TRNG Testchip User Guide & Midterm Requirement

Balance You

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IPR Notice

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- PUF Mode
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4 **Midterm Task**

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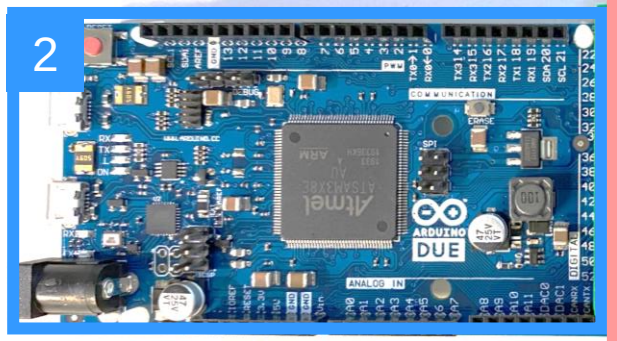
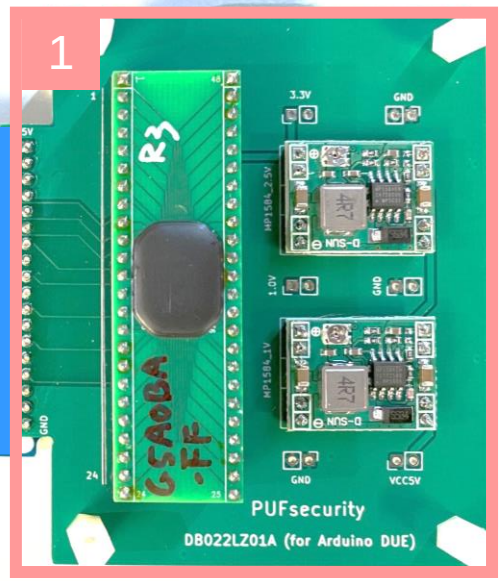
Delivery

1. Testchip & PCB
2. Arduino DUE
3. USB cable
4. Testchip function testing code (compatible with Arduino DUE)





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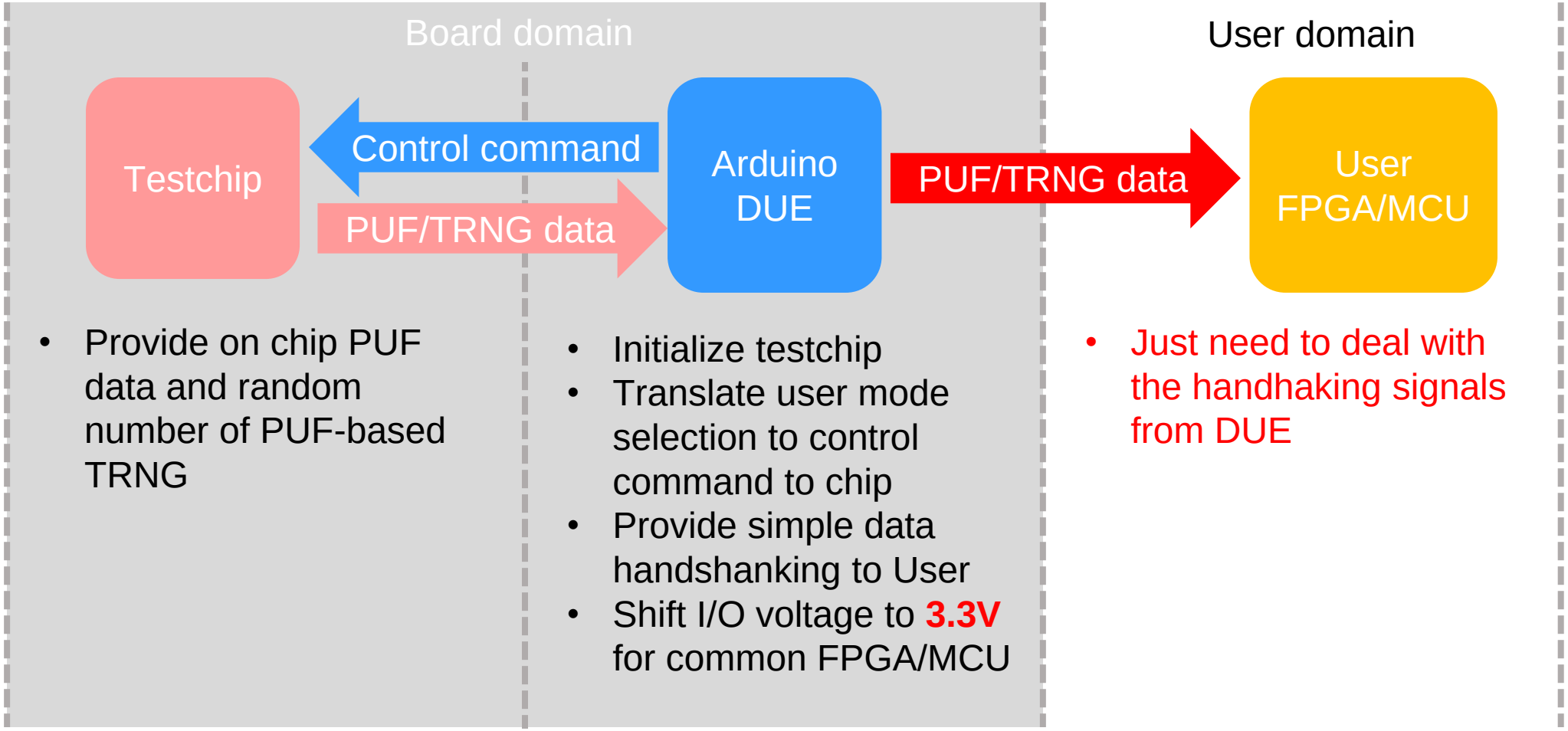
Schematic Diagram



