

REDHAWK and RF-NoC Integration

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Outline

- What is RF-NoC?
- What is REDHAWK?
- How can they work together?
- Demo
- Q&A

RF-NoC

- Simplifies IP integration with USRP FPGA devices
- Accelerate signal processing applications with hardware
- Modularizes processing with blocks
 - Standard interfaces
 - Command and control (strobe registers, AXI)
 - Data flow to/from FPGA (AXI)
- Allows virtual bit file reconfiguration with AXI crossbar

FPGA



TRADITIONAL

FPGA

BPSK DEMOD

TRADITIONAL

FPGA

BPSK DEMOD



TRADITIONAL

FPGA

BPSK DEMOD

TRADITIONAL

FPGA



FPGA



RF-NoC

FPGA

BPSK DEMOD

SPLITTER

PLL

MULTIPLY

FIR

DETECTOR

RF-NoC

FPGA

BPSK DEMOD



RF-NoC

System Integration

- Necessary for any complex system
 - Signal processing stages assembled from different sources
 - Performance may dictate mixing processing technologies
 - Scale may require multiple, networked, processing platforms
- Often an expensive process
 - Always CONOP-specific
 - Reliable, survivable system software is deceptively difficult
 - Support tail creates a long series of issues
- Integrated solution does not cheaply port
- A System Framework solves these problems

REDHAWK

- System Framework for integration of technologies
 - Libraries/Packages/Modules (C++/Java/Python)
 - Software frameworks (e.g. GNU Radio, Octave, etc.)
 - Specialized computing hardware (e.g. FPGA, GPU, etc.)
 - Specialized RF hardware
- Intrinsically distributed
- Tooling supports development and operation of systems

REDHAWK Device Abstraction

- Generalize hardware management
 - Standardize RF hardware interactions
 - Commoditize computing hardware interactions
- Isolate system developer from hardware
- Front End Interfaces (FEI)
 - Reduce hardware communication to capability request
 - Bandwidth, center frequency, sample rate, etc.
 - Advanced capability such as location request also possible

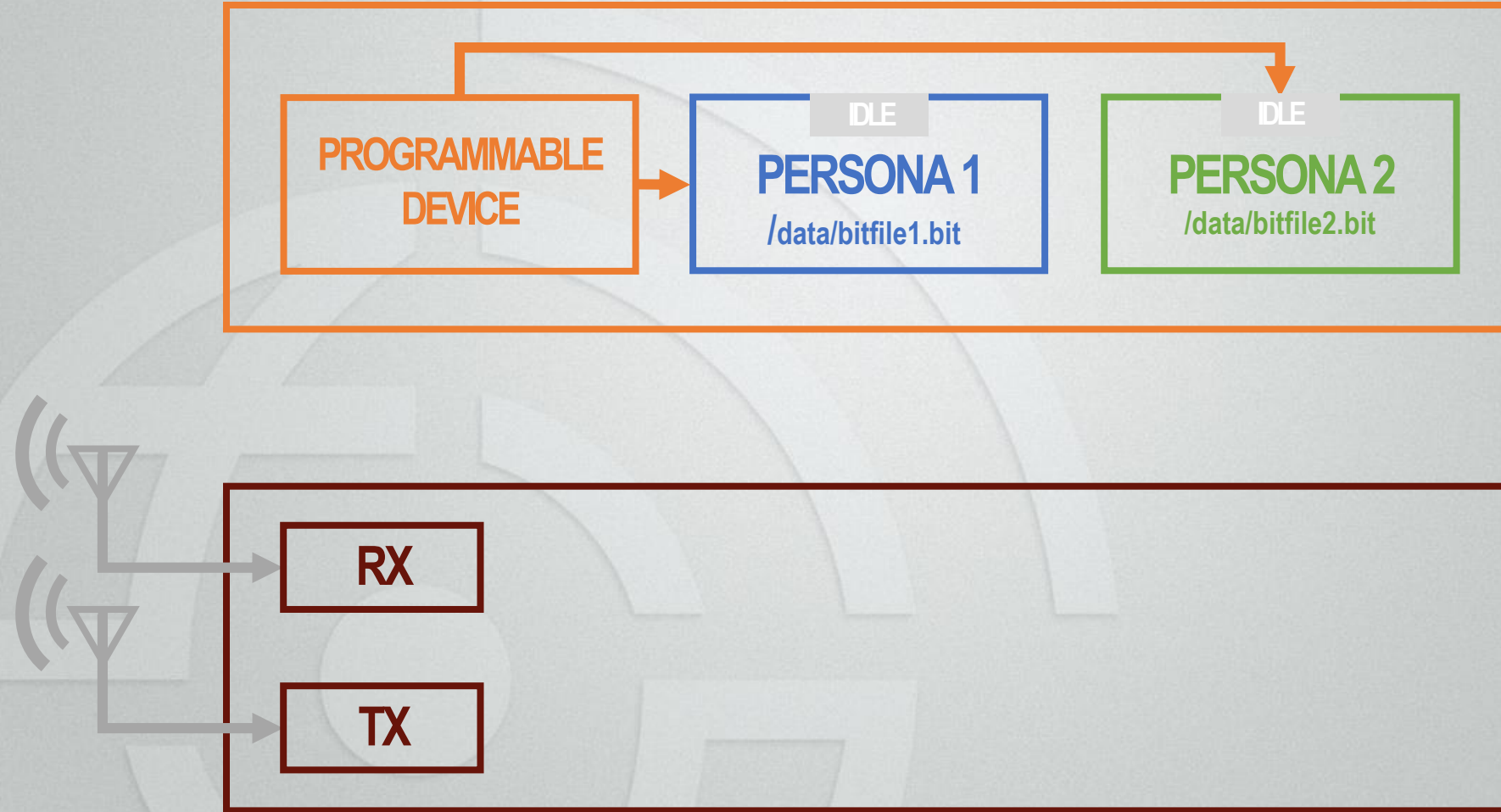
Programmable Device

- Manage life cycle of FPGA hardware
 - Load and unload bit files
 - Prevent multiple load requests
- Aggregate and control RF hardware
 - Represent static assets external to FPGA
 - Dynamically present capabilities based upon current load
- Launch and administer FPGA application use
 - Persona Devices

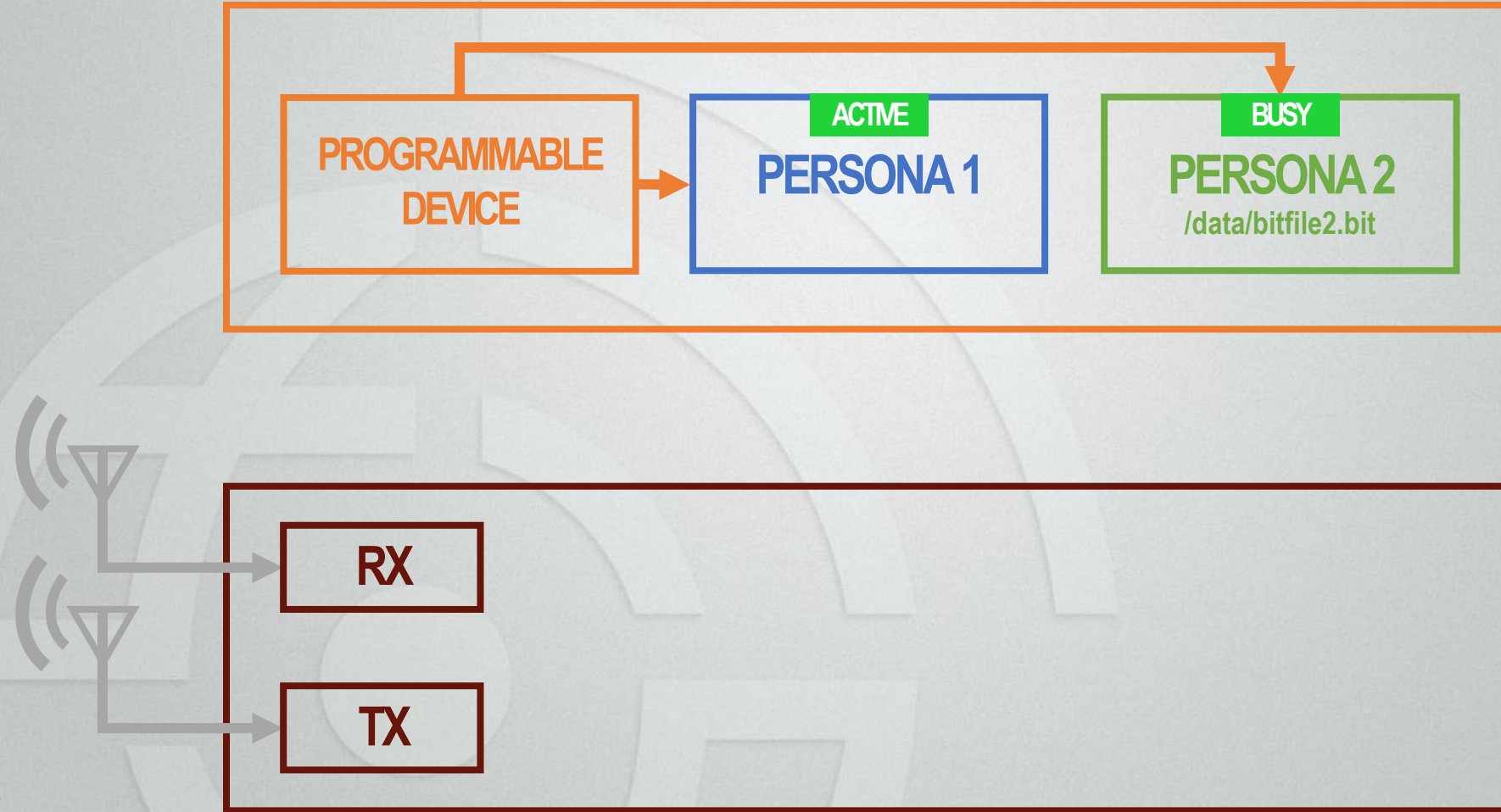
Persona Device

- Serve as interface to specific bit file abilities
 - Command and control
 - Data flow to and/or from FPGA
- Integrated RF-NoC flow
 - RF-NoC block connections statically specified
 - Persona acts as single interface for all blocks
 - Persona IO is block chain IO via streamers
 - Persona properties aggregate RF-NoC block properties

