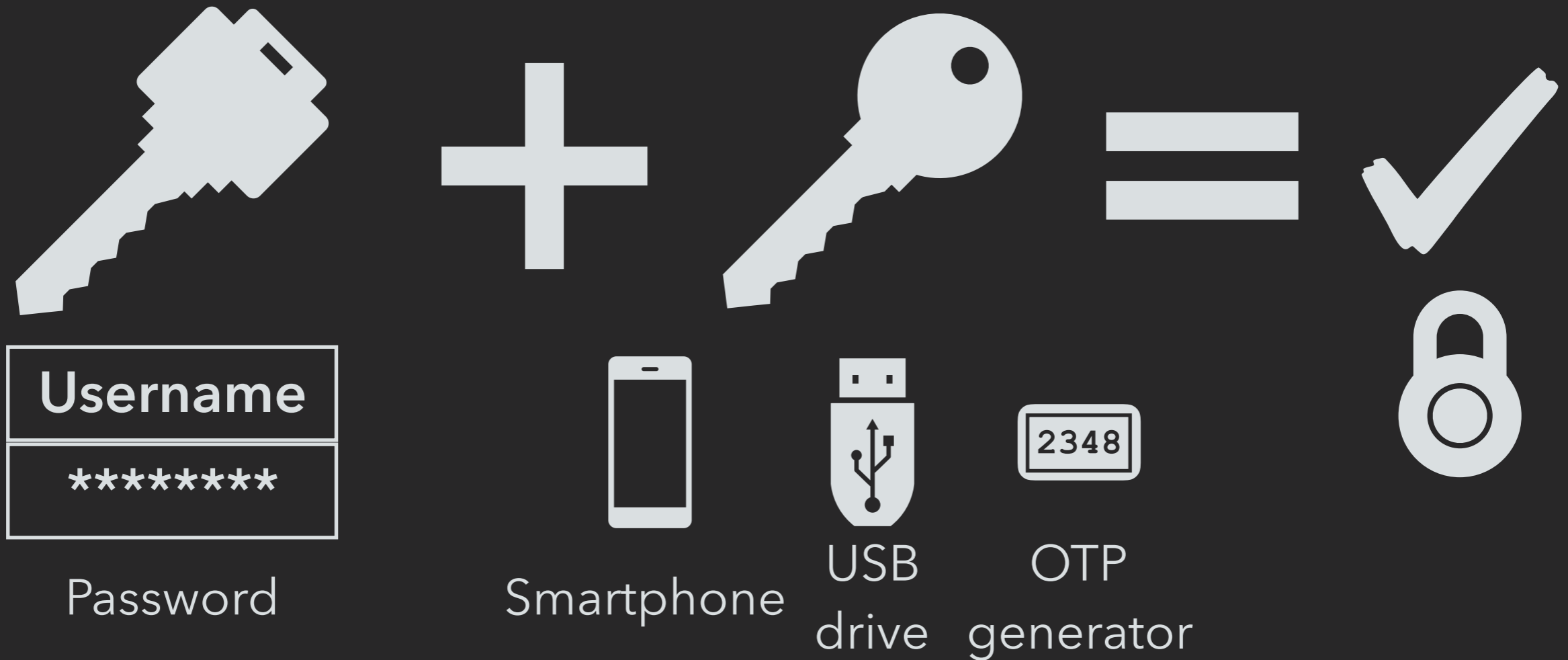
Cell charge leakage

PUF key

Unique random
number

0101101101000...

