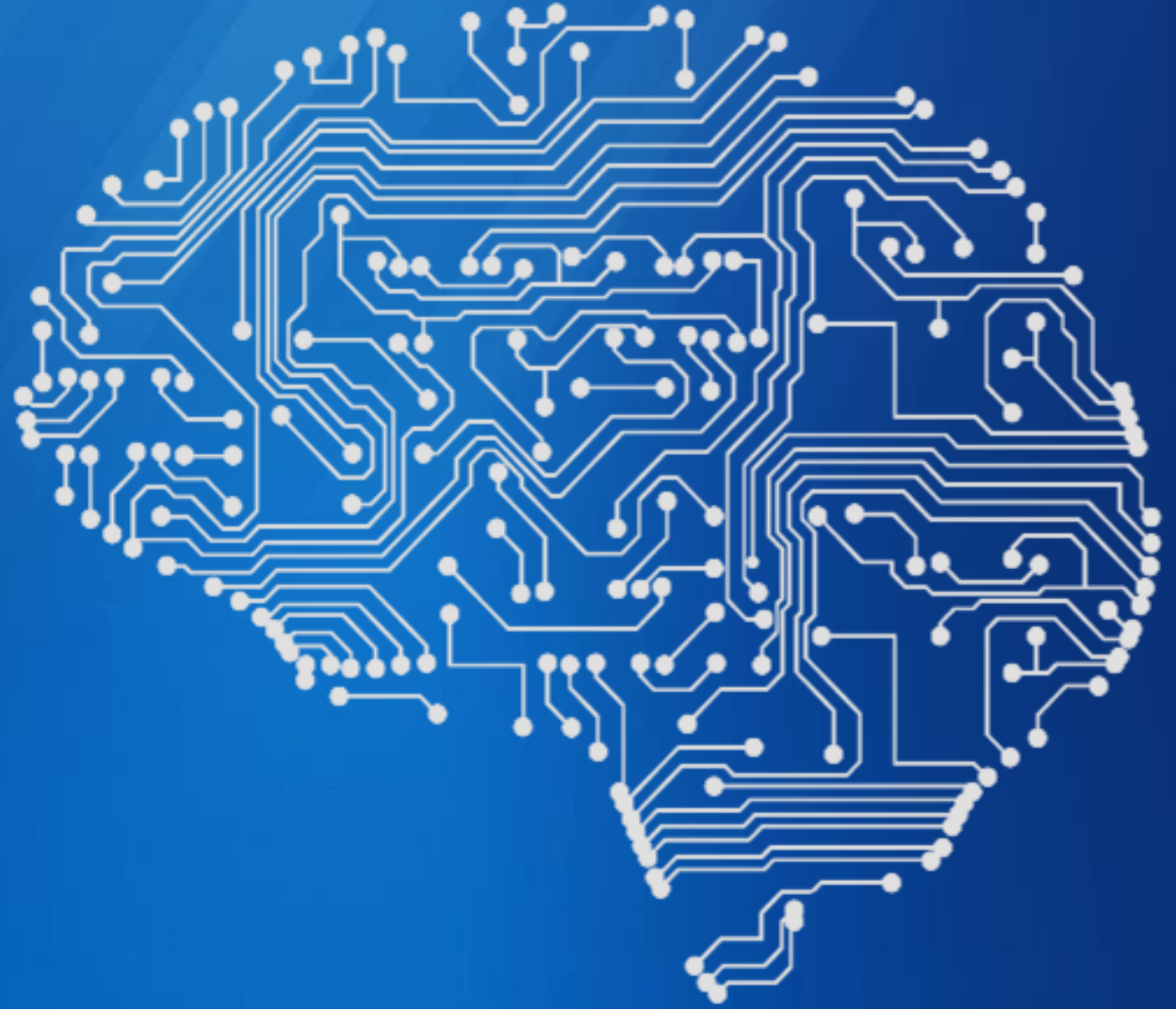


May 20, 2015

NetSpeed Orion Low Power Product Overview Meeting

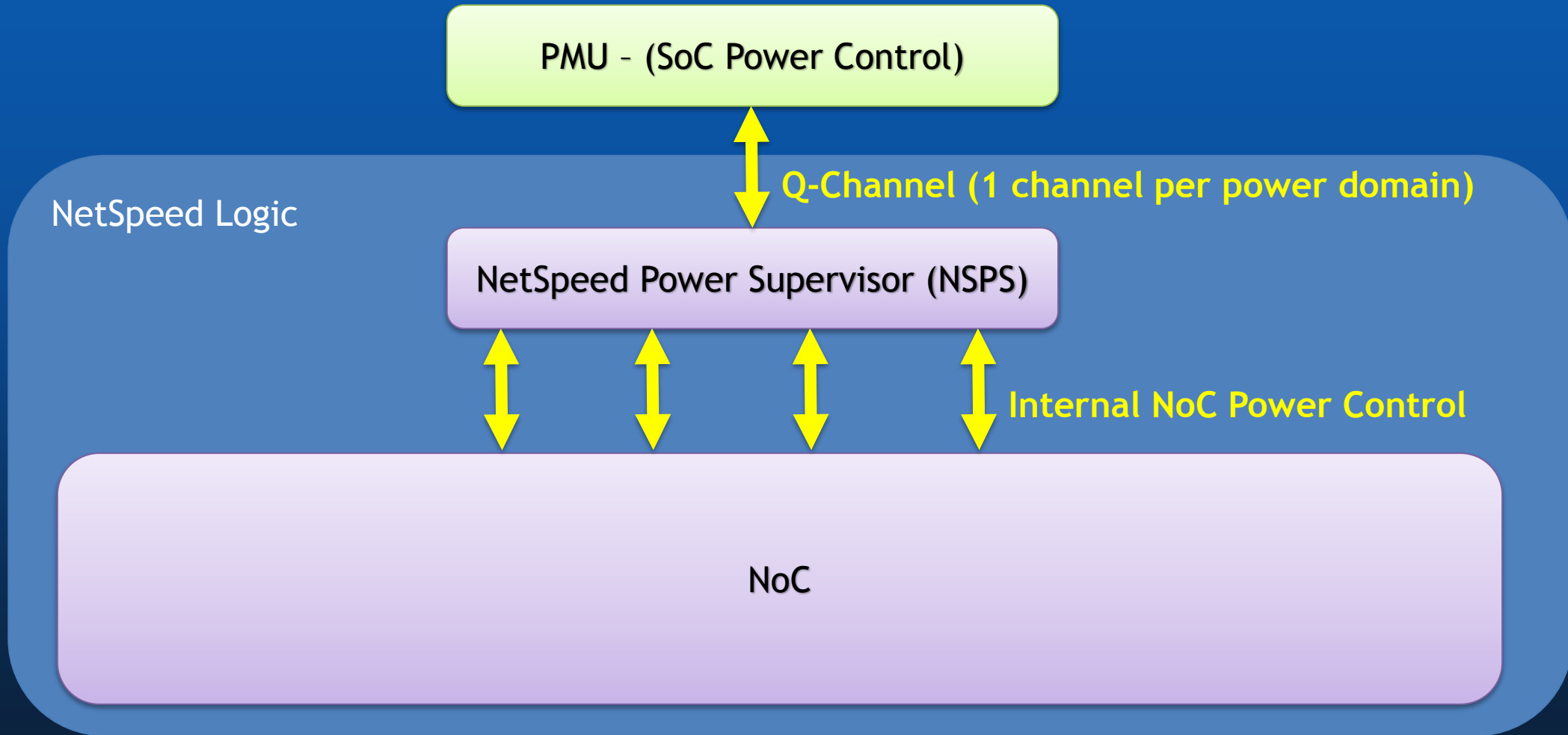


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Introduction

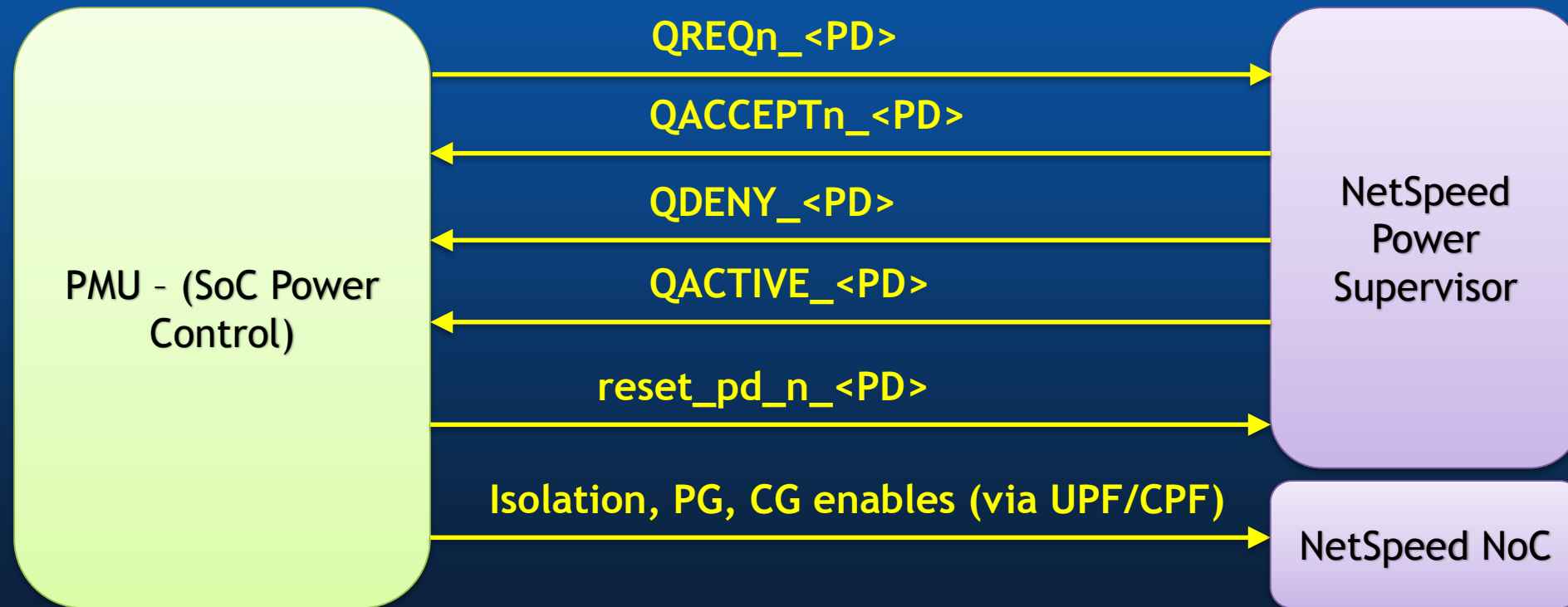
- NetSpeed Orion supports an extensive set of low power features: clock gating, power gating, and multiple voltage domains
- Highly automated: power intent is specified in NocStudio configuration file, low power solution generated automatically
- Simple, industry standard power control interface: AMBA Low Power Signaling Interface – Q-channel
- NetSpeed Power Supervisor implements a simple state machine to coordinate power sequencing activity among all NoC elements
 - Fencing and Draining
 - Auto-Wake-Up
 - Sleep Request/Sleep Acknowledge (idle state detection and confirmation)
- Simulation and synthesis supported by automatically generated CPF/UPF files