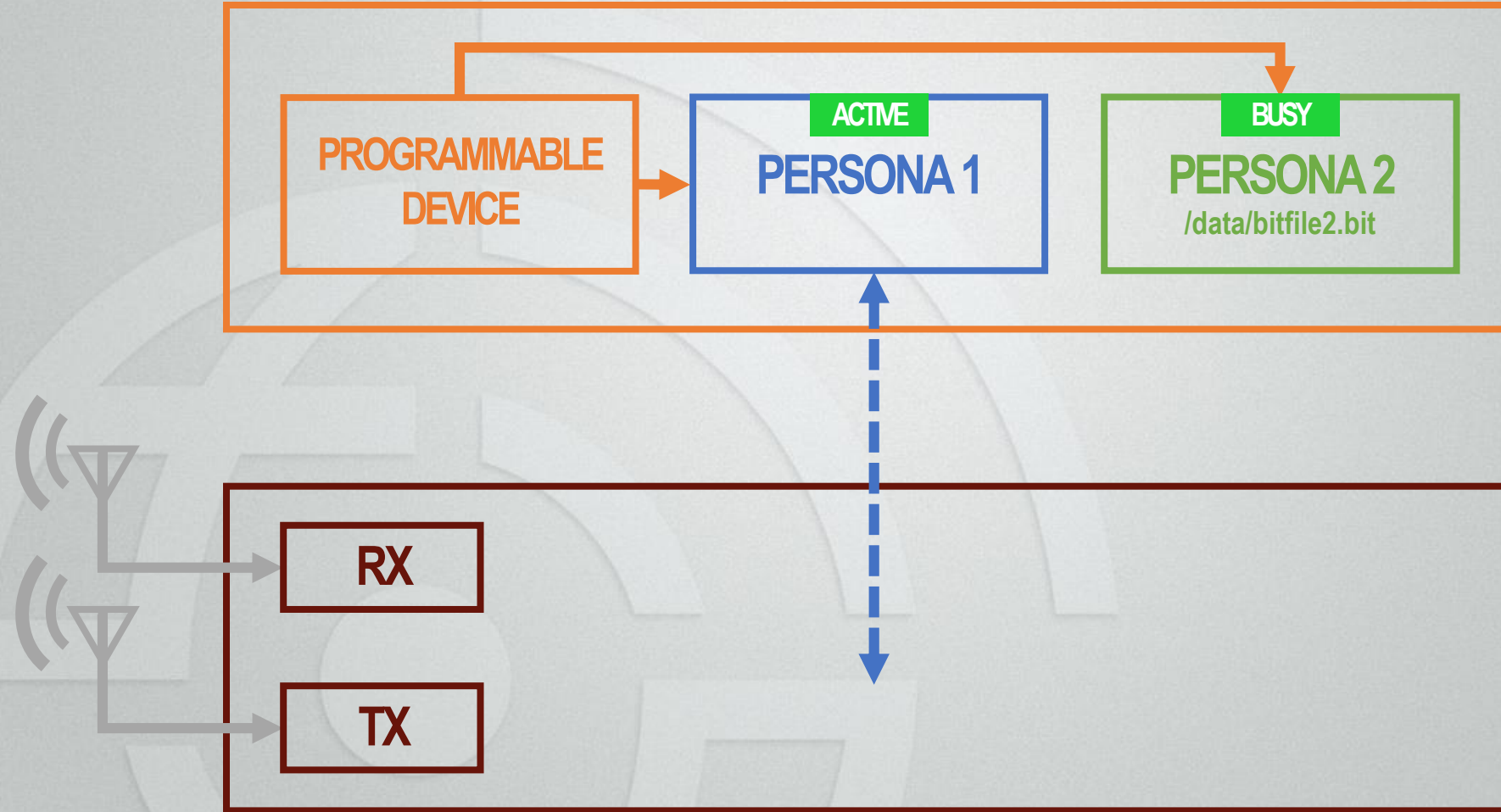
INTEGRATED PERSONA FLOW



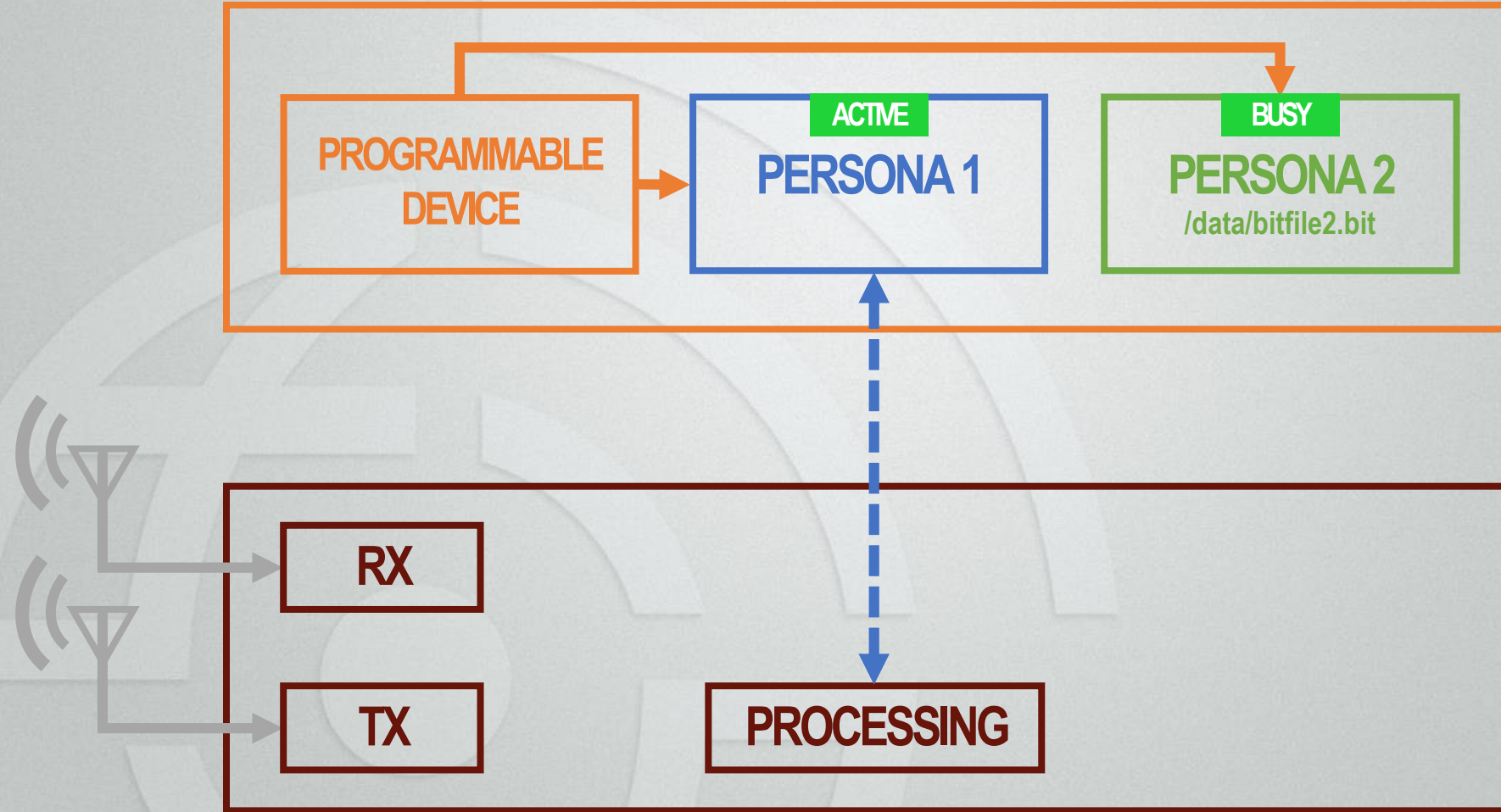
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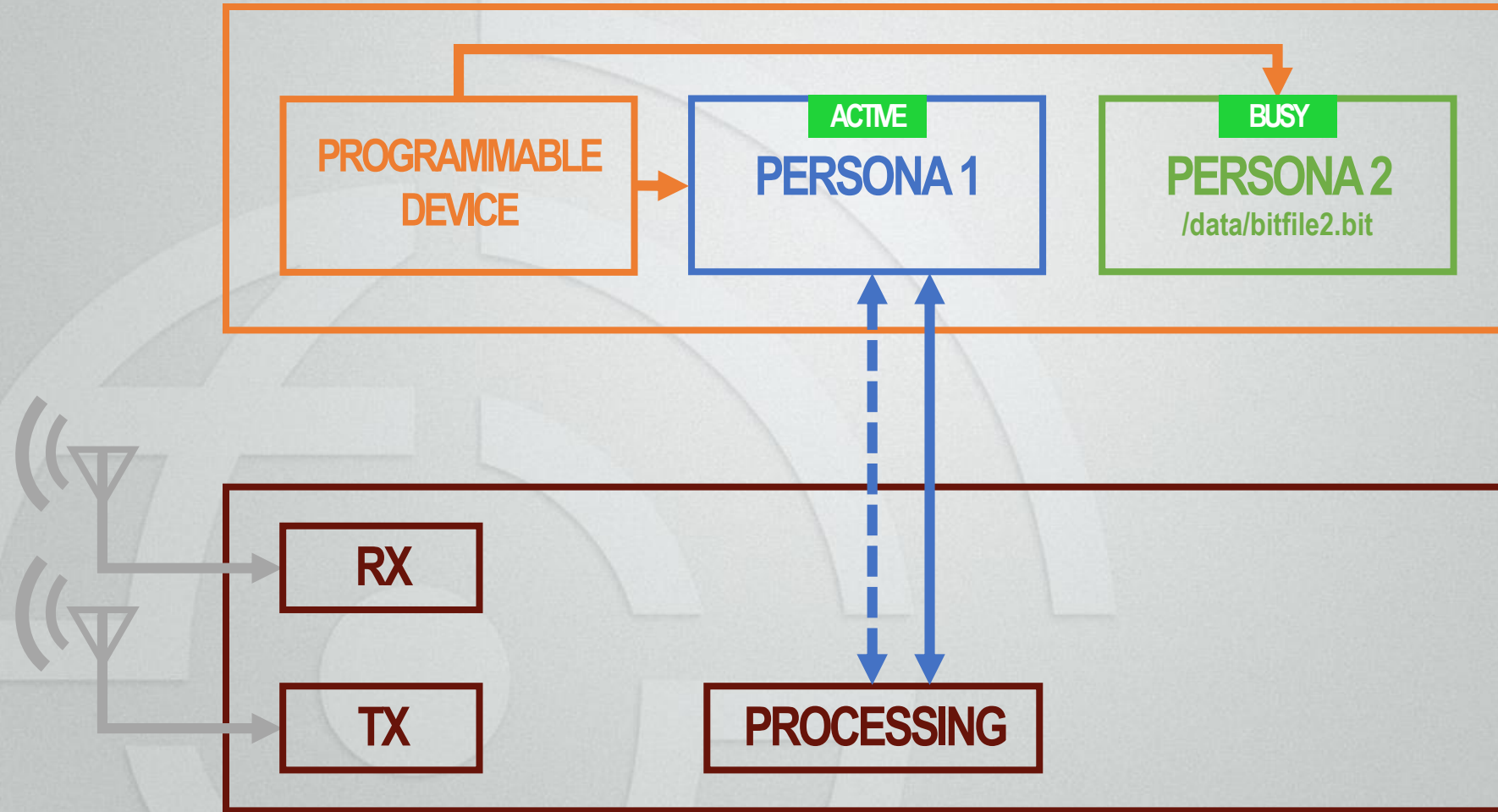
