



Radio Virtual Machine (RVM)

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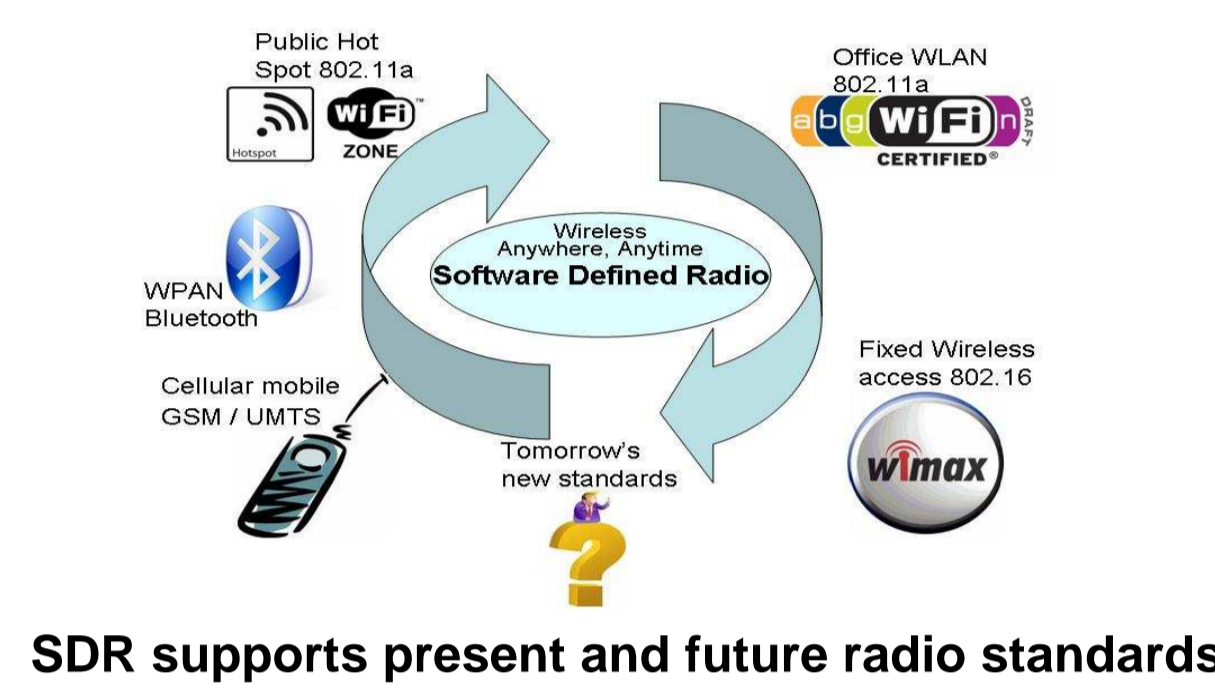
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Software-Defined Radio (SDR) technologies

A lots of promise

- Lower costs
- Faster time to market
- Faster prototyping of new products
- Easier update/upgrade of SDR products
- Interoperability between SDR devices



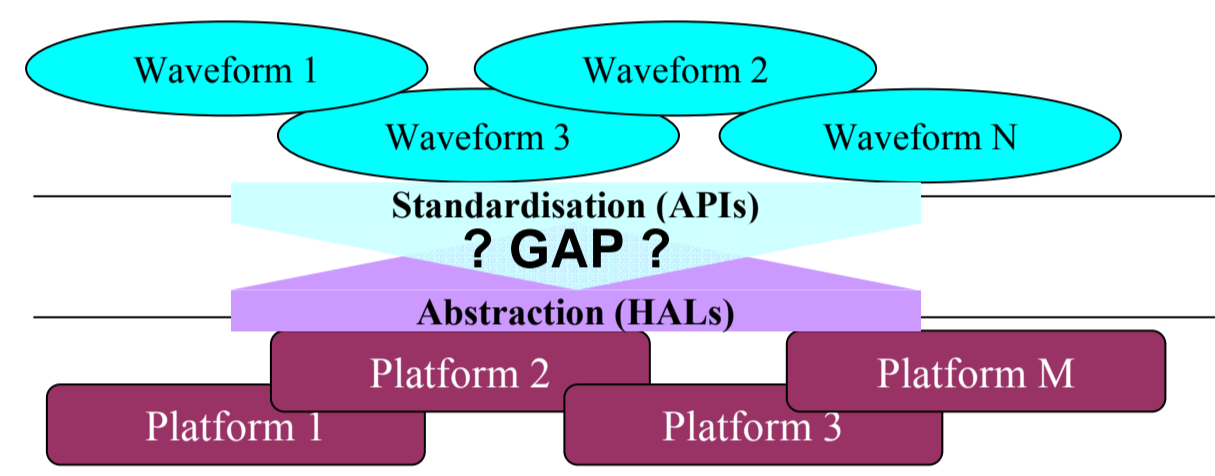
SDR supports present and future radio standards

