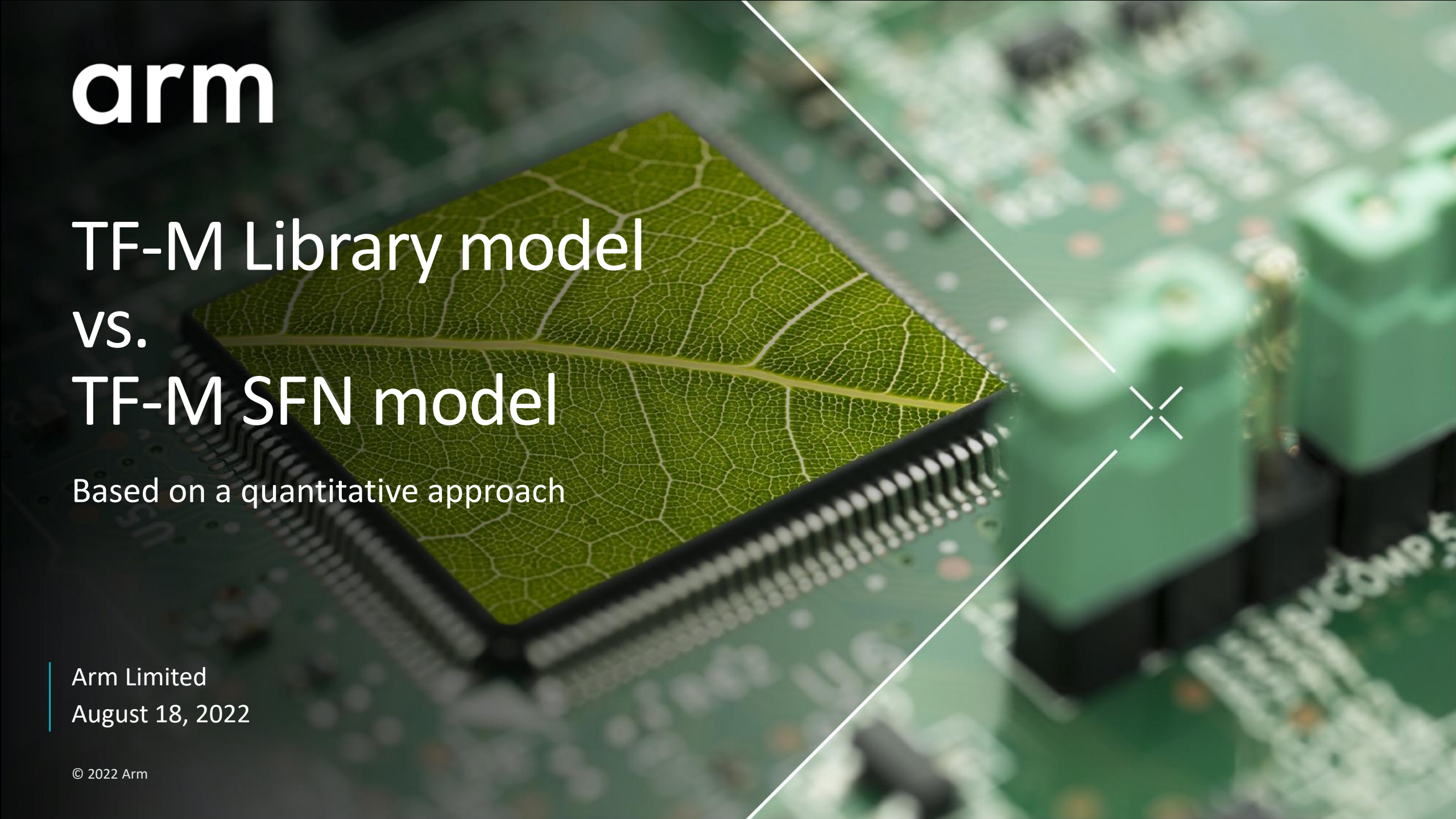


TF-M Library model vs. TF-M SFN model

Based on a quantitative approach

Arm Limited

August 18, 2022

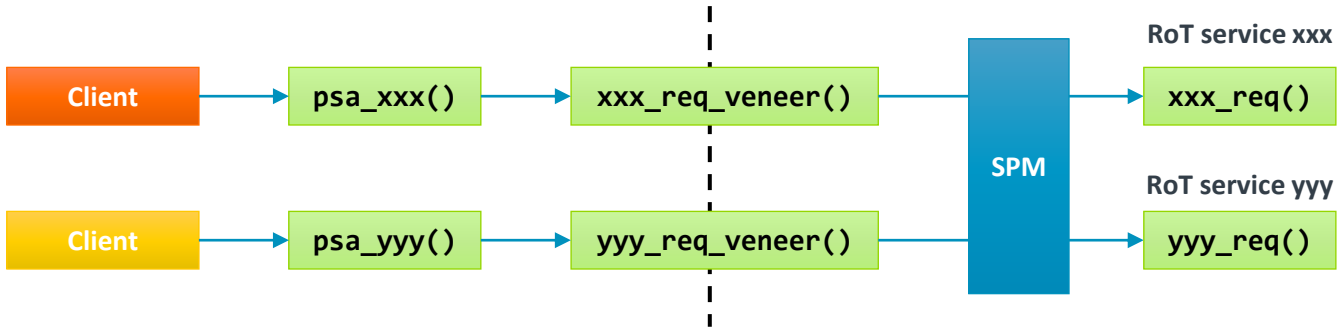
Purpose

- Compare TF-M Library model and SFN model implementation *based on some quantitative data*
  - Memory footprint
  - Performance
  - Development/management effort

- Implementation details/functionalities are not the focus
  - Refer to FF-M 1.1 extension Appendix C for detailed analysis on these existing frameworks