Basic Architecture – 3 Layers – Simplify and Abstract NoC Power Control Details

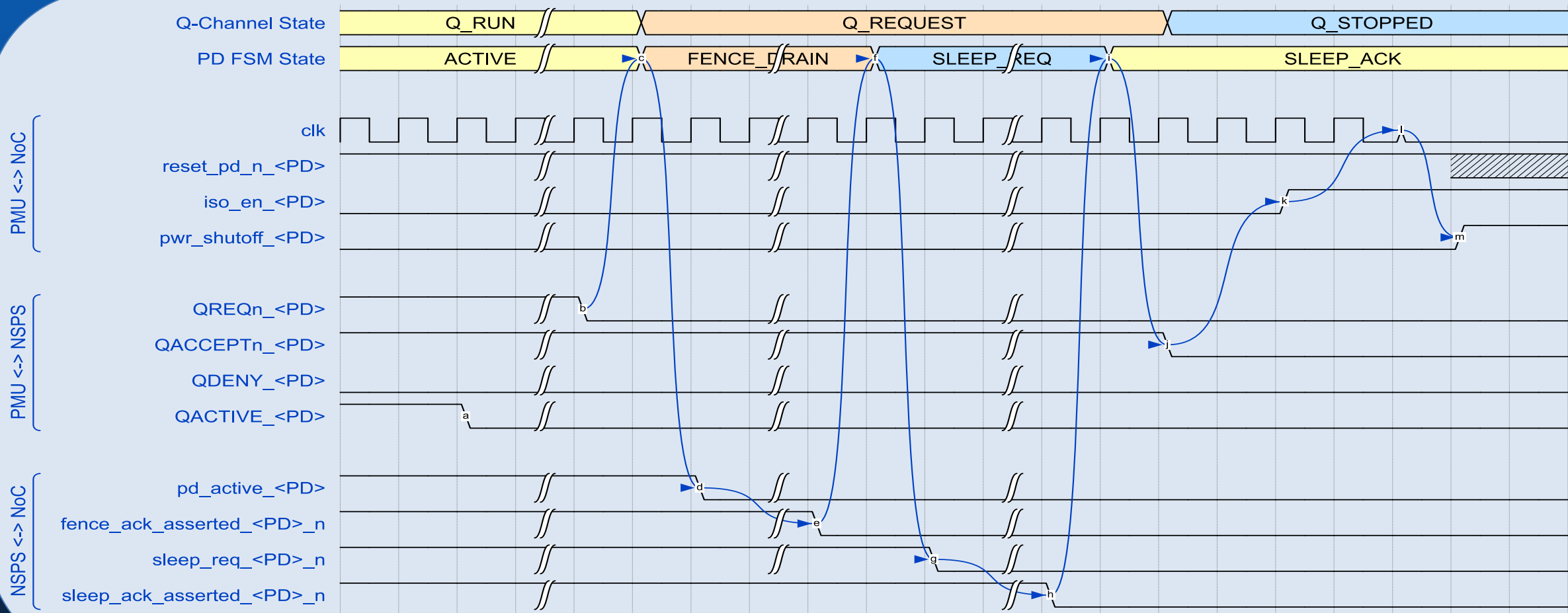


PMU (SoC Power Control) Interface

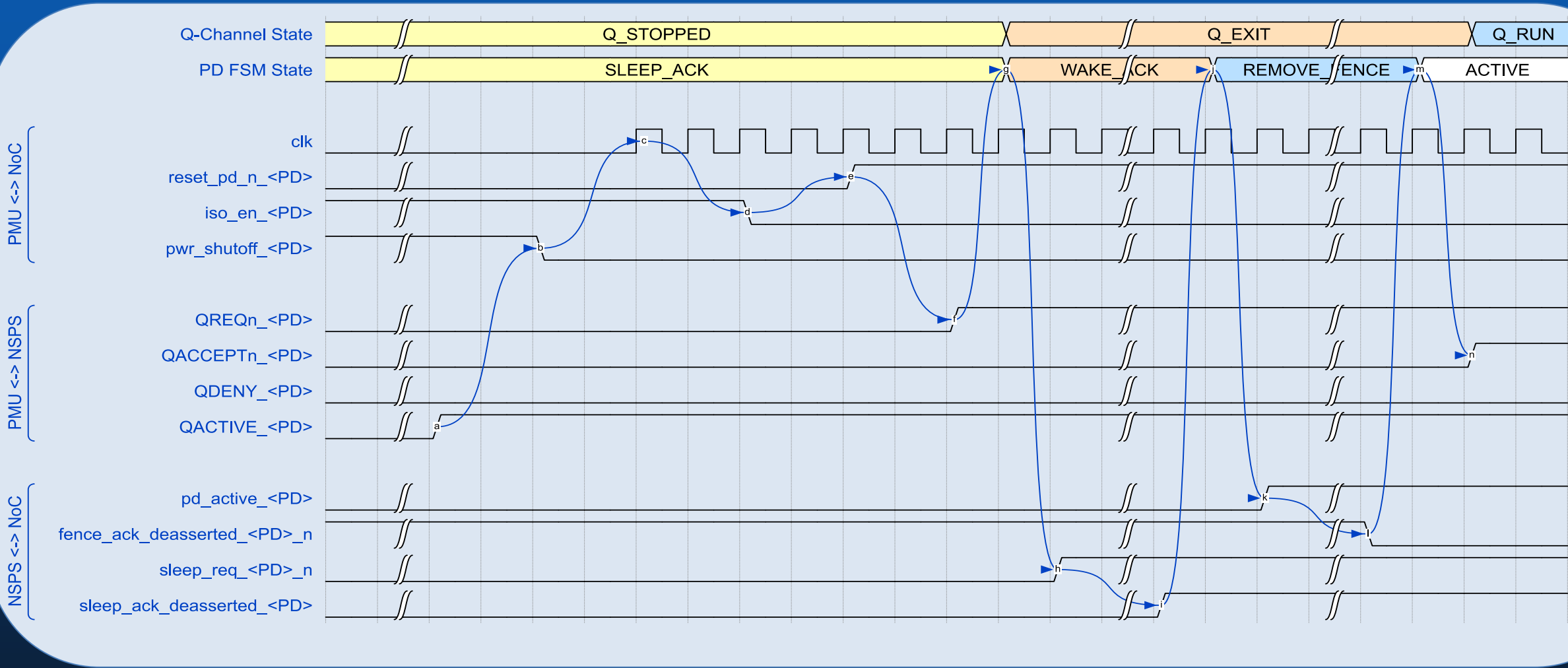
- AMBA Q-Channel Signaling Interface: 4 signals – QREQn, QACCEPTn, QDENY, QACTIVE
- ResetPwrDomain_n: per domain reset under PMU control
- Power Controls: Integrated via UPF/CPF – isolation, power gating, clock gating enables, level shifters