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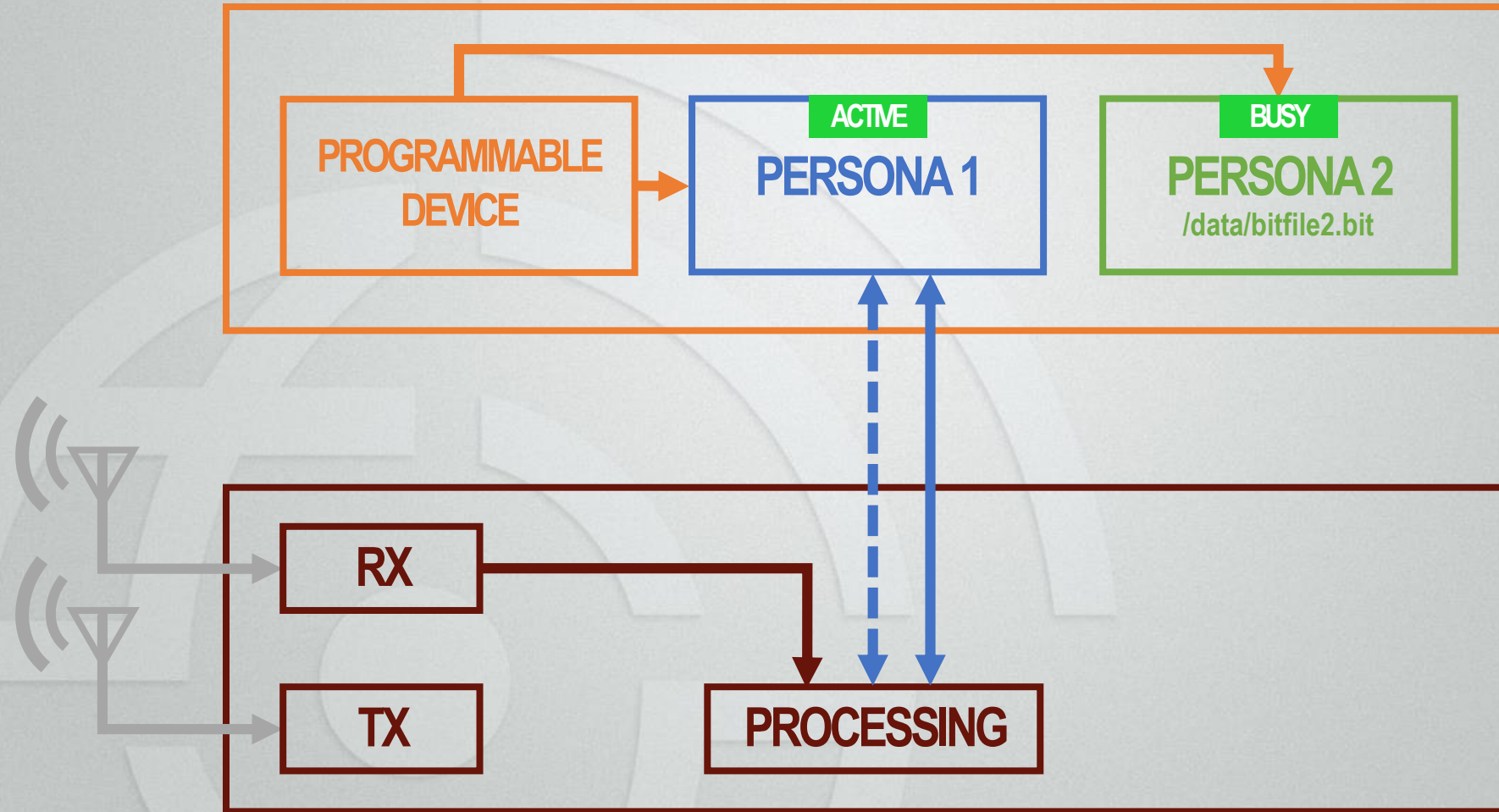
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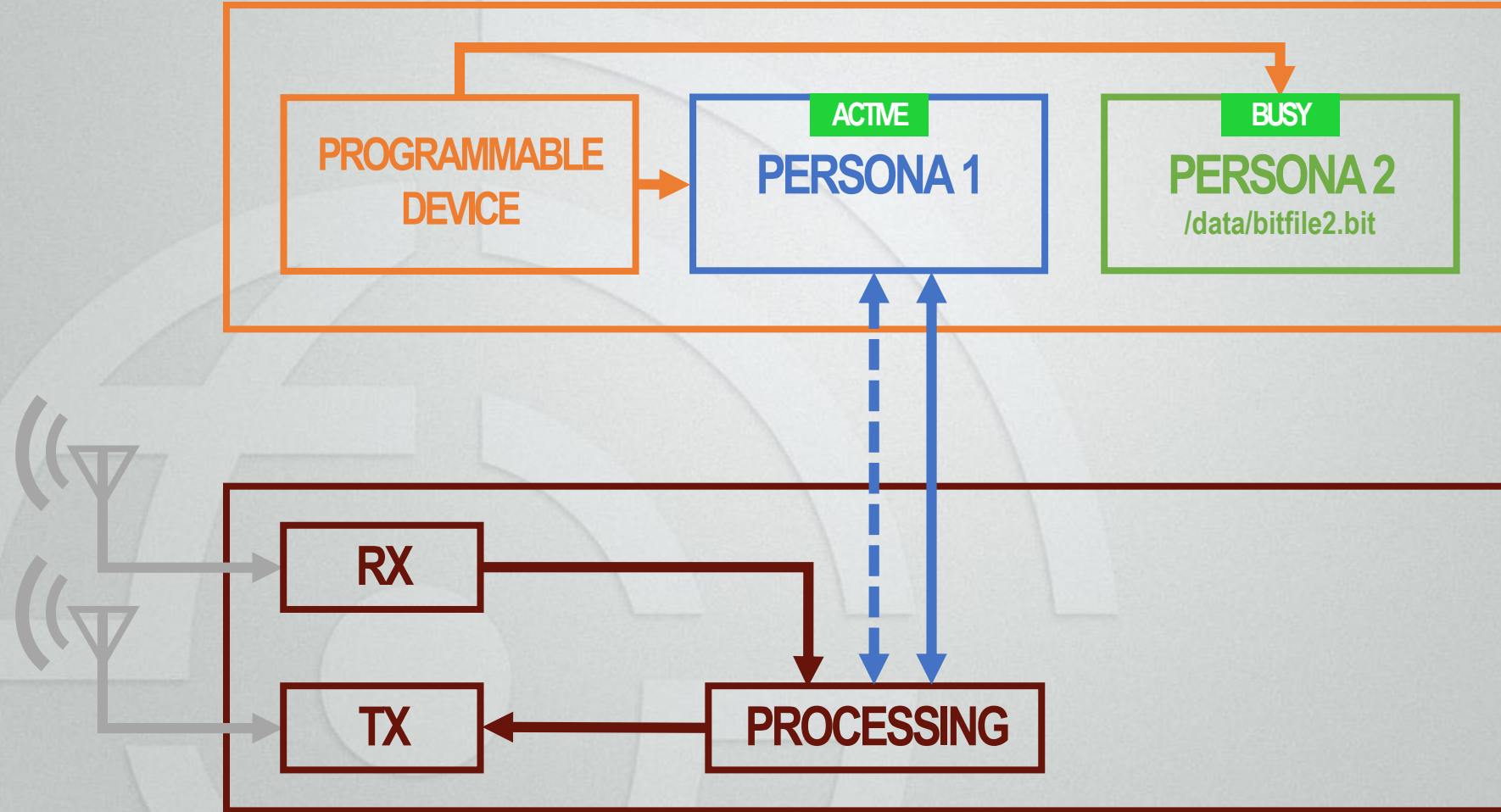