SDR implementation challenges

- Reconfigurability \Rightarrow multi-standard radios
- Portability \Rightarrow multi-platform radios

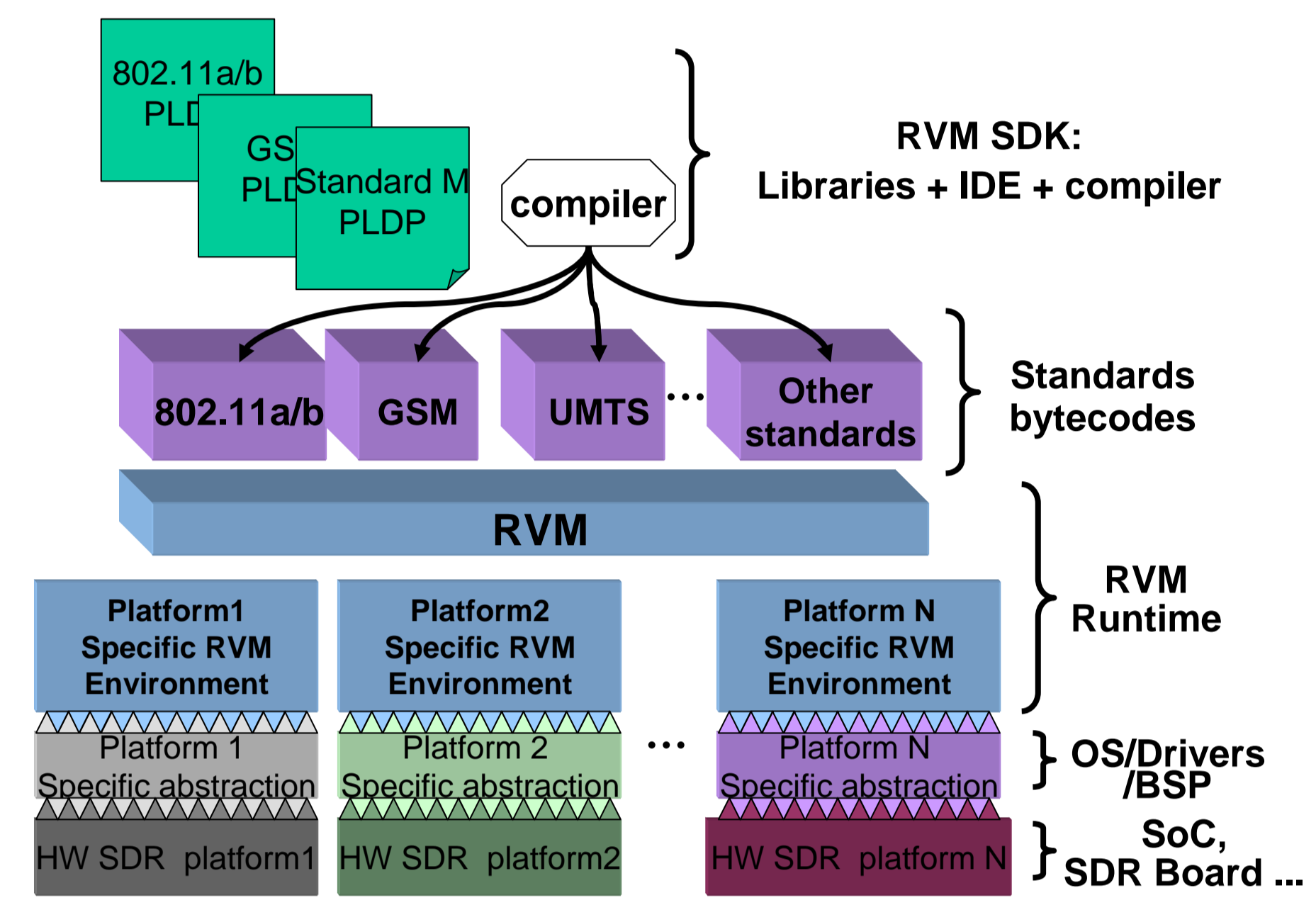
Need for an adaptation layer

- Expresses the convergence of PHY standards
- Meets hard real time constraints
- Hides Platform complexity
- Extensible



With RVM concept SDR meets its challenges

RVM concept principles



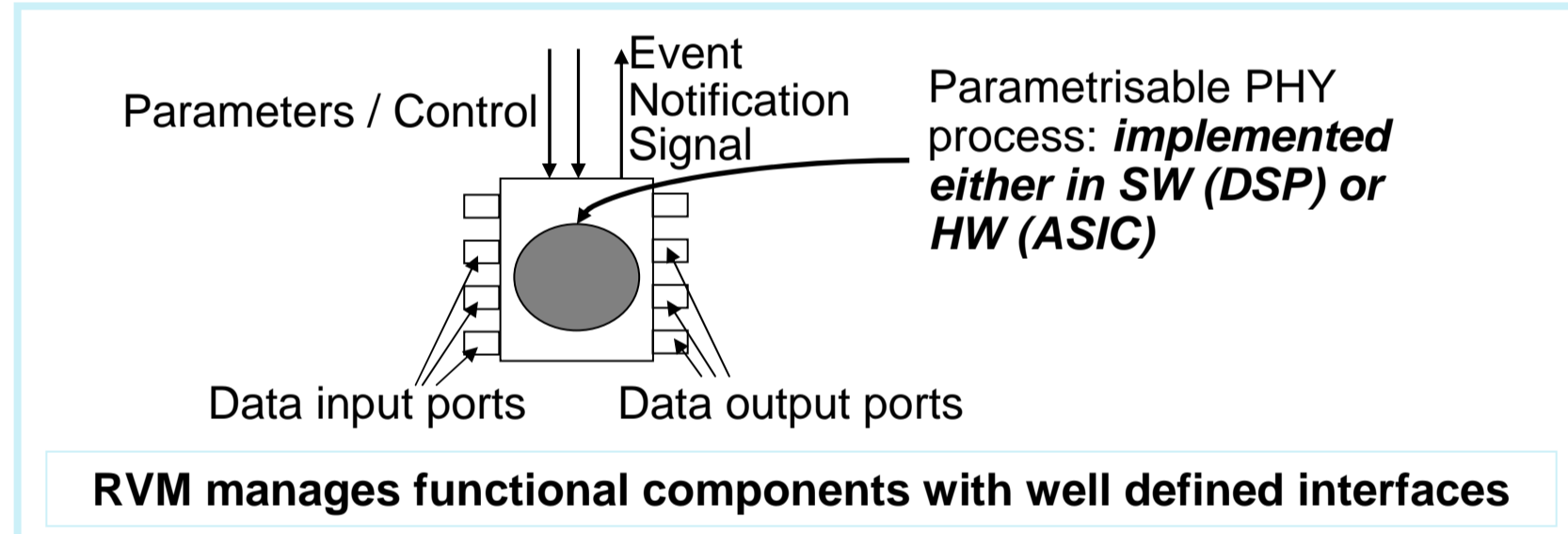
RVM advantages

- Isolation of radio application from its execution platform
- Dynamic software download
- Maintenance and deployment of only one bytecode per platform
- Implements processes with low computational requirements when no hardware support

Models and Proposals for the RVM

New programming model for PHY Layer description

- Abstract component view hiding implementation details



RVM manages functional components with well defined interfaces

- PHY Layer Description Program (PLDP) expressed in a programming language dedicated to the description of physical layer protocol (sometimes called waveform language)

