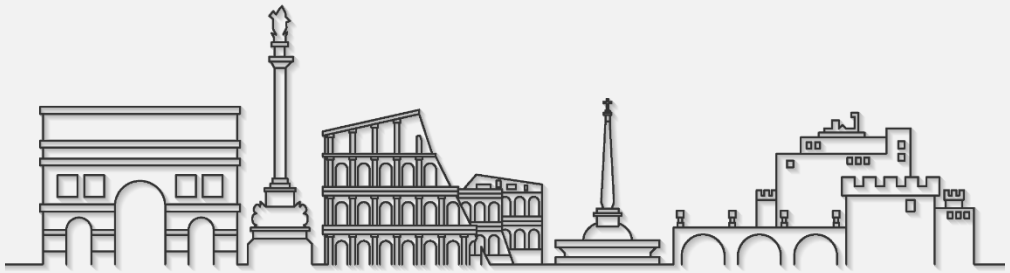

CamPUF: Physically Unclonable Function based on CMOS Image sensor Fixed Pattern Noise

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Contents

01. Introduction

CamPUF

- FPN extract from an image
- Image Sensor PUF based on DSNU
- Derive a unique and stable key

01. Introduction

CamPUF

◆ PRNU

- Photo-Response Non-Uniformity
- Caused by the responsivity variation between pixels
- Be vulnerable to shared images

◆ DSNU

- Dark Signal Non-Uniformity
- be extracted only from dark frames
- Caused by the variations of dark current

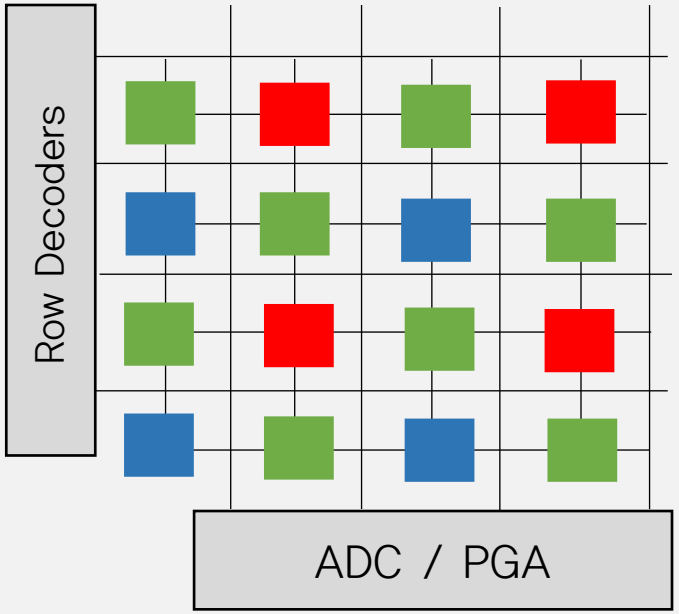
02.Noise in cmos image sensor

Noise source introduce FPN

- Temporal Noise
- Shot Noise, Thermal Noise, etc

CDS(Correlated double sampling)

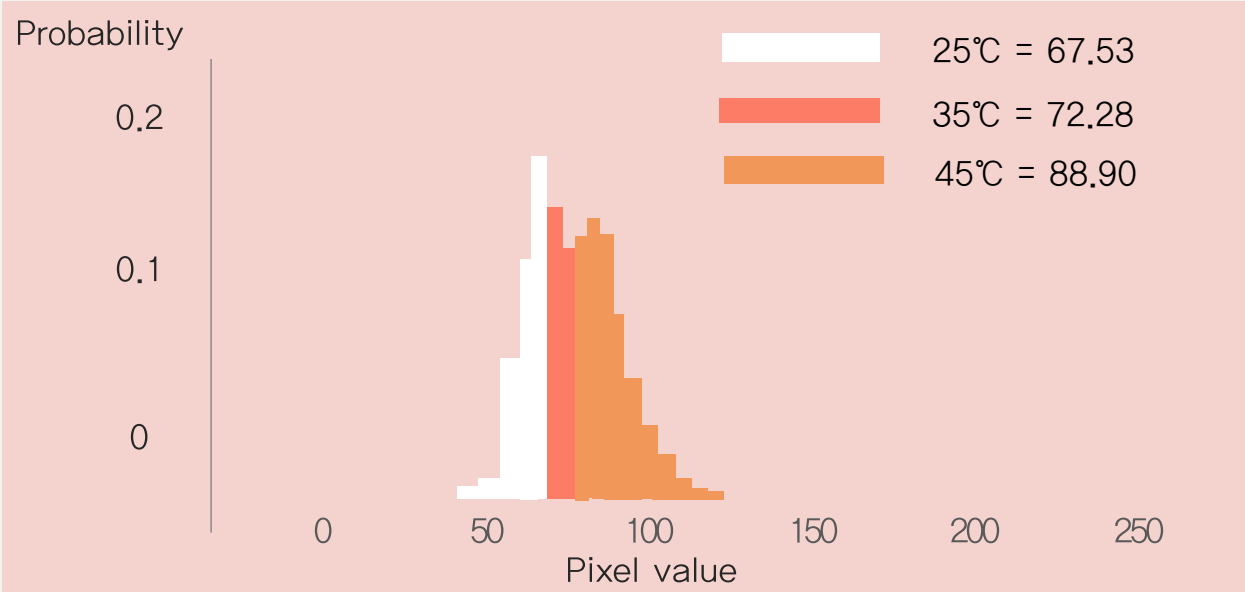
- Removes offset FPN factors
- Does not reduce DSNU