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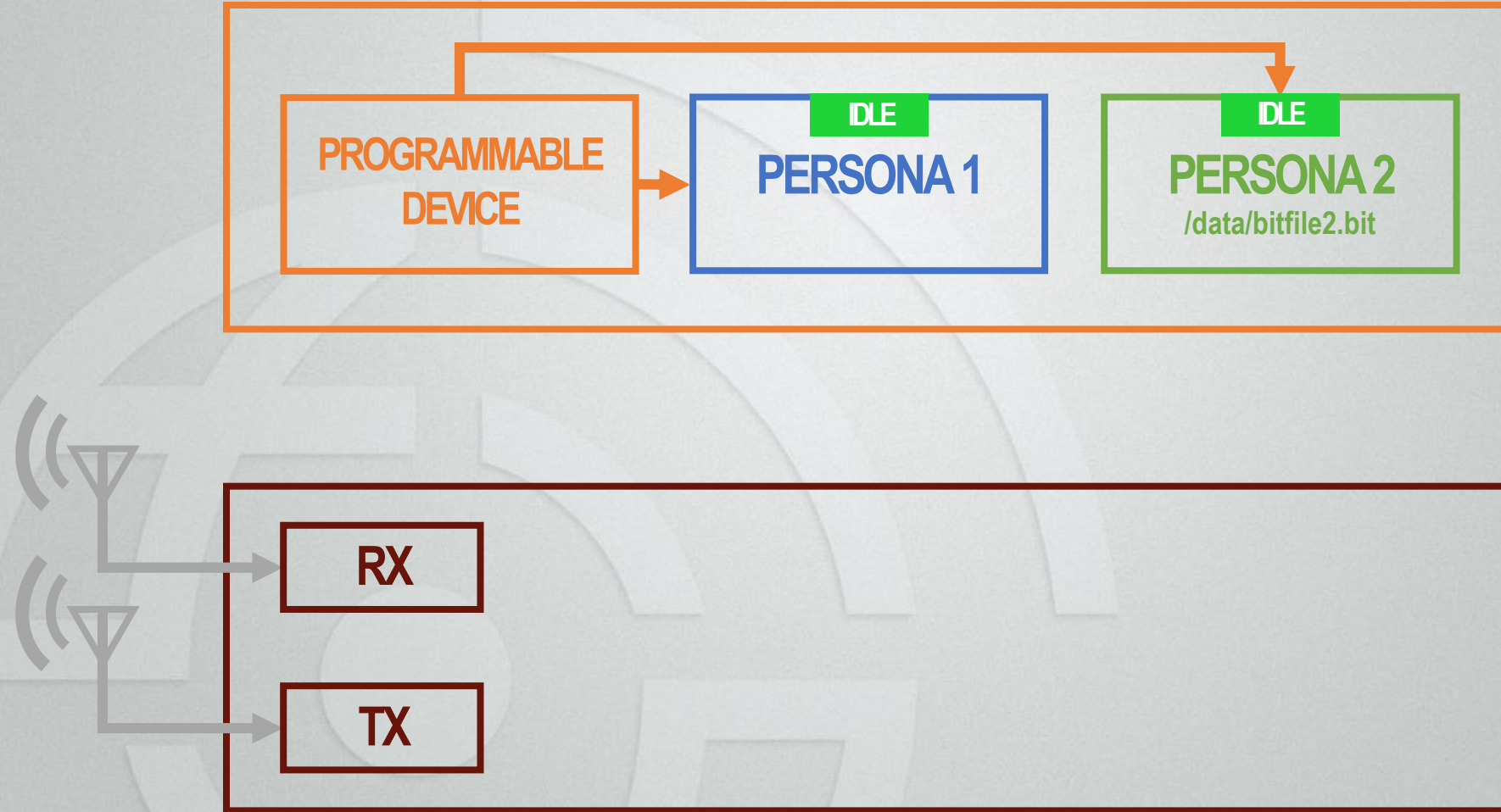
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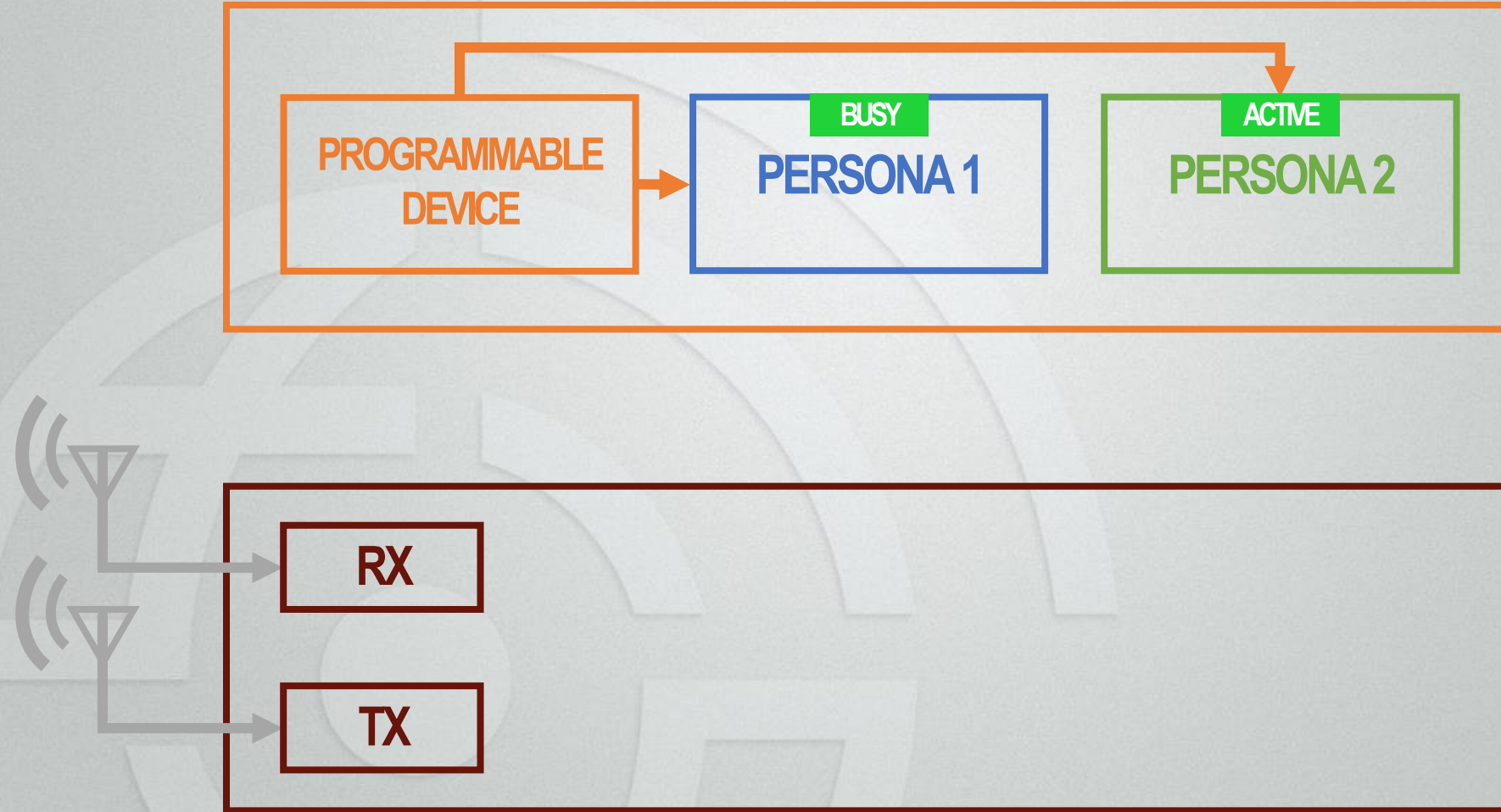