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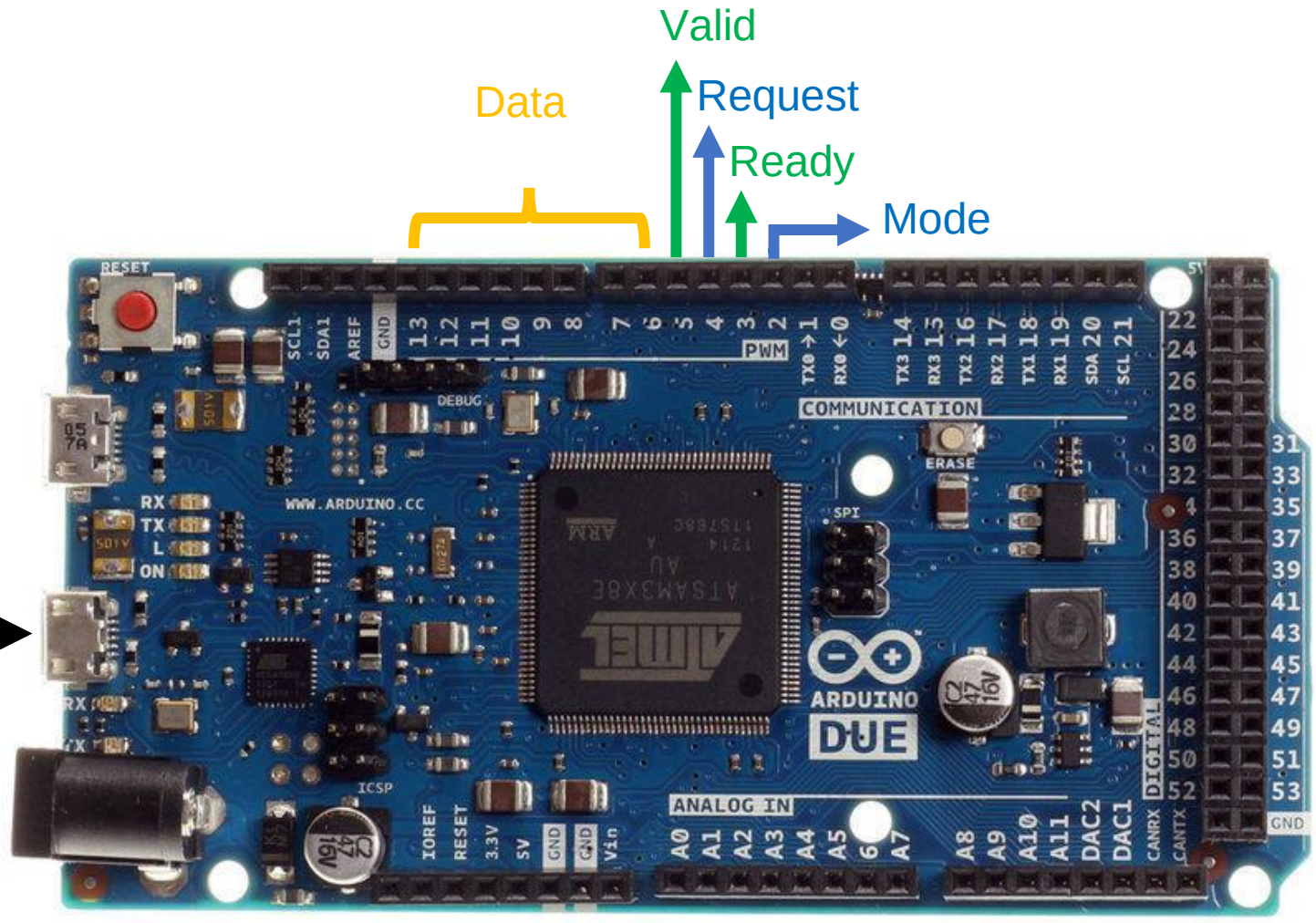
Pin Assignment on DUE