Thermal Noise

- DSNU Increases as temperature increases
- Use Relative value
- Pixel that used to be bright keeps bright

  even if the temperature changes



03.DSNU based PUF design

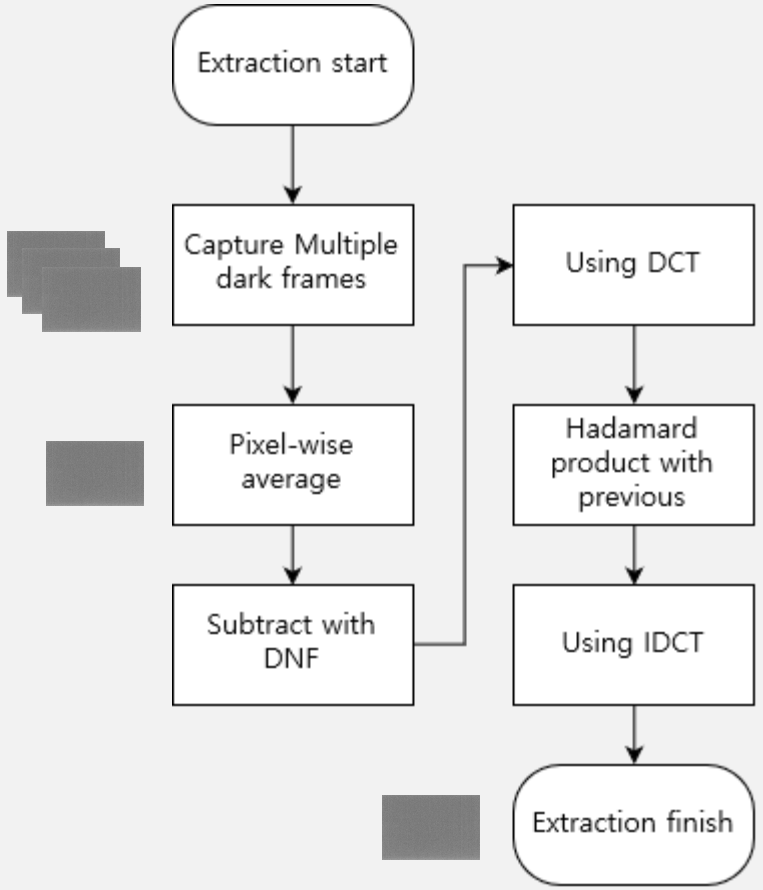
enrollment and Authentication

◆ DSNU fingerprint is extracted from raw dark frames

- Noise Residual n = f – DNF(f)

  (Using Filter e.g. Wiener filter)

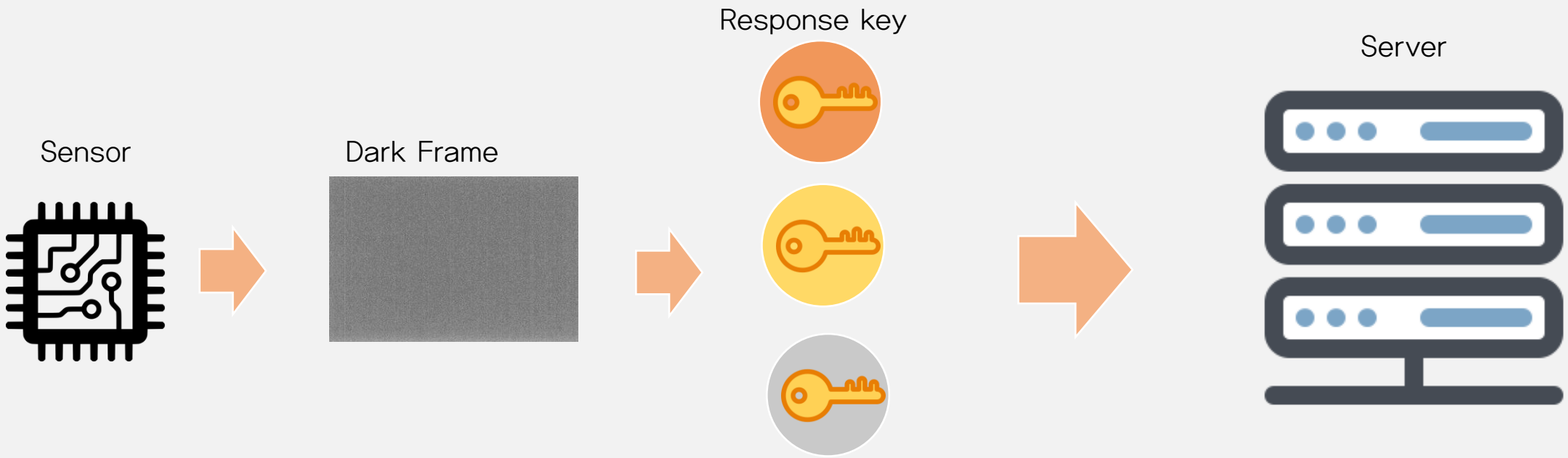
- Extract only high-frequency noise component