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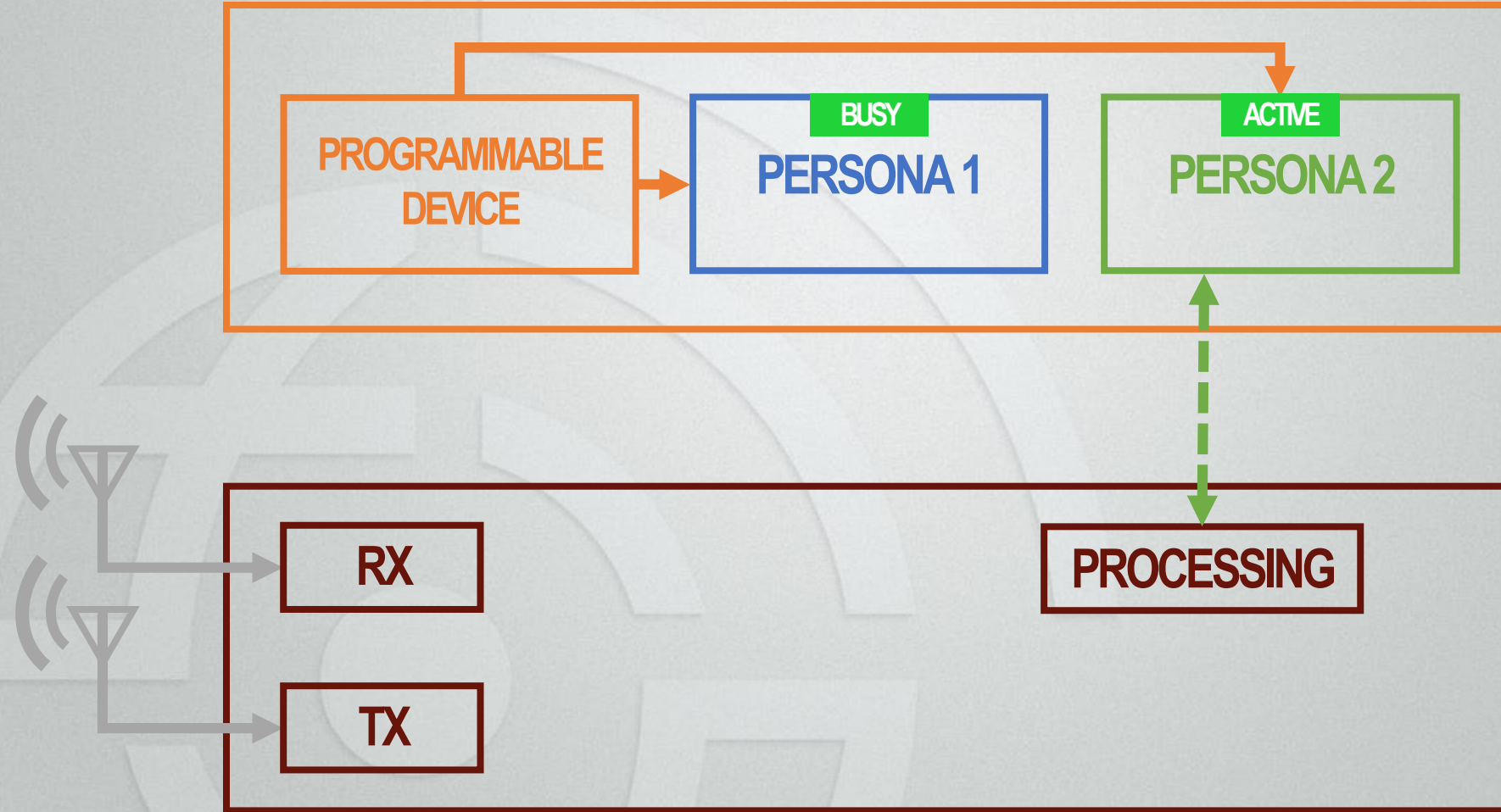
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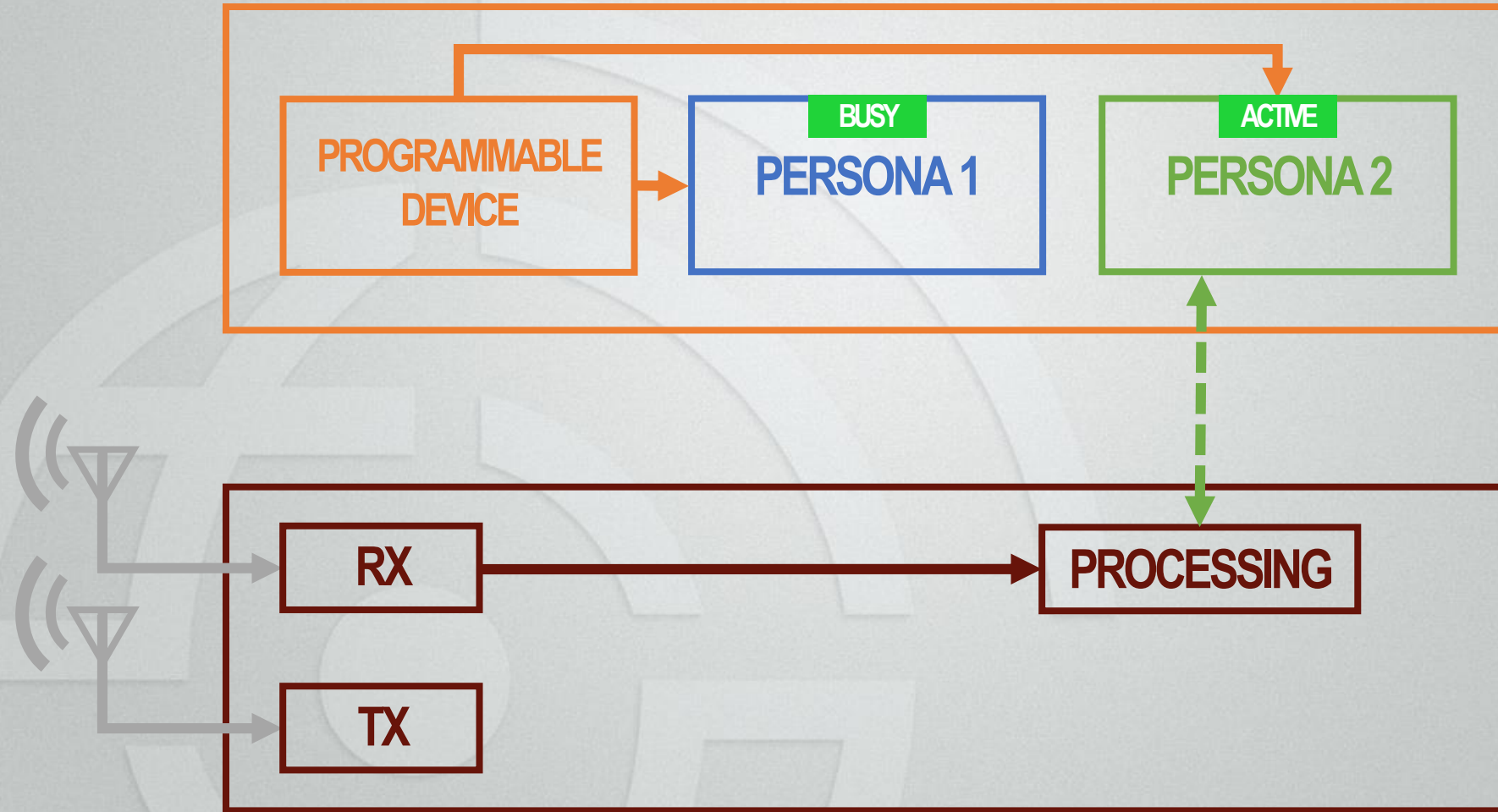