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Pin Assignment on DUE

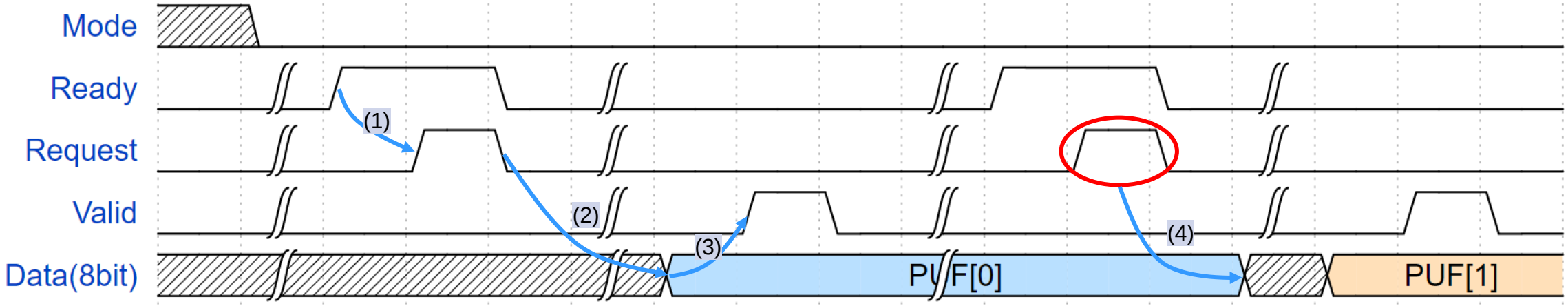
Signal	Direction	Pin @ Arduino DUE	Descriptions
Mode	Input	Digital Pin[2]	Set PUF/TRNG mode
Request		Digital Pin[4]	User request for a random number
Ready	Output	Digital Pin[3]	Whether data* is ready for user to request
Valid		Digital Pin[5]	Whether user can catch a random number on Data pins
Data		Digital Pin[6:13]	8-bit data*

* Data can be either the value of PUF or random number depending on the “Mode” state.

Feature

- Asynchronous data transfer
- Two mode for user to select
  - Set “Mode” pin to LOW: PUF output mode
  - Set “Mode” pin to HIGH: TRNG output mode
  - User can change mode without DUE reset
- 4096 bits PUF data
  - Output byte-by-byte with 512 times handshaking
- PUF-based true random number generator (TRNG)

PUF Mode Signal & Waveform



- Mode pin set LOW
- After 512 times handshaking, the next output PUF data will return to PUF[0] again.