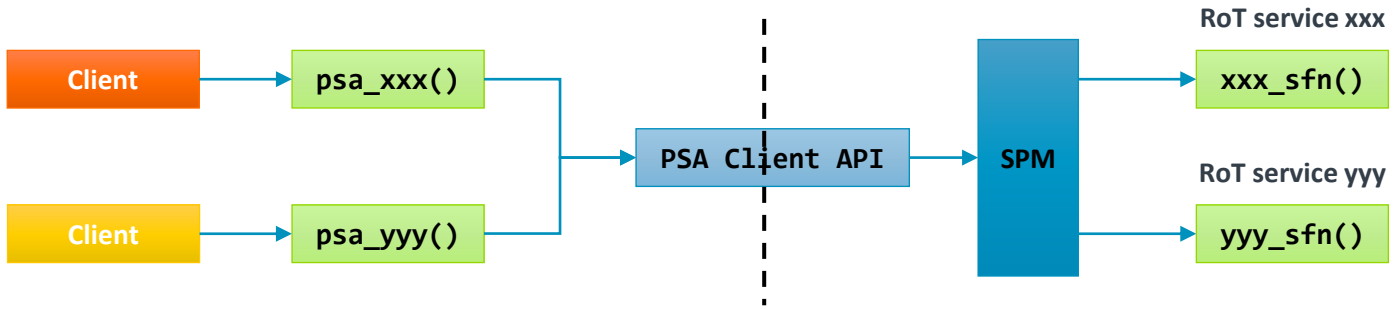
TF-M Library model

- A TF-M specific lightweight framework implementation
  - Secure Processing Environment (SPE) as a *secure library*
    - Based around a set of secure service functions
    - Those functions run as callbacks from Secure Partition Manager (SPM)
    - Each secure service function exports its corresponding veneer function
  - Use cases
    - Isolation level 1
    - Highly resource-constrained devices
    - Single Armv8-M TrustZone scenario