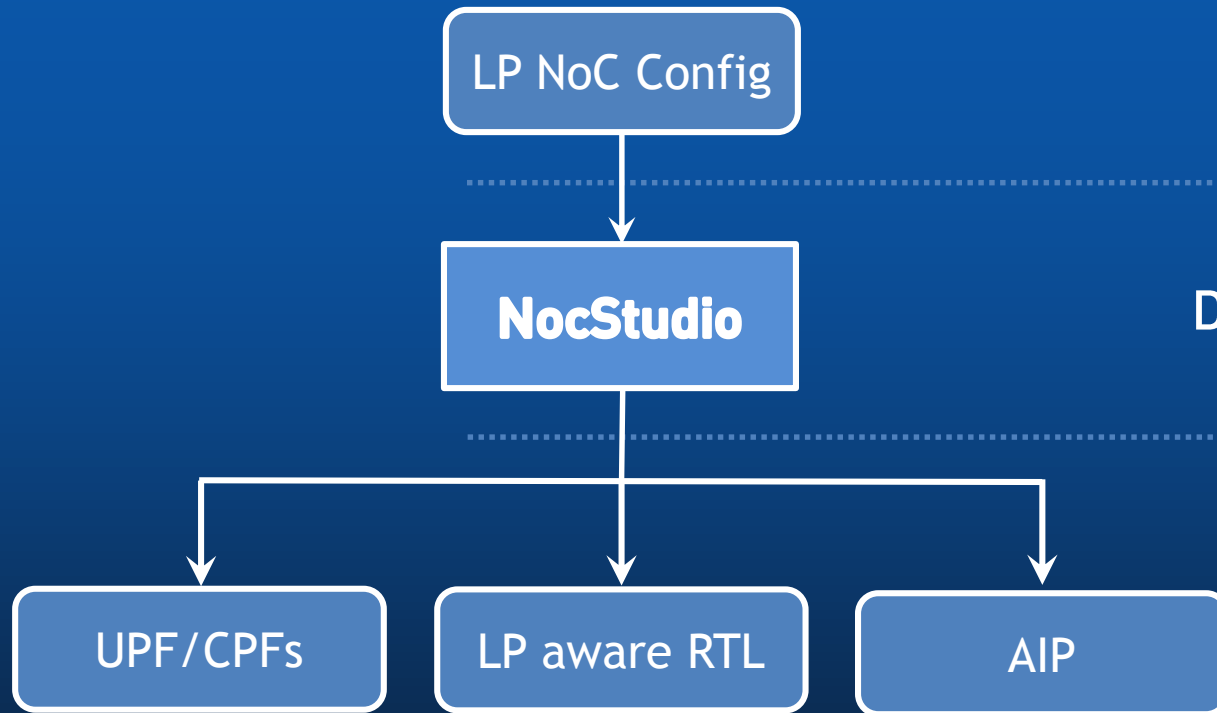
PMU Signalling – Power Down Sequence



PMU Signalling – Power Up Sequence w/Auto-Wake Request



NetSpeed Low Power Flow



Input specification contains power domains and profiles

Understands Traffic and Power profiles
Does analysis/optimization for power domains
Generates low power collateral