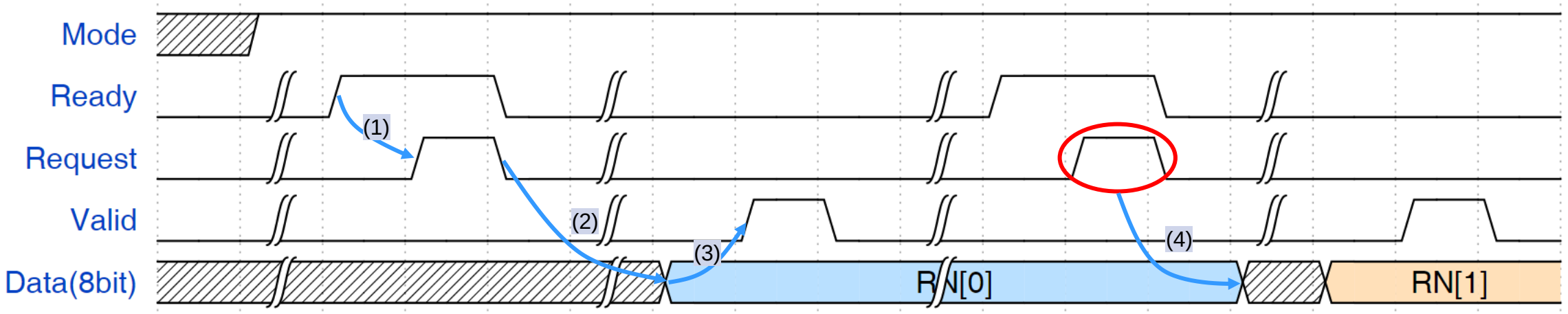
(1) When “Ready” goes HIGH, user can send a “Request” pulse with minimum pulse width 12ns.

(2) When DUE gets “Request”, it starts to set 8 bits PUF value at “Data” pins.

(3) When “Data” pins are ready, DUE generates a pulse with 1 us at “Valid” pin for user detection.

(4) “Data” pins keeps last PUF value until DUE gets next “Request”.

TRNG Mode Signal & Waveform



- Mode pin set HIGH

(1) When “Ready” goes HIGH, user can send a “Request” pulse with minimum pulse width 12ns.

(2) When DUE gets “Request”, it starts to set 8 bits random number at “Data” pins.

(3) When “Data” pins are ready, DUE generates a pulse with 1 us at “Valid” pin for user detection.

(4) “Data” pins keeps last random number value until DUE gets next “Request”.

Midterm task

At least

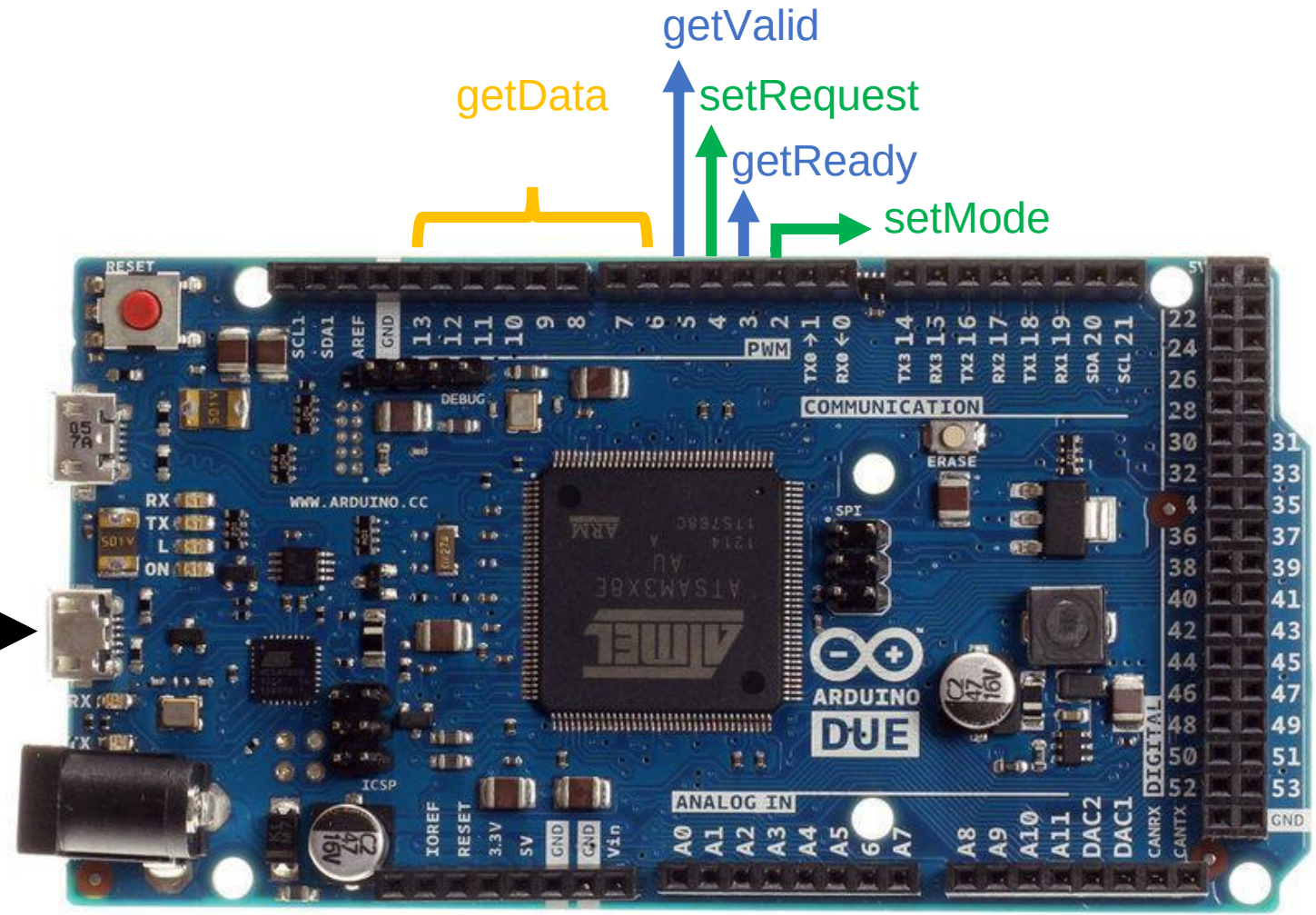
- Write an Arduino program for reading PUF data from the testchip
- Write an Arduino program for reading TRNG data from the testchip
- Write an Arduino program for using 128 bits PUF as the key to encrypt a 128-bit plaintext using AES algorithm