03.DSNU based PUF design

Enrollment and Authentication

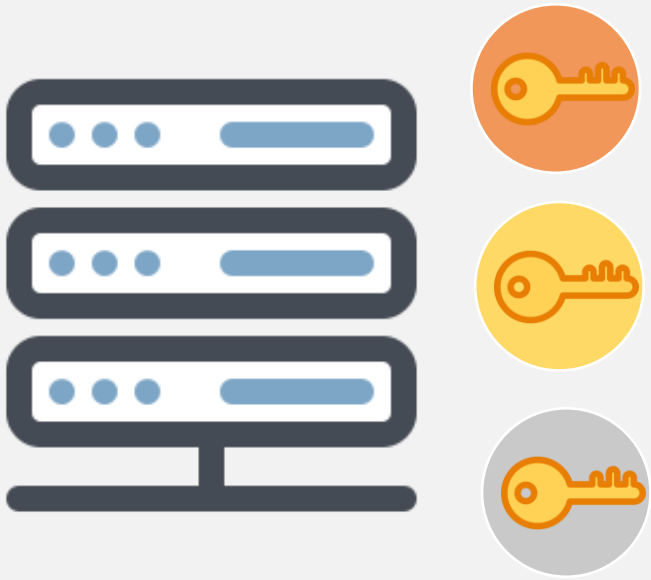
Enrollment



03.DSNU based PUF design

Enrollment and Authentication

Authentication

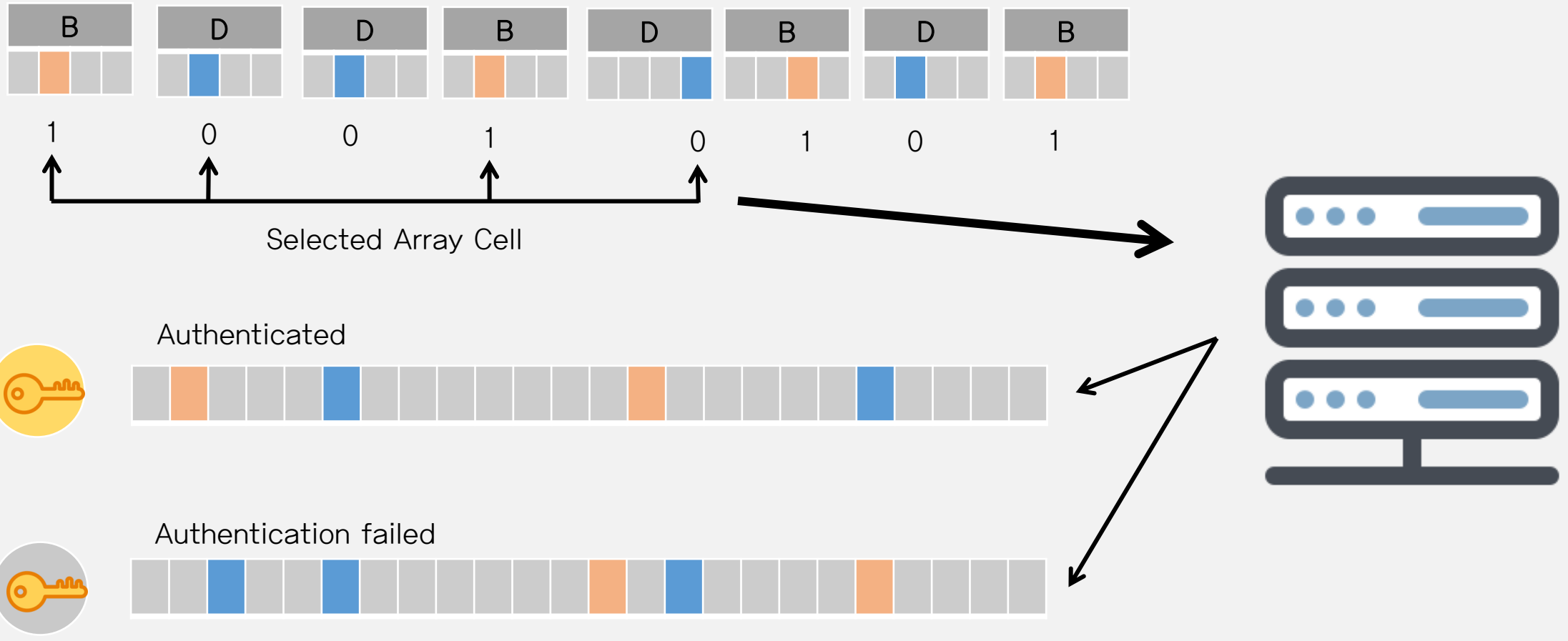


Challenge, Grant/deny

Auth.request / Response

03.DSNU based PUF design

Enrollment and Authentication



03.DSNU based PUF design

Some problem in CamPUF

◆ Sensor Aging and Defect Conpensation

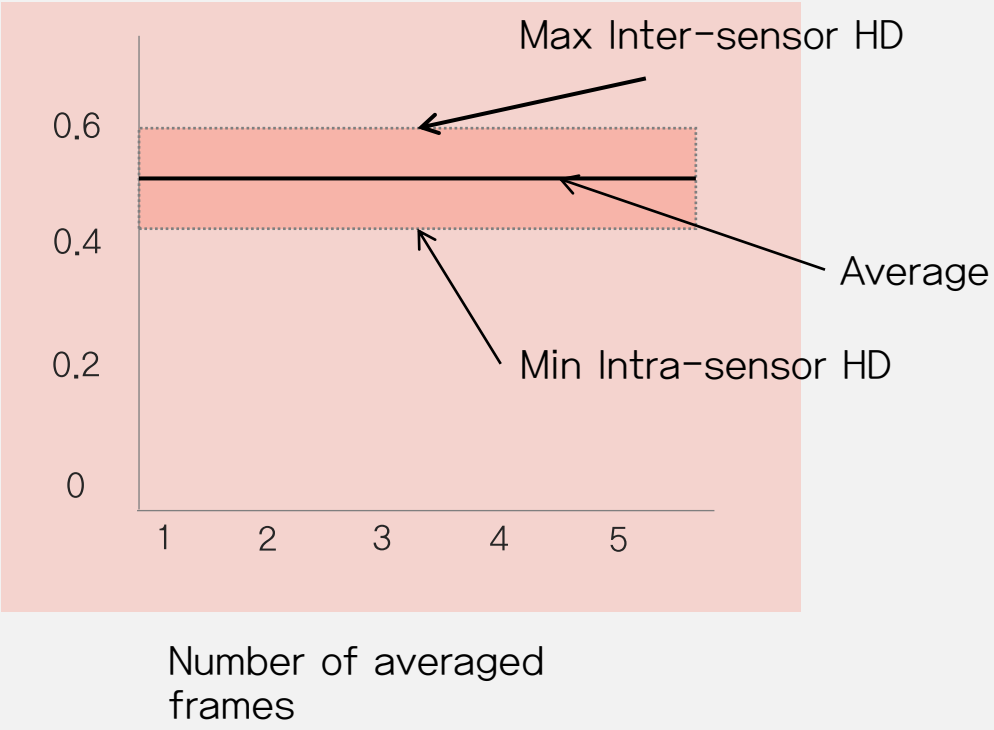
- Select more pixels than necessary
- Re-enrollment will not happen

◆ Multiple Challenge-Resonse Pairs

- Generating a limited number of CRPs
- Focus on single-CRP impremention

Intra and Inter-sensor HDs

- Margin is wide enough
- HD is observed in N1 frame



04. Experimental Validation

Uniqueness and Robustness of Keys

Intra HDs for varying temperatures

- Captured 20 frame at diffenent temperatures

- Rate of HD in different temperatures
  (Lower is better)

- Intra-sensor HDs -

Enrollment \ Authentication	25℃	35℃	45℃
25℃	0.000	0.000	0.000
35℃	0.023	0.002	0.000
45℃	0.062	0.001	0.000

Reference

- CamPUF: Physically Unclonable Function based on CMOS Image Sensor Fixed Pattern Noise

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- Y. Cao et al. 2015. COMS Image Sensor Based Physical Unclonable Function for cogerent Sensor-Level Authentication.

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THANKYOU