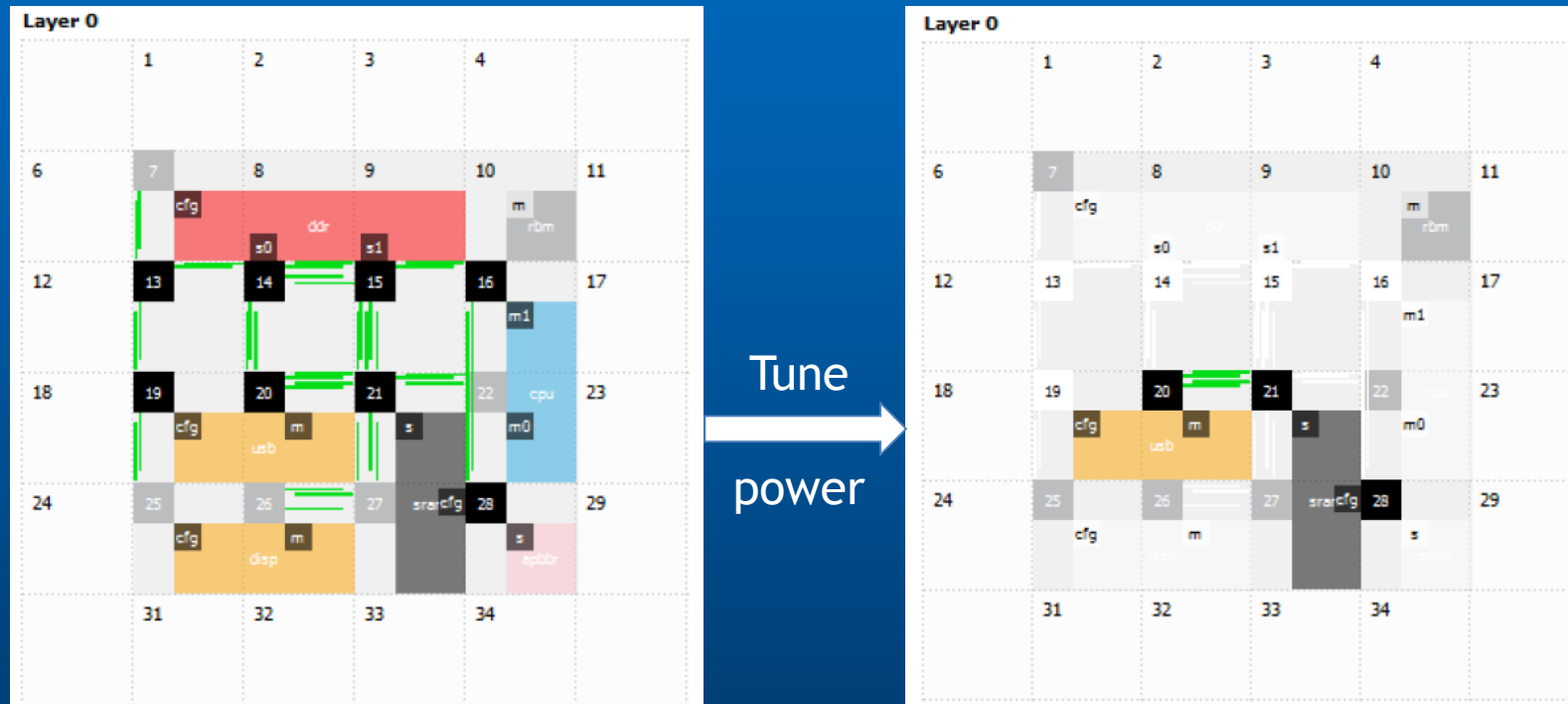
Power Aware Design & Verif:
UPF/CPF - Power Intent
RTL with LP controls
Assertions & Checkers