Bonus

- Design two types of S-box, 1) look-up-table based, 2) arithmetic on finite field based
- Compare with the processing time on different types

Proposed Pin Set on Your DUE

Your DUE



USB cable (Program with testing code)

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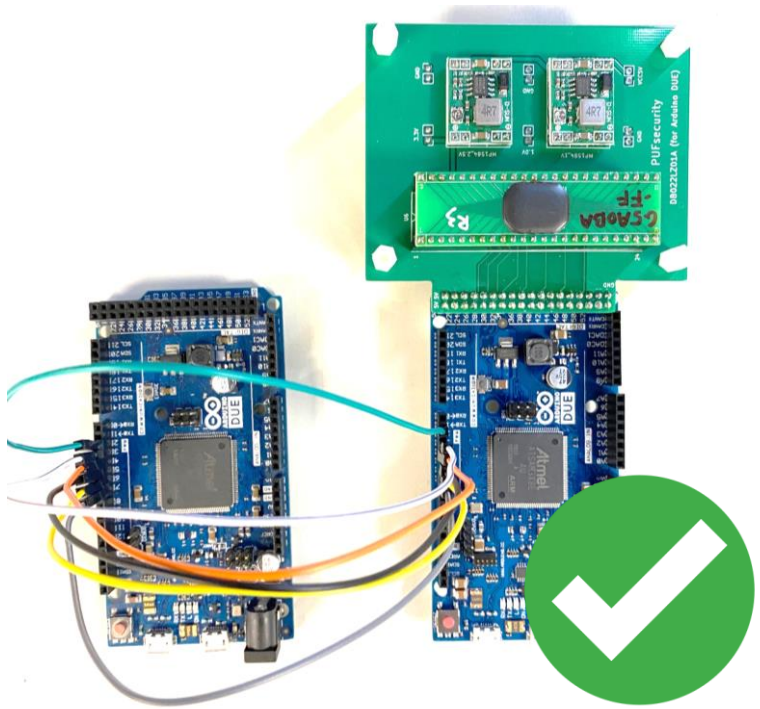
Corresponding Pin Definition in Arduino Code