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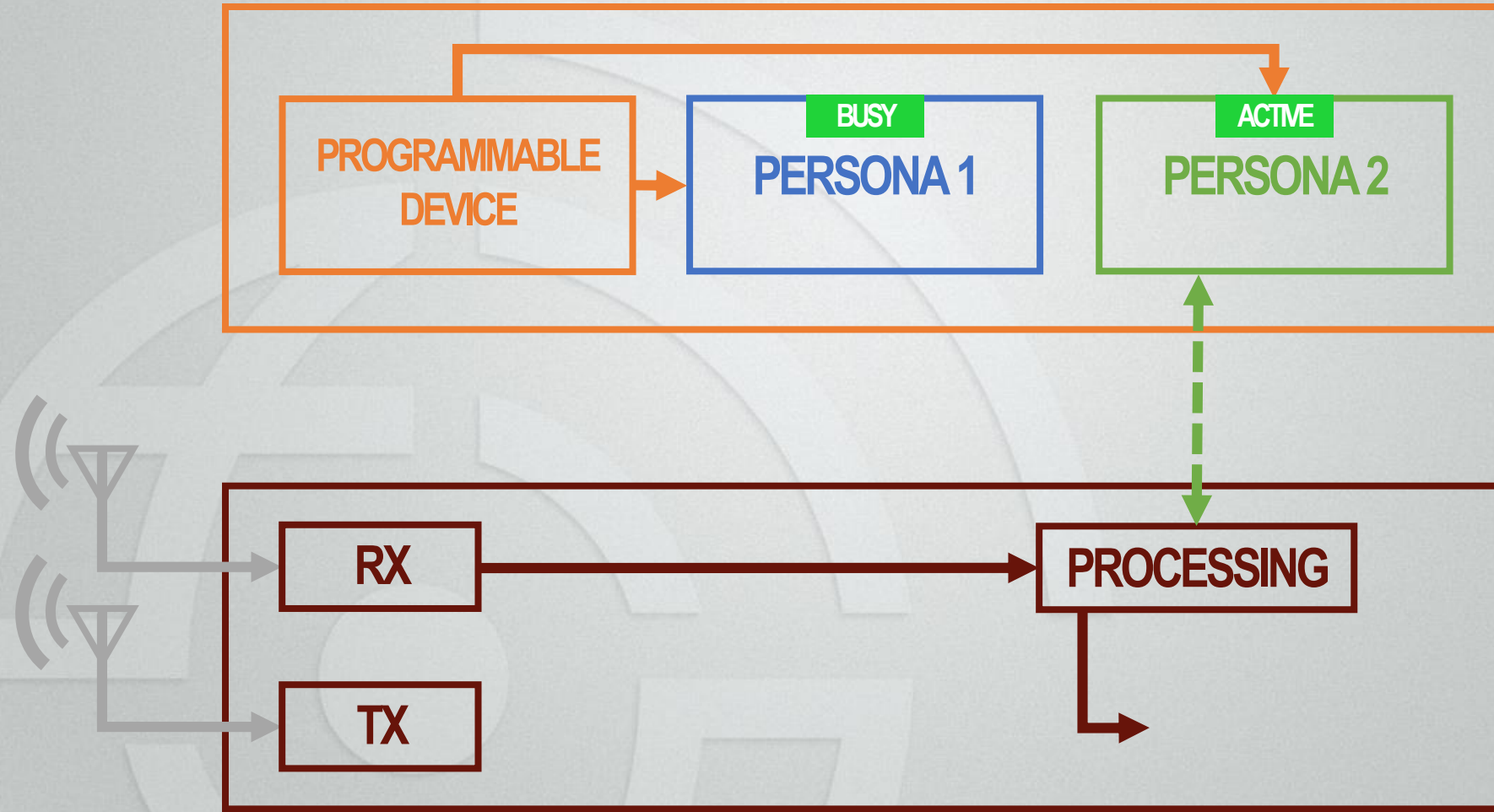
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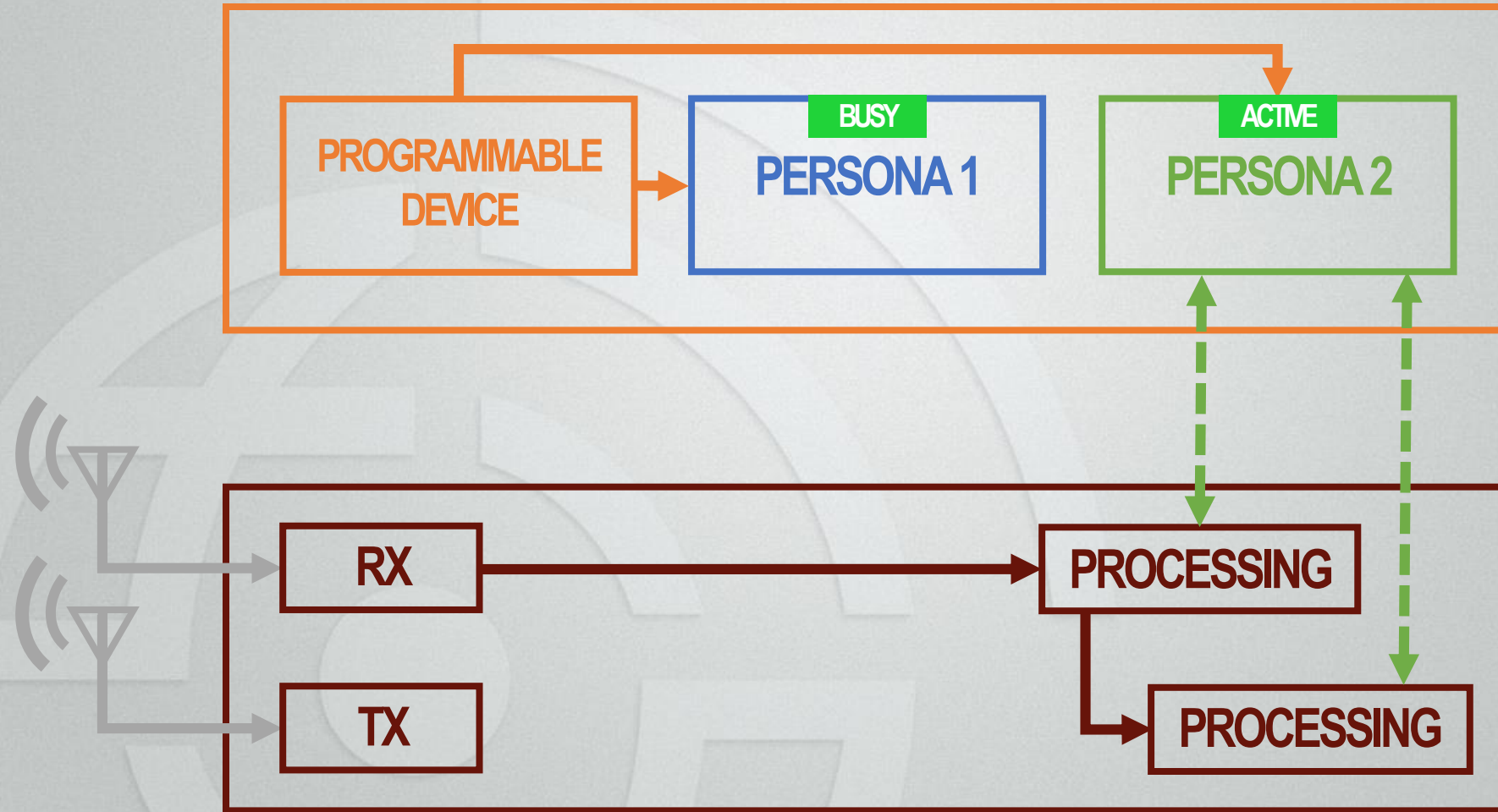
INTEGRATED PERSONA FLOW