PUF APPLICATION: TWO-FACTOR AUTHENTICATION

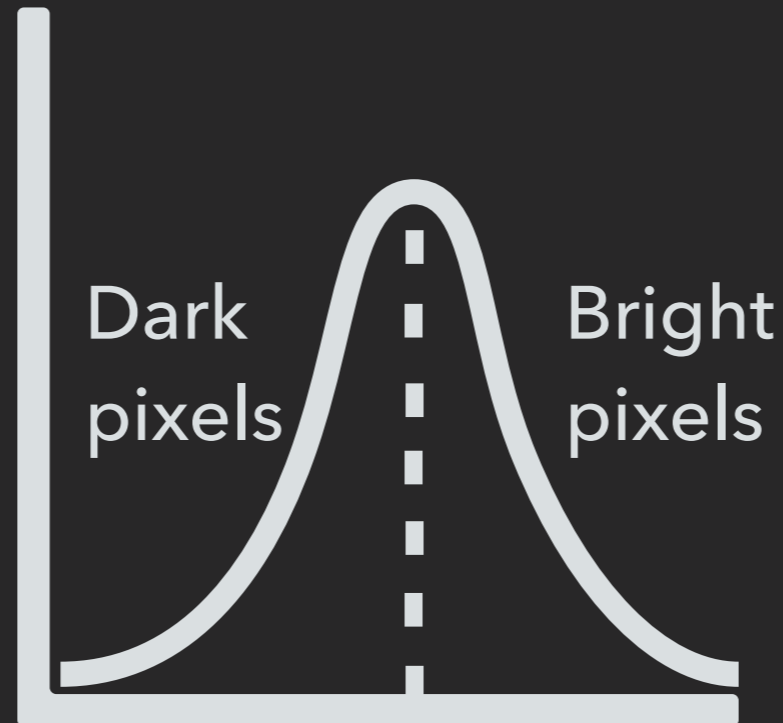
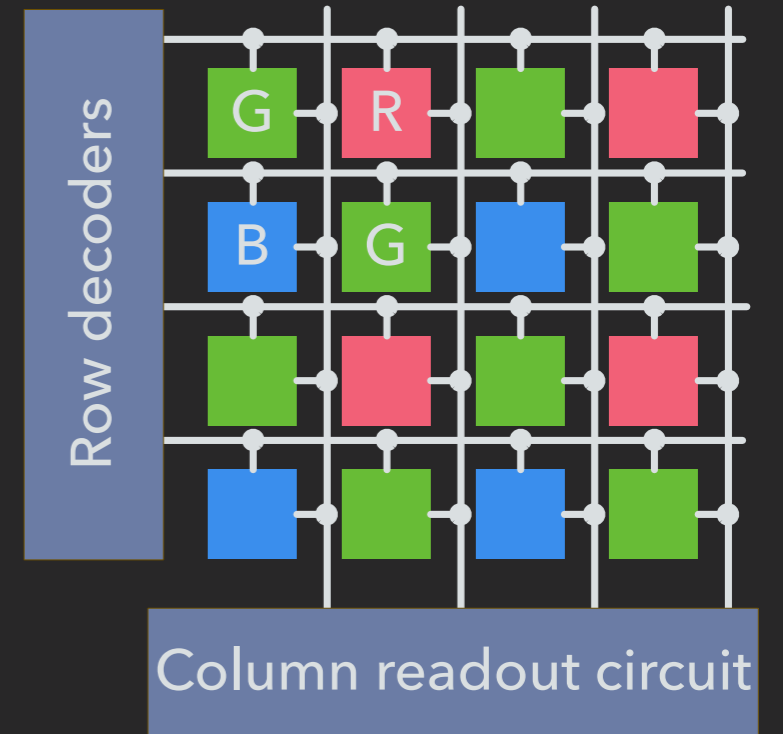
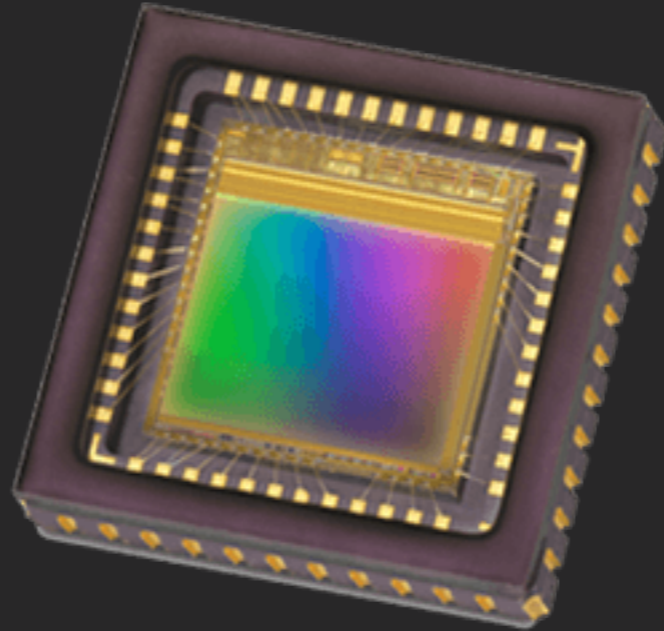
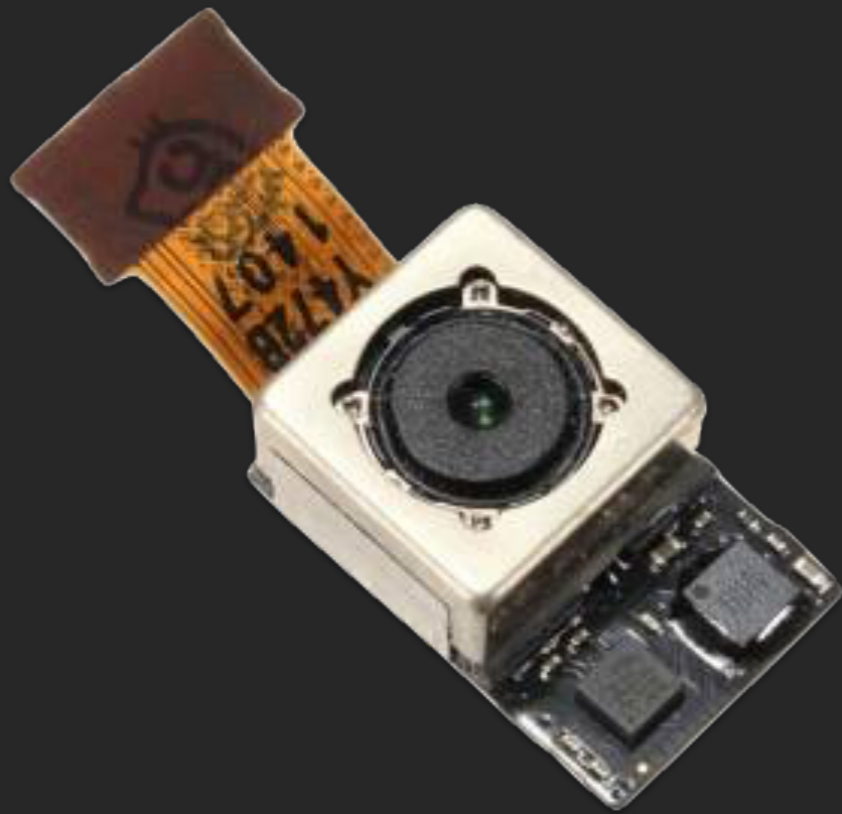


Something you KNOW

Something you HAVE

= PUF device

CMOS IMAGE SENSOR-BASED PUF



CMOS IMAGE SENSOR-BASED PUF

- ▶ **Unique fixed pattern noise (FPN)** appears in the captured images



Same model, different noise patterns

PROTOTYPING AND EVALUATION



Sony IMX377
(12 megapixels)



Google Nexus 5X

- ▶ Camera2 API
- ▶ Raw and jpeg images
- ▶ Temperature-controlled chamber
- ▶ Maximum ISO
- ▶ Minimum shutter speed
- ▶ Additional experimental results on Google Nexus 5 available in the paper

EXPERIMENTAL RESULTS: KEY EXTRACTION