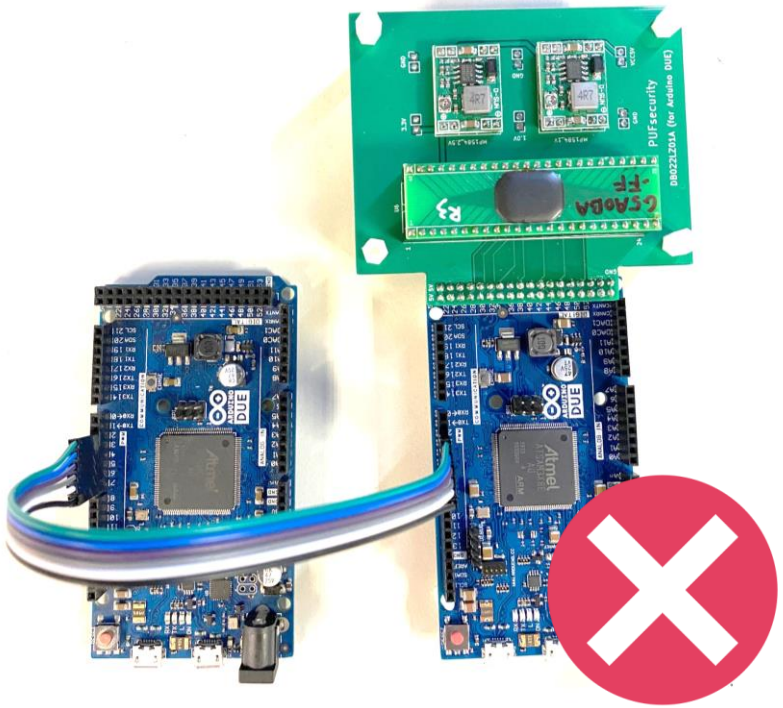
**Warning: Never program any file to the testchip DUE

```
/*** data handshake pins ***/
const byte modePin = 2; //attach to mode pin
const byte requestPin = 4;  //attach to request pin
const byte getReadyPin = 3; //attach to Ready pin
const byte getInterruptPin  = 5; // attach to valid pin
const byte dataPin[8] = {6, 7, 8, 9, 10, 11, 12, 13}; //attach to data pin
```

Note of Pin connection between Two DUEs

- Valid, Ready, Request, Mode signals are **sensitive**, please have those jump wires separated when connecting





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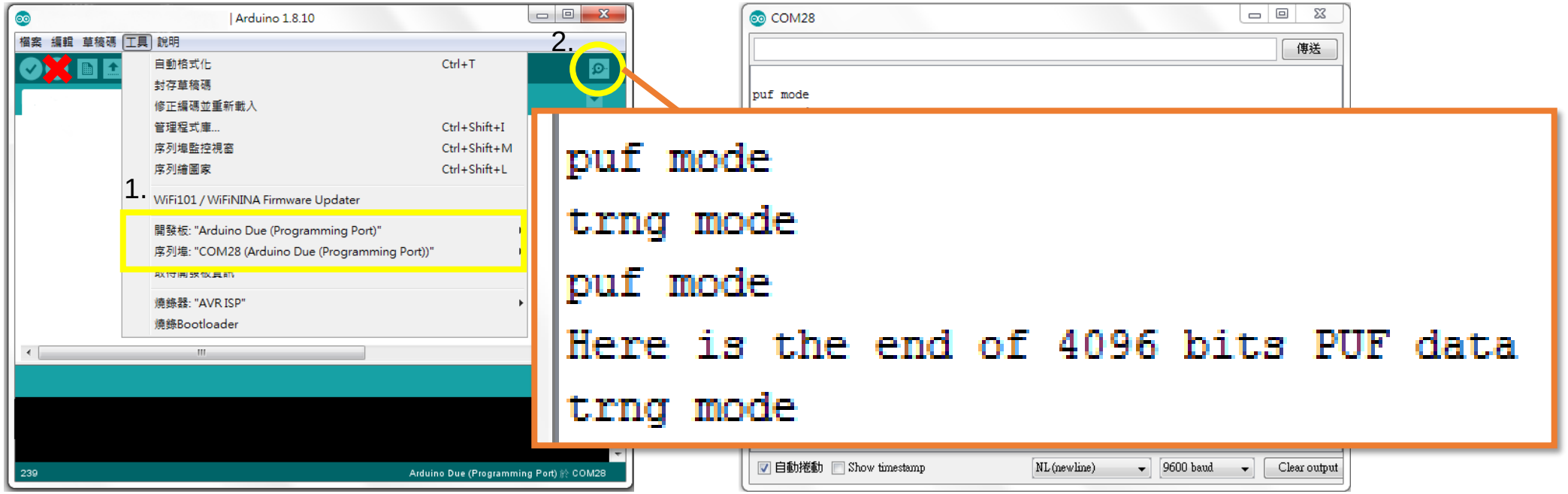
Status of Testchip DUE

- It shows the following information by opening a serial monitor which is connected to the port of testchip DUE
  - Current mode you set
  - Whether you finish the PUF data reading or not(PUF mode only)



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THANK YOU

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