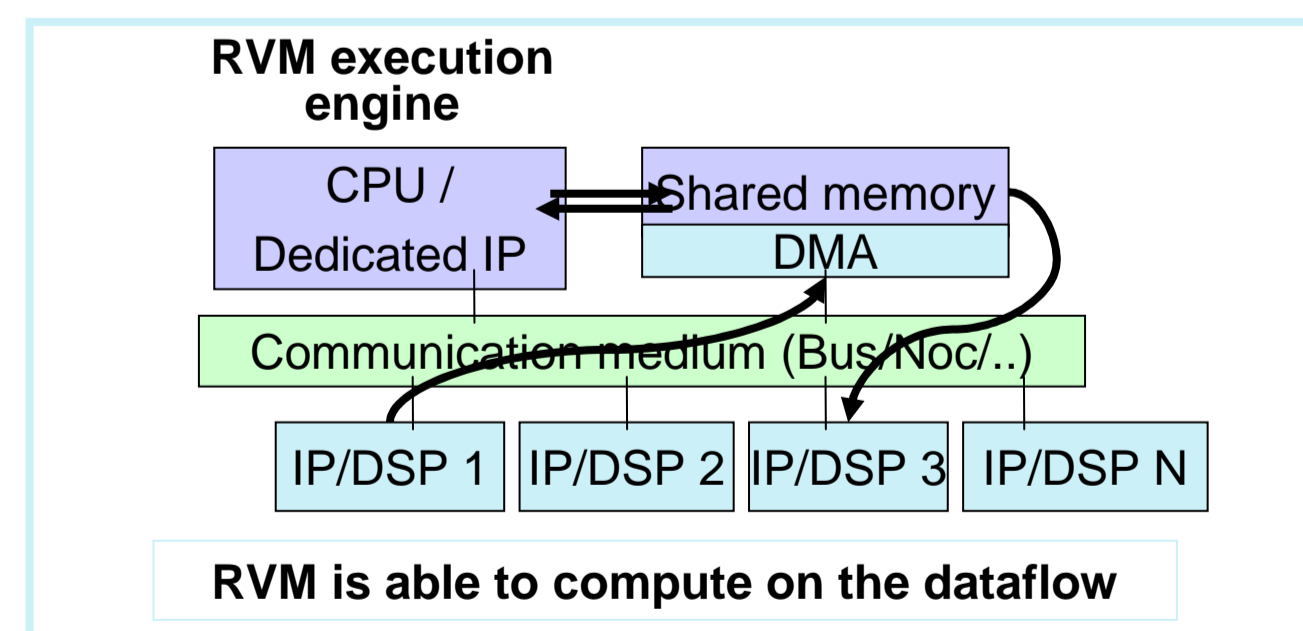
```
[...]
-- ressource allocation
dma1 = dma_engine.allocate()
phaseestim=phase_estimator.allocate()
rotor1 = rotor.allocate()
dma2 = dma_engine.allocate()
-----
--** COARSE GRAIN DRIFT ESTIM **--
-- VM connects allocated blocks
rvm.connect(RF.out, dma1.in)
rvm.connect(dma1.out, phaseestim.in)
rvm.connect(phaseestim.out, dma2.in)

-- block configuration
dma1.program("BEGIN \
{RECEIVE_AND_SEND 160} END;")
phaseestim.configure("STS", 160)
dma2.program("BEGIN \
{RECEIVE 1; SEND_IT SIGTER;} END;")
-- VM waits for interrupt
(phase_drift,phase_amount)=rvm.wait(SIGTER)
--rotor configuration with phase drift
rotor.configure(phase_drift, phase_amount)
phaseestim.configure("LTS", 160)
[...]
```