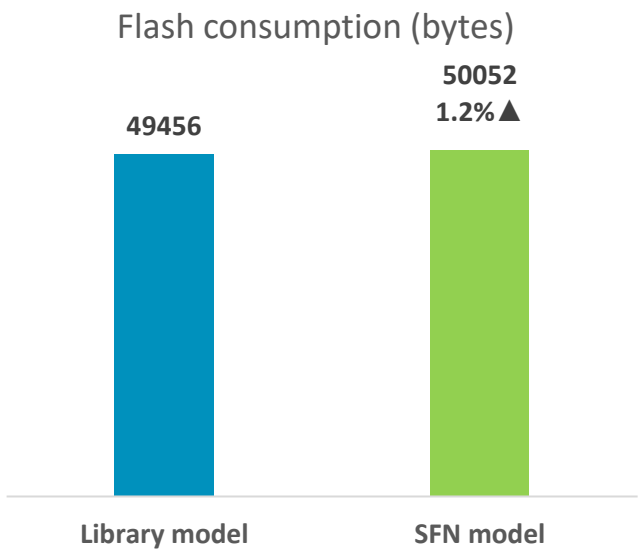
Secure Function (SFN) Model

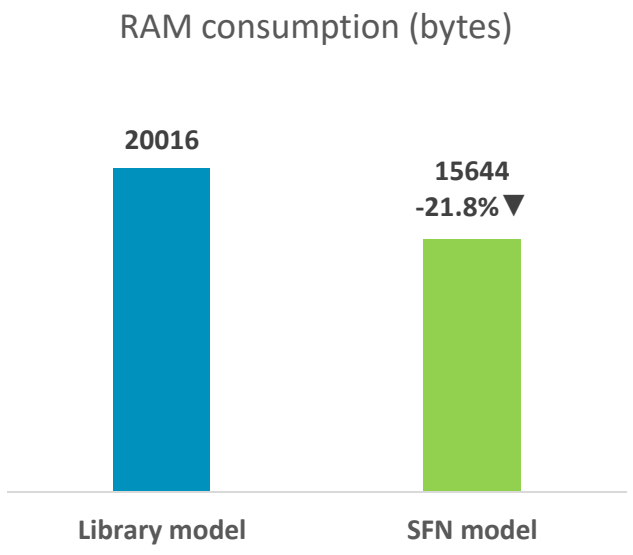
- A new framework defined in FF-M 1.1 extensions
  - A simpler programming model compared to IPC model
    - Reuse RoT service secure function call concept from TF-M Library model and integrate this into FF-M
      - RoT services are implemented as Secure Functions (SFN) that are called by the framework when the client makes a request to the service
    - Identical PSA Client APIs with IPC model
    - Reduce framework overhead for systems that do not require high levels of isolation
  - Use cases
    - Isolation level 1
    - Highly resource-constrained devices



Library model vs. SFN model

- Memory footprint
  - Similar flash consumption
    - Code + RO data + RW data
  - SFN model consumes less RAM than Library model does
    - RW data + ZI data

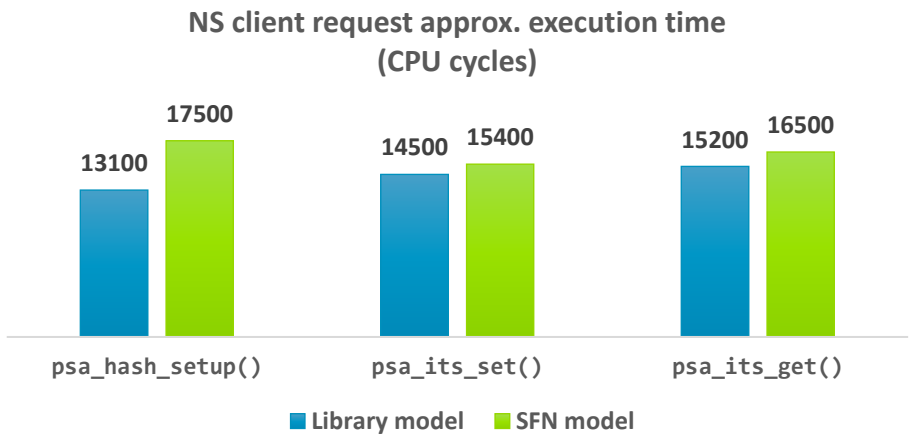


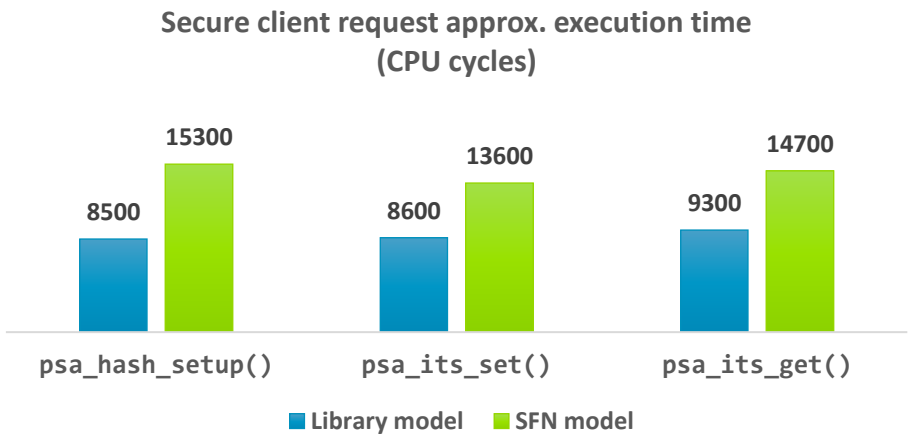


* Test config: Profile Small, Armclang 6.18, AN521, MinSizeRel build type

Library model vs. SFN model

- SFN model costs longer in client calls than Library model does
  - Additional operations required by FF-M
    - Client permission verification
    - RoT service version validation
    - Input parameter overlapping checks to avoid double-fetch inconsistency
    - Message construction and parse
    - RoT service invokes `psa_read()` to read input parameters