INTEGRATED PERSONA FLOW



INTEGRATED PERSONA FLOW



Hardware-Accelerated Components

- Serve as interface to portion of bit file abilities
 - Command and control
 - Data flow to and/or from FPGA
- RF-NoC Hardware-Accelerated Components
 - Allowed access to block(s) by RF-NoC Persona
 - Connected in-fabric by RF-NoC Persona
 - Included in REDHAWK application description
 - Block flow described by application developer, not device developer

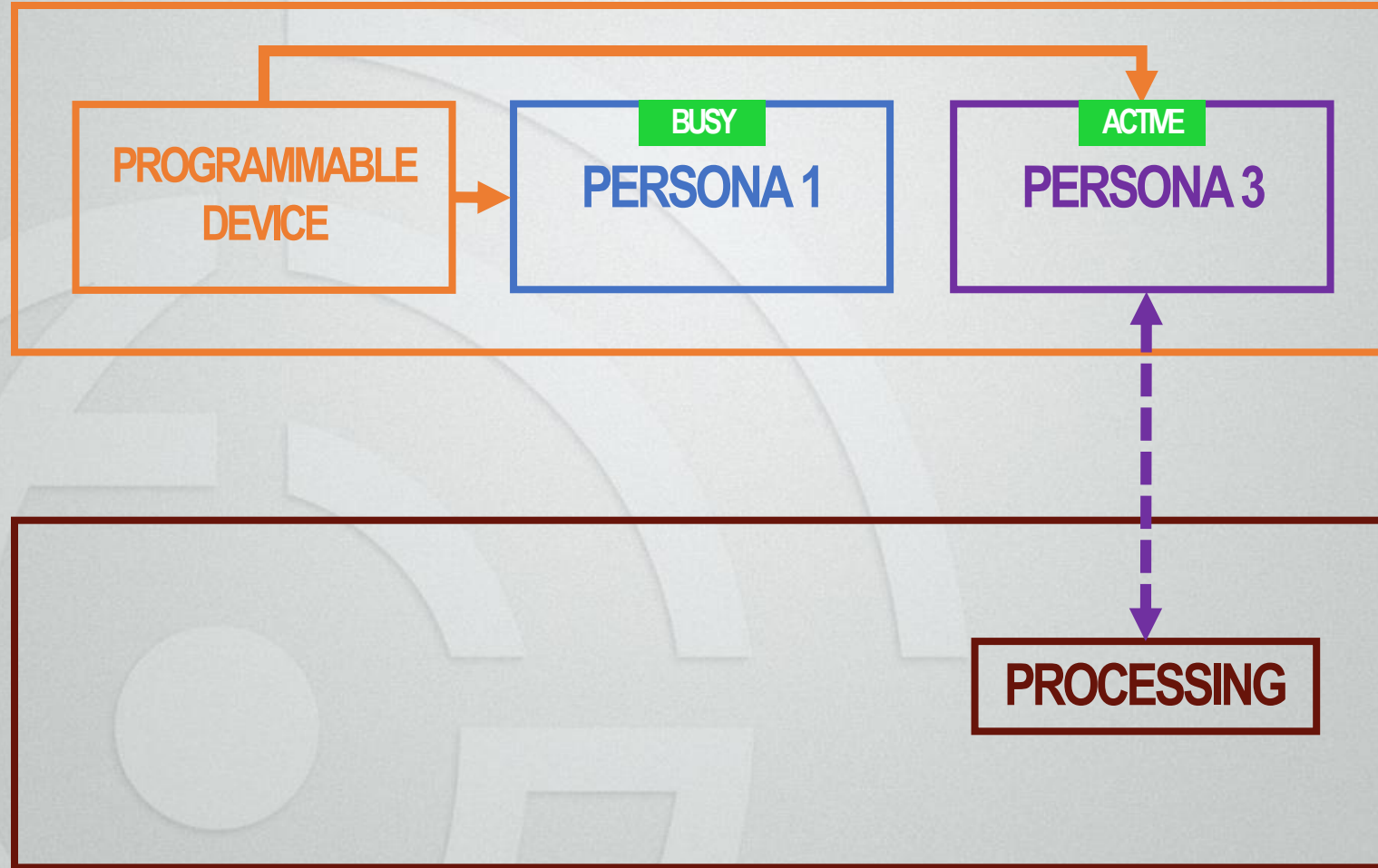