NetSpeed Solution Simplifies the Power Management Problem

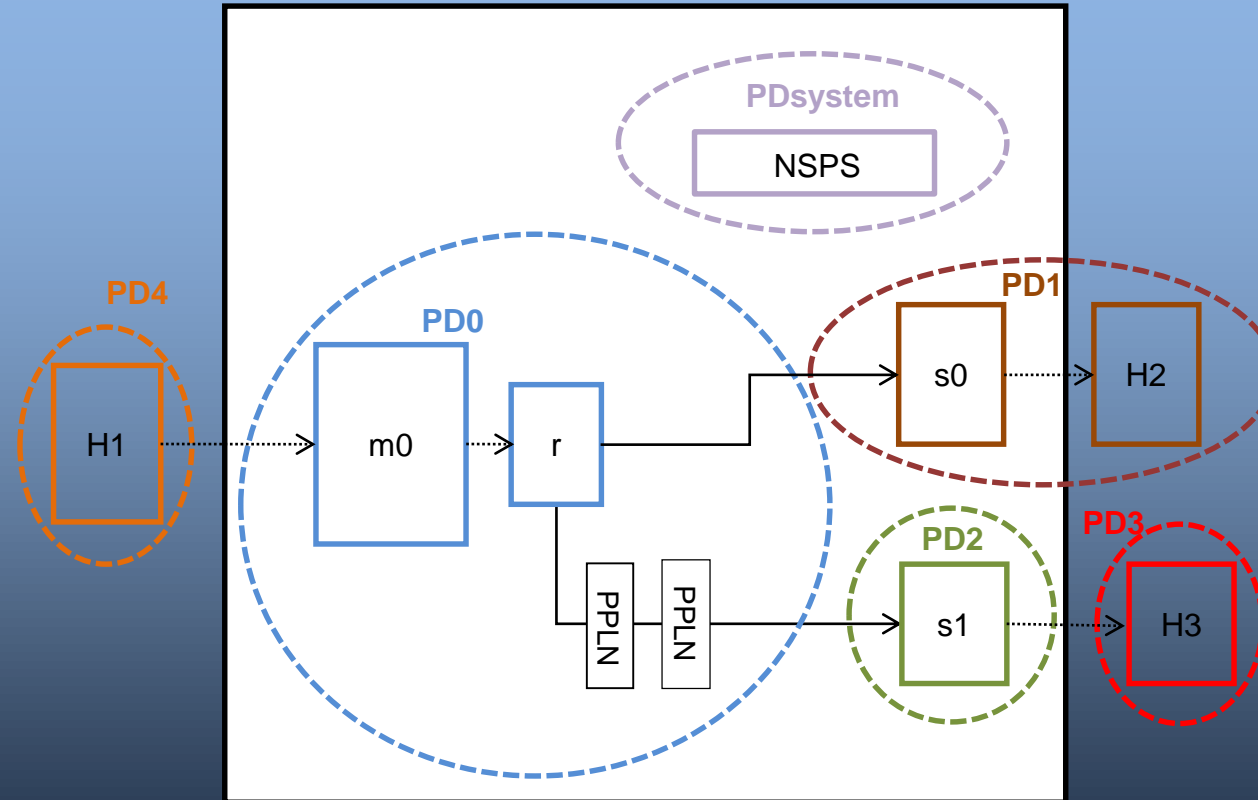
- NocStudio intelligence and algorithms applied to PM
 - NocStudio Traffic Profiles specify communication patterns
 - NocStudio Power Profiles specify power domains that are active
 - In a given Power Profile, NocStudio knows the NoC elements / domains it does not need ON
- Power Management using NocStudio
 - Tune-power efficiently assigns NoC routers to power domains to...
 - Minimize leakage power
 - Minimize physical design complexity
 - Minimize traffic interdependencies and disruptions

Tune Power

- NocStudio creates routers while synthesizing the network
- 'Tune power' is a NocStudio optimization which auto assigns power domains to routers
- Auto-assignment is based on adjacency, hardware cost, and on required traffic flows



Example: A Simple NoC with Power Management



Simple 1 Master and 2 Slave Config

Low Power Flow: Power Intent Spec in Config

```
new_mesh 4 4 1 lp_example regbus_enabled
mesh_prop low_power_enabled yes
```

Low power features enabled.

```
add_power_domain PD0
add_power_domain PD1
add_power_domain PD2
add_power_domain PD3
add_power_domain PD4
```

Creates new power domains for NoC elements.

```
add_host m0 .....
add_traffic .....
add_range .....
```

Assign created power domains to NoC bridges. Host power domain can be set same as bridge.

```
bridge_prop m0/m power_domain PD0
bridge_prop m0/m power_domain_host PD4
bridge_prop s0/s power_domain PD1
bridge_prop s0/s power_domain_host PD1
bridge_prop s1/s power_domain PD2
bridge_prop s1/s power_domain_host PD3
```

Creates power mode conditions or power state tables. Only bridge power profiles are added.

```
add_power_profile m0_s0 PD0@ON PD1@ON PD4@ON
add_power_profile m0_s1 PD0@ON PD2@ON PD3@ON PD4@ON
add_power_profile s0_s1 PD0@ON PD1@ON PD2@ON PD3@ON
```

Assigns power domains to routers and links based on the power profile info.

```
map
tune_power 1 1
gen_ip
```

UPF/CPF Generation

- Hierarchical CPF/UPFs generated with power intent specification for
 - Pre-Simulation for RTL simulations and
 - Pre-Synthesis including voltage nets, low power libs
- Isolation rules with port level information, easier for post-synthesis integration
- Testbench CPF/UPF for modeling host interface power domains (for Sanity bench)