STR22 - STM32WBA (BLE 5.4)

This course describe the STM32 WBA (BLE 5.4)) architecture and practical examples

Objectives

- Understand STM32WBA SoC (Cortex-M33 + single-core BLE stack).
- Bring up CubeWBA projects and verify the BLE stack.
- Build GAP/GATT apps (services, security, notifications).
- Use BLE 5.x features: Extended/Periodic Advertising, Coded PHY, BLE 5.4 (PAwR, EAD).
- Optimize throughput, latency, and low-power with RF active.
- Prepare OTA/DFU, NVM/bonding, keys, and a production checklist.

Course Environment

- Theoretical course
  - PDF course material (in English) supplemented by a printed version for face-to-face courses.
  - Online courses are dispensed using the Teams video-conferencing system.
  - The trainer answers trainees' questions during the training and provide technical and pedagogical assistance.
- Practical activities
  - Practical activities represent from 40% to 50% of course duration.
  - Code examples, exercises and solutions
  - For remote trainings:
    - One Online Linux PC per trainee for the practical activities.
    - The trainer has access to trainees' Online PCs for technical and pedagogical assistance.
    - QEMU Emulated board or physical board connected to the online PC (depending on the course).
    - Some Labs may be completed between sessions and are checked by the trainer on the next session.
  - For face-to-face trainings:
    - One PC (Linux ou Windows) for the practical activities with, if appropriate, a target board.
    - One PC for two trainees when there are more than 6 trainees.
  - For onsite trainings:
    - An installation and test manual is provided to allow preinstallation of the needed software.
    - The trainer come with target boards if needed during the practical activities (and bring them back at the end of the course).
- Downloadable preconfigured virtual machine for post-course practical activities
- At the start of each session the trainer will interact with the trainees to ensure the course fits their expectations and correct if needed

Target Audience

- Any embedded systems engineer or technician with the above prerequisites.

Evaluation modalities

- The prerequisites indicated above are assessed before the training by the technical supervision of the traineein his company, or by the trainee himself in the exceptional case of an individual trainee.
- Trainee progress is assessed in two different ways, depending on the course:
  - For courses lending themselves to practical exercises, the results of the exercises are checked by the trainer while, if necessary, helping trainees to carry them out by providing additional details.

- Quizzes are offered at the end of sections that do not include practical exercises to verifythat the trainees have assimilated the points presented
- At the end of the training, each trainee receives a certificate attesting that they have successfully completed the course.
  - In the event of a problem, discovered during the course, due to a lack of prerequisites by the trainee a different or additional training is offered to them, generally to reinforce their prerequisites,in agreement with their company manager if applicable.

Plan

Day 1

SoC & wireless overview

- Cortex-M33 core (app + BLE stack in single core).
- Memory map & RF shares.
- Radio supply (SMPS/LDO).
- TX power path & limits.
- Board RF layout notes.

Exercise: *Stack/version check*

Project bring-up (CubeWBA)

- CubeWBA package layout.
- MX config for clocks/GPIO.
- Minimal BLE app skeleton.
- Assert/log policy.
- Build & debug checklist.

Exercise: *App skeleton*

Clocking & RF setup

- HSE/LSE choices.
- PLL to SYSCLK.
- RF timing sources.
- CCIPR selectors.
- MCO for validation.

Exercise: *MCO verify*

BLE GAP basics

- Roles: peripheral/central.
- Advertising parameters.
- Scan & connect flow.
- PHY select (1M/2M/Coded).
- Conn params update.

Exercise: *Peripheral advert*

GATT basics

- Services & characteristics.
- UUIDs (16/128-bit).
- Properties & CCCD.
- MTU exchange.
- Read/write ops.

Exercise: *Custom service*

Security & privacy

- Pairing/bonding (LESC).

- Passkey/Numeric Compare.
- Re-pair vs re-use bonds.
- Privacy (RPA) basics.
- Key store/NVM notes.

Exercise: *Bond & resume*

Day 2

Notifications & throughput

- Notify vs indicate.
- ATT_MTU & data length.
- App buffering strategy.
- Connection interval impact.
- Error/retry counters.

Exercise: *Notify meter*

Extended & Periodic Advertising

- Extended ADV sets.
- PHY/Tx power per set.
- Periodic ADV (PA sync).
- Sync loss handling.
- App timing notes.

Exercise: *Periodic scan*

BLE 5.4 features (focus)

- PAwR concept & roles.
- Subevents & responses.
- EAD (encrypted ADV).
- Scheduling constraints.
- Practical use cases.

Exercise: *PAwR demo*

PHY & range options

- 1M vs 2M trade-offs.
- Coded PHY (S=2/S=8).
- TX power steps.
- RSSI/SNR hints.
- Basic link budget.

Exercise: *Coded PHY walk*

Central role (scanner/client)

- Filtered scanning.
- Auto-connect policy.
- GATT discovery.
- Client reads/writes.
- Multi-link basics.

Exercise: *Simple central*

Day 3

Power profiles with RF

- Idle vs advertising vs connected.

- Conn interval/latency effects.
- PHY & Tx power impact.
- Sleep policies & wake.
- Measurement method.

Exercise: *Power sweep*

OTA/DFU workflow

- App OTA over BLE.
- Image slots & versioning.
- Rollback basics.
- Failure recovery plan.
- Minimal release notes.

Exercise: *OTA update*

NVM & keys

- Bond/key storage.
- Privacy data handling.
- App params in Flash.
- Wear considerations.
- Backup/erase policy.

Exercise: *Persist check*

RF & production notes

- Antenna keep-outs.
- Match network hints.
- Crystal accuracy.
- Tx power/regulatory.
- Coexistence basics.

Exercise: *RSSI sweep*

Robustness checklist (wrap-up)

- Stack version fixed.
- BD_ADDR policy set.
- Error counters logged.
- Low-power numbers saved.
- Version/CRC tags added.

Exercise: *Self-audit sheet*

Renseignements pratiques

Inquiry : 3 days