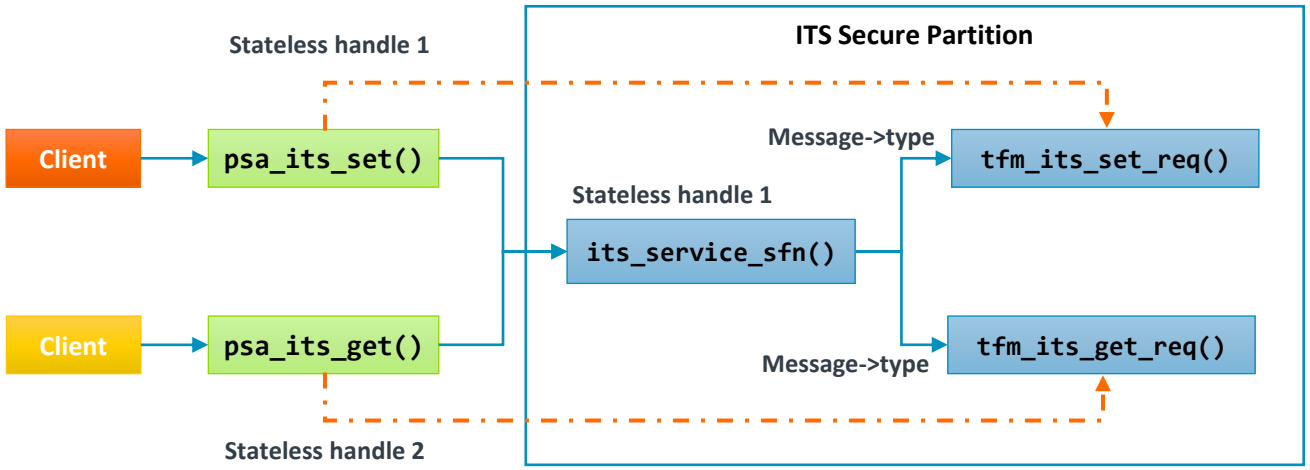




*TF-M Profiler tool
*Test config: Profile Small, GNU Arm, Musca-S1, Debug build type

Library model vs. SFN model

- SFN model costs longer in client calls than Library model does (cont'd)
  - TF-M specific implementation of SFN model
    - SFN models shares some common routines with IPC model to simplify implementation/maintenance
      - Such as dynamic handle/message instance allocation
      - Can be optimized further if required
    - Entry functions for TF-M stateless RoT services
      - TF-M Secure Partition implement an entry function to dispatch stateless RoT service callbacks
      - Reduce consumption of stateless handles to reserve indexes for 3rd-party RoT service usage
      - 3rd-party RoT services can export RoT service callbacks directly without an entry function




```
psa_status_t its_service_sfn(const psa_msg_t *msg)
{
    switch (msg->type) {
    case TFM_ITS_SET:
        return tfm_its_set_req(msg);
    case TFM_ITS_GET:
        return tfm_its_get_req(msg);
    …
    }

    …
}
```

Library model vs. SFN model

- Development/Maintenance effort
  - How many conditional checks/branches are maintained for Library mode/SFN model?
    - Each one wraps Library/SFN model specific implementation in shared routines with IPC model
      - Changes of Library/SFN may impact IPC model, and vice versa
      - "Bidirectional" development/maintenance effort with IPC model
    - Library model: `TFM_PSA_API/TFM_LIB_MODEL`
      - Dedicated standalone SPM/HAL implementation
    - SFN model: `CONFIG_TFM_PSA_API_SFN_CALL/CONFIG_TFM_SPM_BACKEND_SFN`
      - Share common routines/implementation with IPC model

	Library model	SFN model
C code	114	9
Linker scripts	17	0
Build system (including manifest tool)	74	11
Total	215	20

```
#ifndef TFM_PSA_API
$<$<BOOL:${TFM_PSA_API}>>:…>
```

```
#elif CONFIG_TFM_PSA_API_SFN_CALL == 1
$<$<BOOL:${CONFIG_TFM_SPM_BACKEND_SFN}>:…>
```

Library model vs. SFN model

- Observations
  - Similar memory footprint
  - SFN model is “*slower*” due to more execution steps compliant with FF-M
  - Less development/maintenance effort for SFN model, with essential IPC model

arm

Thank You
Danke
Gracias
Grazie
谢谢
ありがとう
Asante
Merci
감사합니다
धन्यवाद
Kiitos
شكرًا
ধন্যবাদ
תודה