PLDP program corresponding to the phase drift estimation

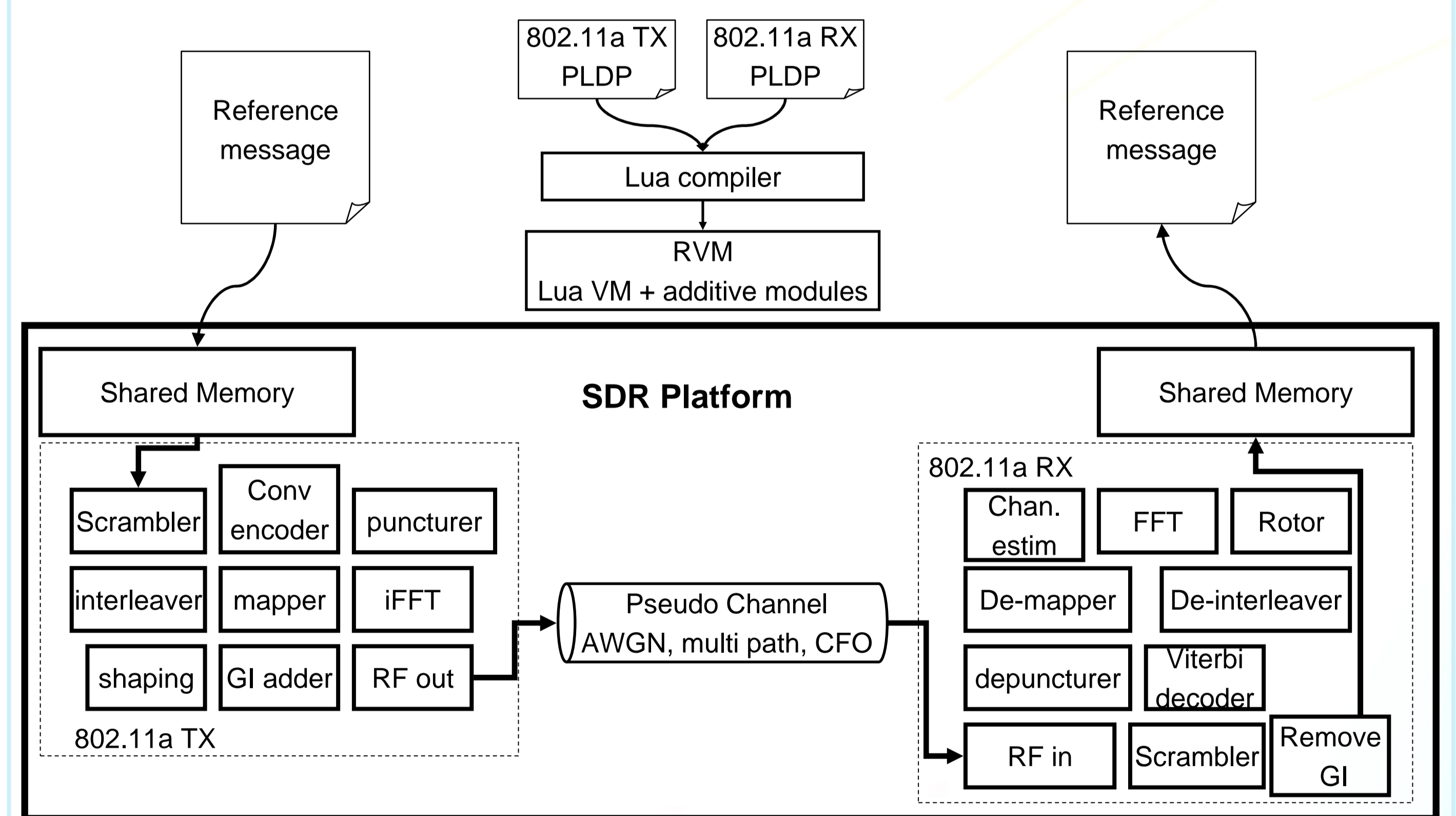
Execution model

- RVM is able to access the data-flow
- Configurations could be sent :
 - Directly from the RVM
 - RVM sends requests to IPs to get their configurations from system shared memory



RVM is able to compute on the dataflow

A RVM prototype running on PC: 802.11a PHY Layer On Lua RVM



- Components are implemented in software on standard PC
- Components run in parallel threads
- 802.11a is functional (real time is not met of course)
- The "proof of concept" implementation is successful

Ongoing Work

- Real Time implementation of the RVM concept on the CEA-LETI MAGALI chip
 - Development of a MAGALI specific RVM environment upon F2 API (FAUST2/MAGALI HAL)
 - Experimenting RVM API using a lightweight Lua VM
 - Experimenting RVM with Squawk JVM(Java VM)
 - RVM runs on ARM1176 core with DBX (Direct Bytecode Execution) feature
- Evaluation of the RVM overhead
- Proposal of new paradigms and optimizations

