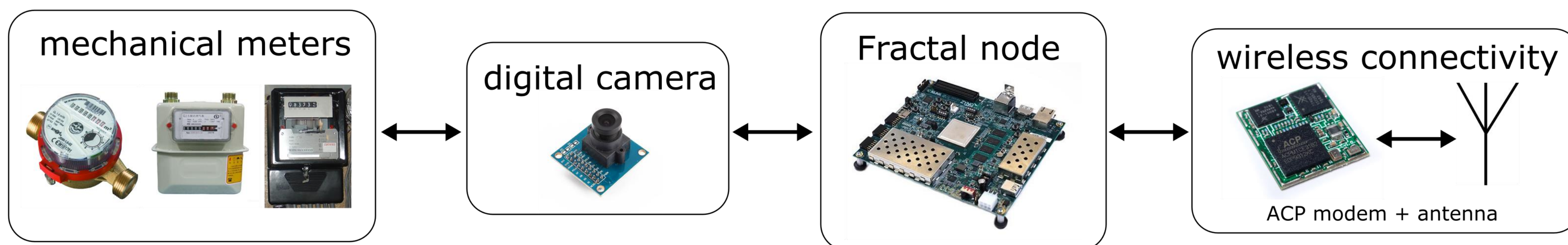


UC Description

UC3 targets to develop a **secure, low-cost** alternative to classical smart meters. The system consists of a camera, the fractal node, and a modem for **wireless connectivity**. The system shall be **battery-powered**, cheap and small such that it can be directly tagged on existing mechanical meters without the need for extra electrification or connectivity.



Main Objectives	Reasoning	Addressed in
Low power consumption	The target system is battery powered and needs a very low standby current and a low active power consumption	WP4_T41-03, UC3_07, UC3_08
Security	User data must be stored encrypted. Firmware must be verified to ensure the device has not been manipulated	UC3_03, UC3_04, UC3_05
Wireless connectivity	The device must be able to connect to the cloud under difficult circumstances, e.g., in basements	UC3_06
Low Price / Small form factor	Merging modem functionality with Fractal node allows to save resources, decrease form factor and price	UC3_01, UC3_02
Feature extraction	The relevant information for the utility provider is extracted from an image	WP3_T32-02, WP3_T32-04, WP3_T32-05

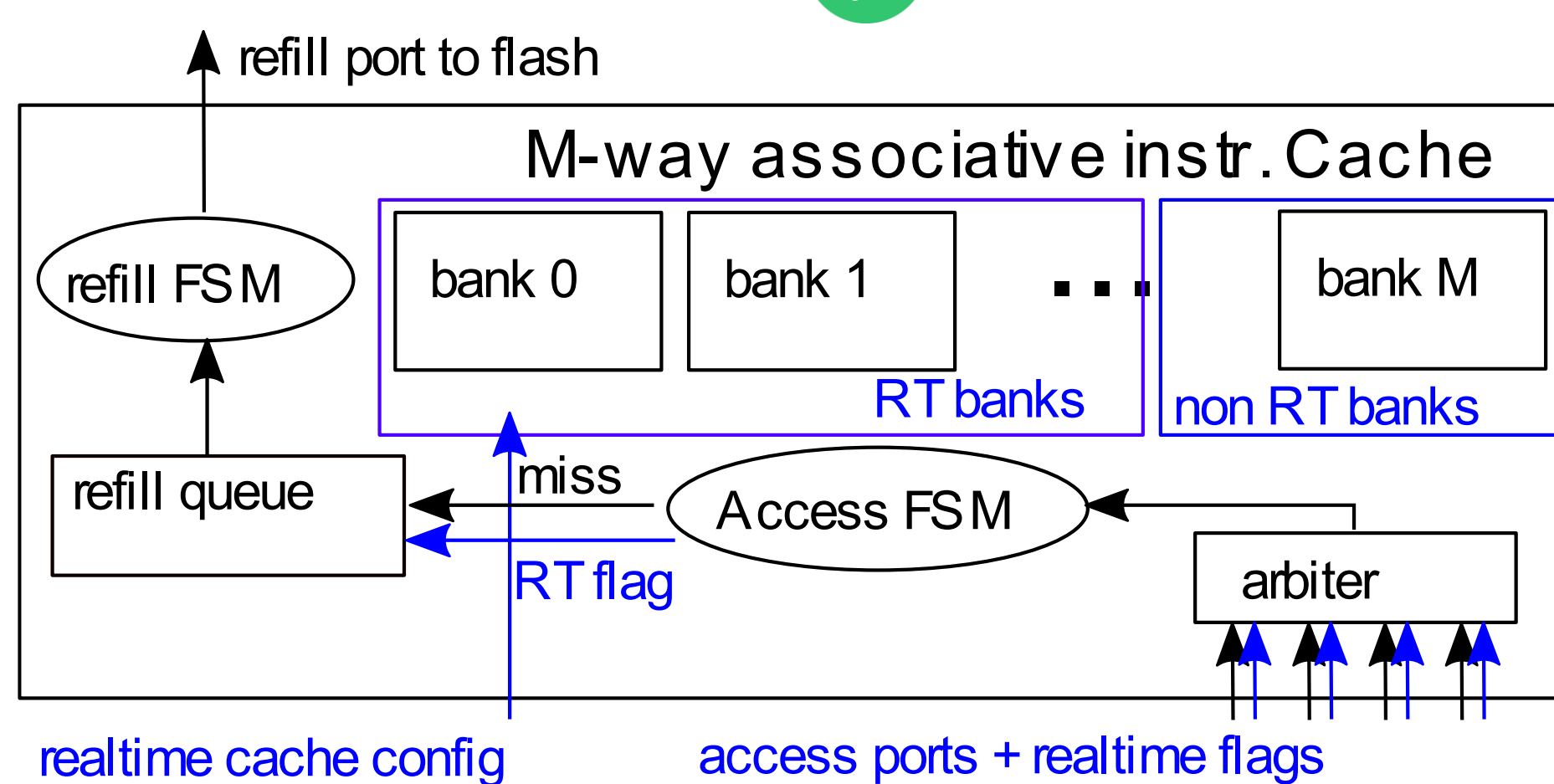
FRACTAL Components

- WP3-T32-02 Pulpissimo platform
- WP3_T32-04 FreeRTOS on PULP
- WP3_T32-05 ML inference demo
- WP4_T41-03 Low Power Services

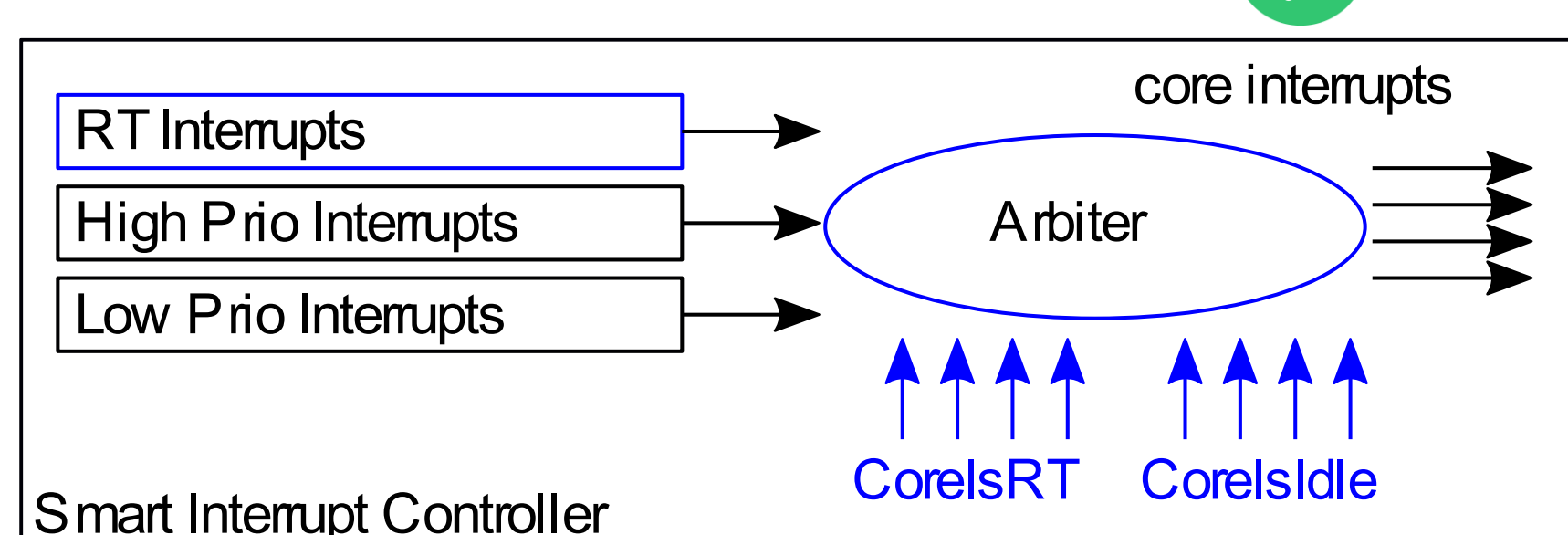
UC Components

Area reduction through merge of NB-IoT modem with Fractal node: Additional hardware modules to run real-time critical threads + user application on the same system:

- UC3_01 Real-time aware caches:



- UC3_02 Smart interrupt distribution system:



KPIs

	Technical KPIs	quantitative criteria
Security	Secure boot time	< 1s
	AES256 encryption/decryption	16 kB block: < 100ms 4 MB firmware < 1m
Low Power	Deep sleep current consumption	< 10 uA
	Battery lifetime with a 2200mAh	> 5 years
Wireless connectivity	Possibility to exchange data using NB-IoT	-10 dB SNR

Security through OpenTitan [1] integration:

- UC3_03 Security services – Secure Boot



Action	Cycles	ms @ 100 MHz
Hashing 10.4 KiB app image	117406	1.17
Hashing 4 MiB benchmark	45616207	456.16
Verify 3072 bit RSA signature with CPU	16472957	164.73
Verify 3072 bit RSA signature with OTBN	1007579	10.08
Verify 64 byte ECDSA-256 signature with OTBN	476576	4.77

- UC3_04 Security services – Encryption / decryption
- UC3_05 Security services – tl2axi adapter

Wireless Connectivity:

- UC3_06 NB-IoT connection from Pulpissimo through NB-IoT modem

Low Power consumption:

- UC3_07 power domains + leakage optimizations
- UC3_08 coarse + fine grained clock gating



	Business KPIs	quantitative criteria
Price / area	Merging modem + fractal node allows to significantly reduce the overall size of the system	> 20% area reduction

EU2020 Horizon



Project N.877056



[1] <https://opentitan.org>