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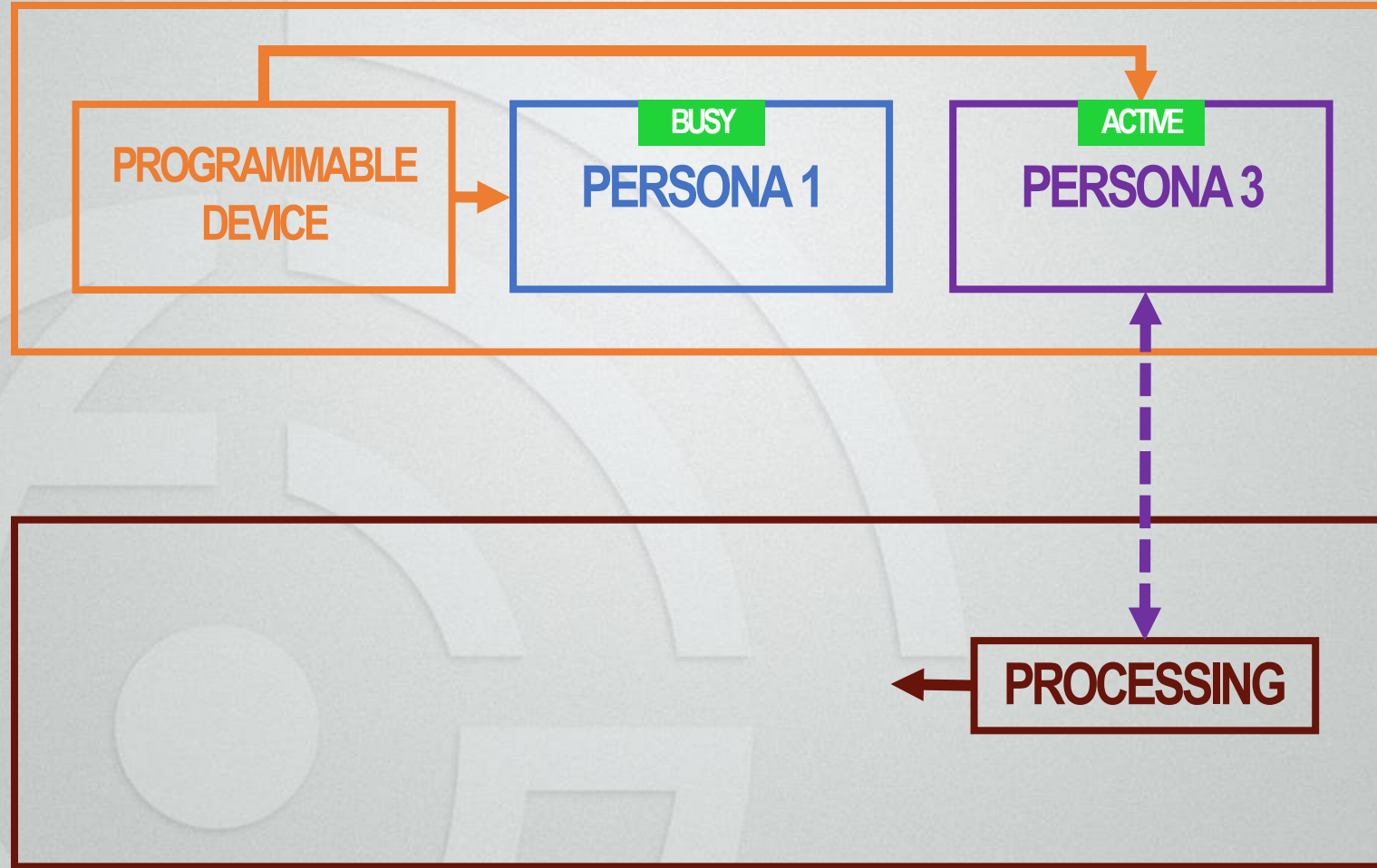
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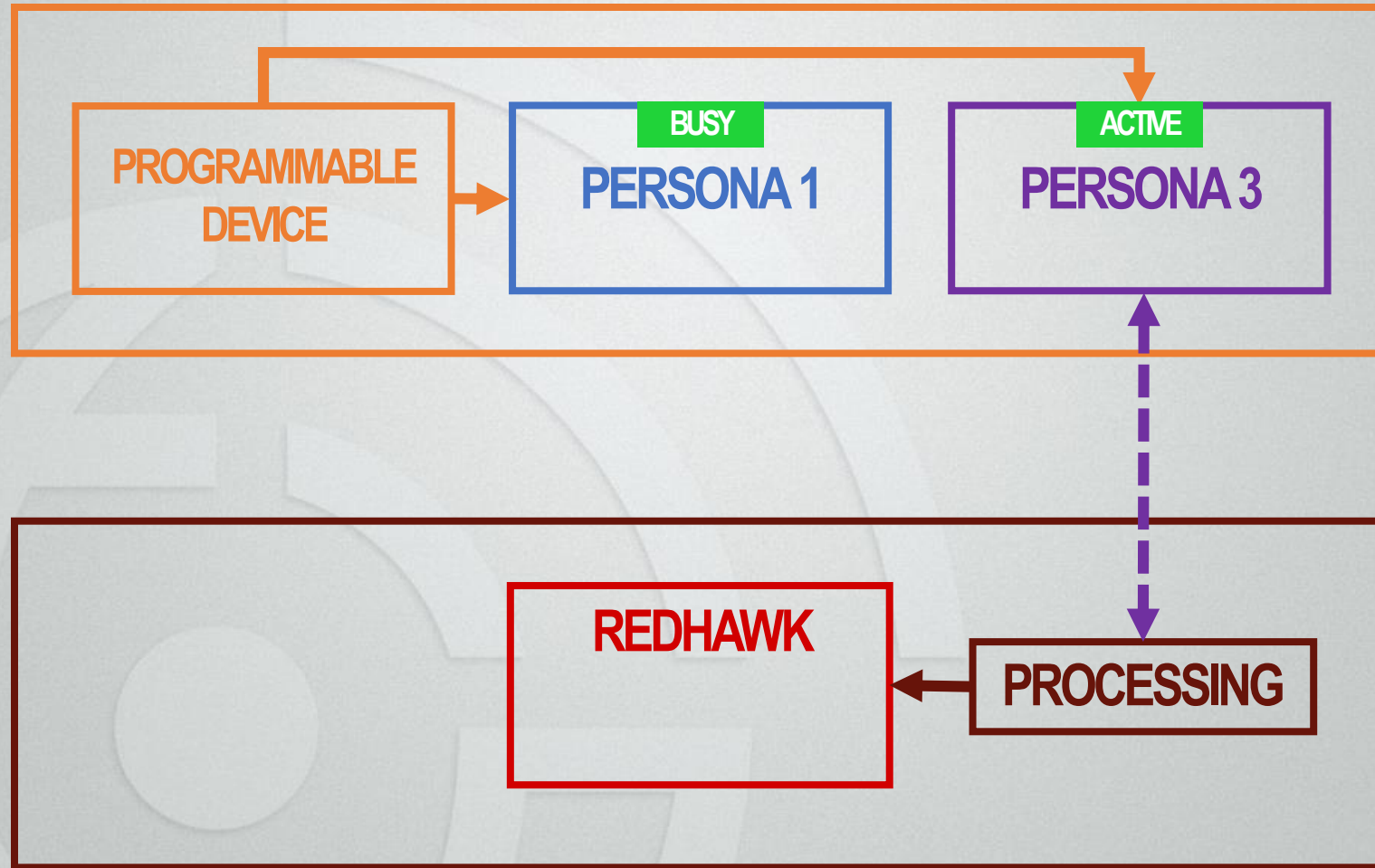
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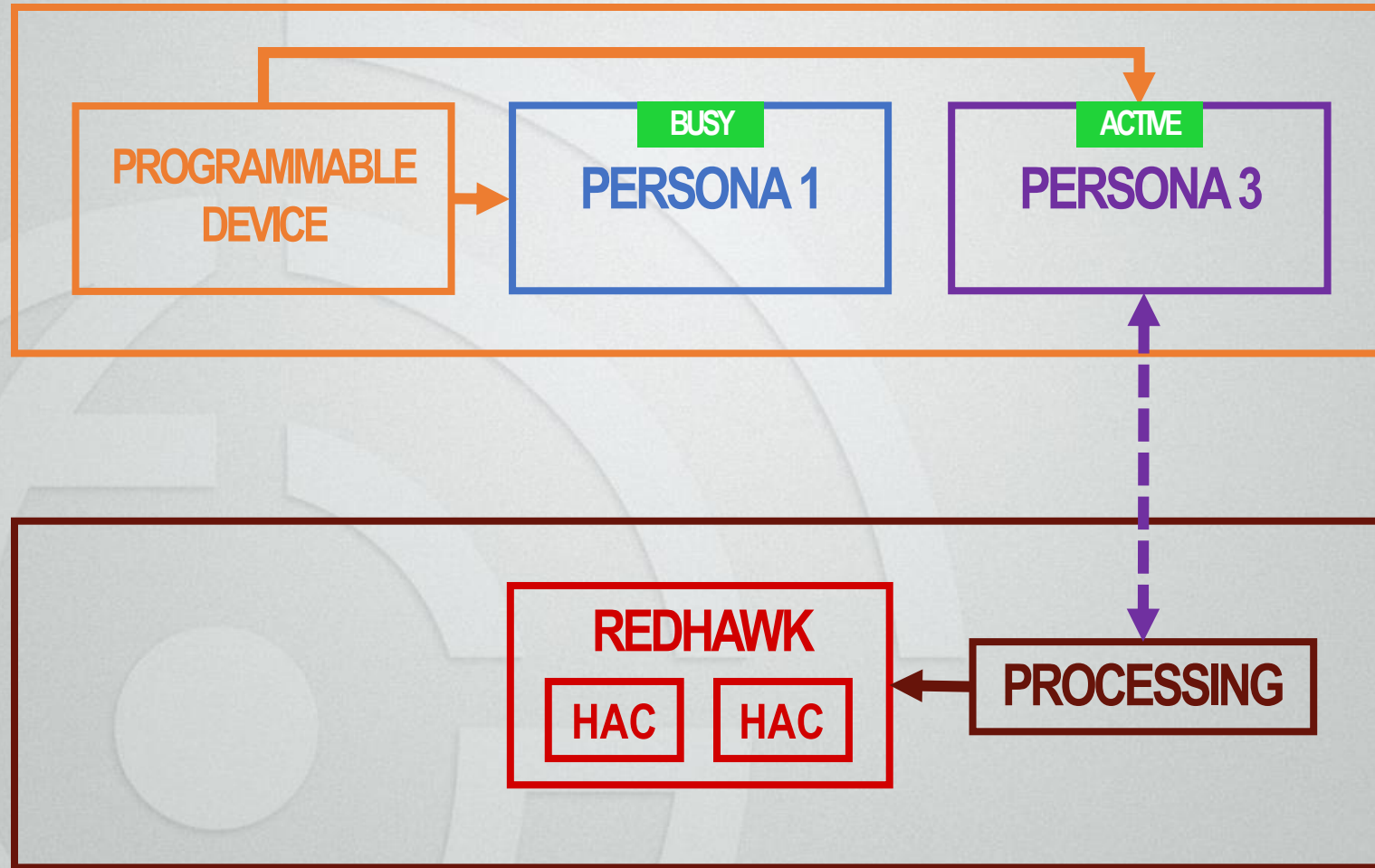
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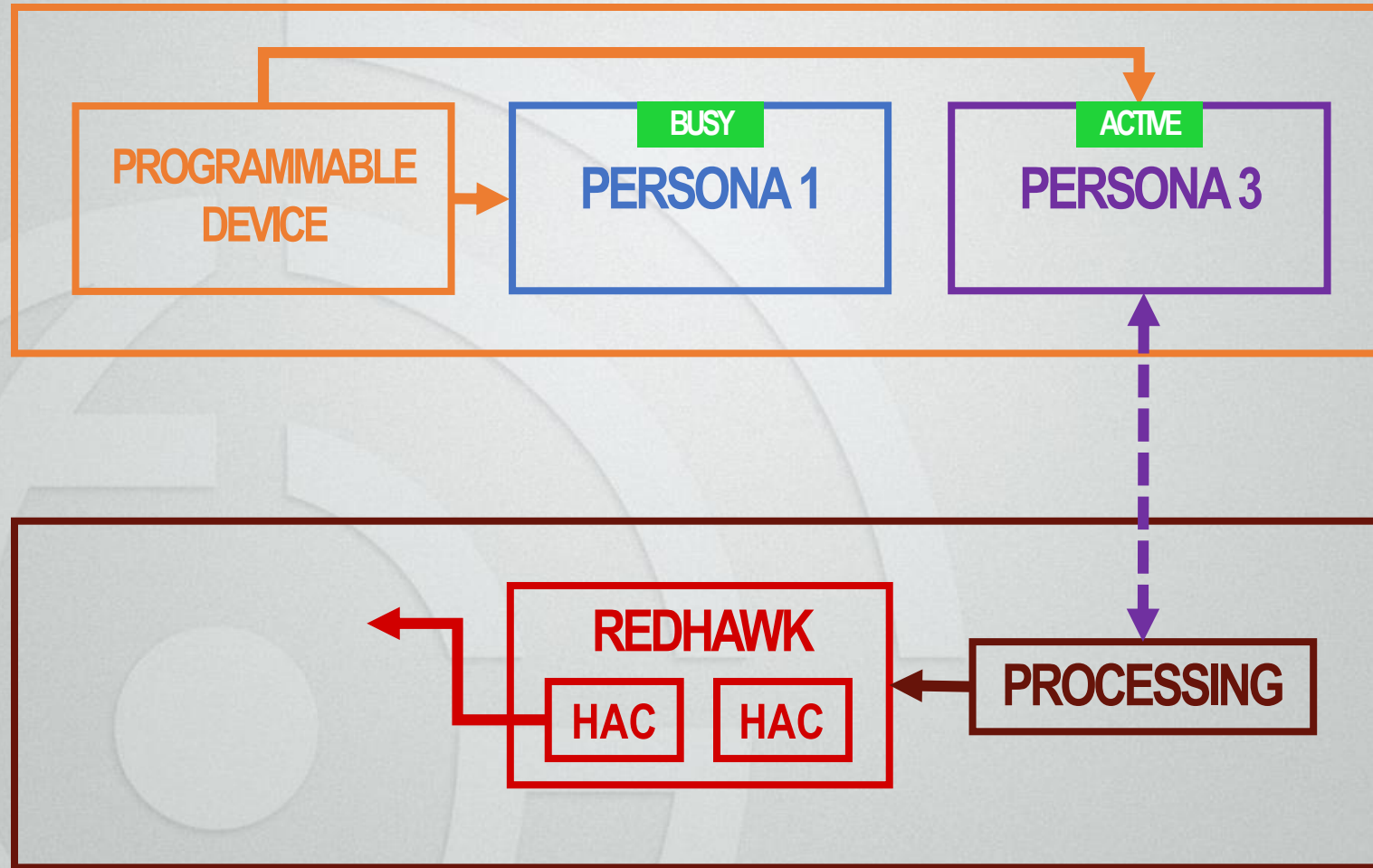
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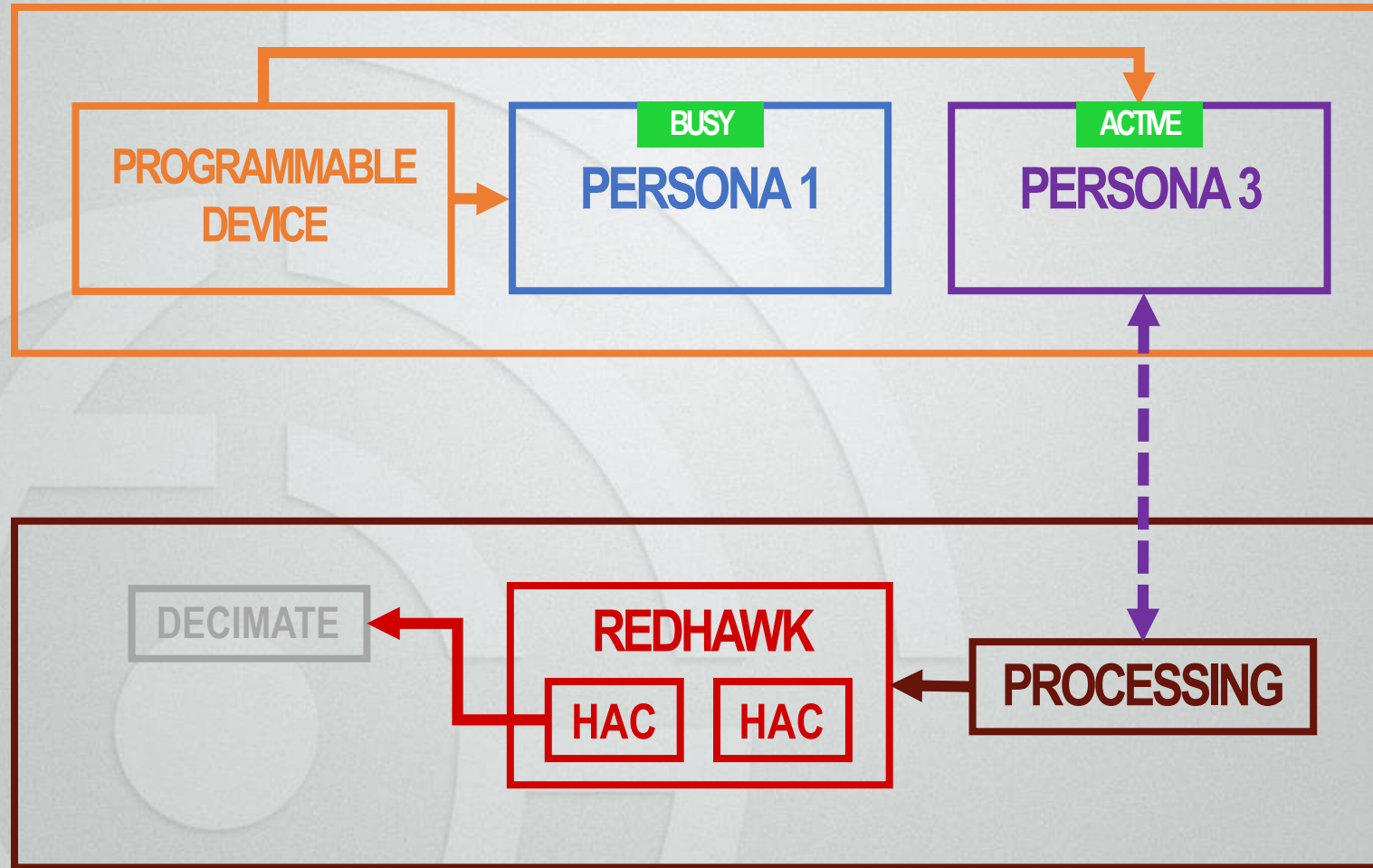
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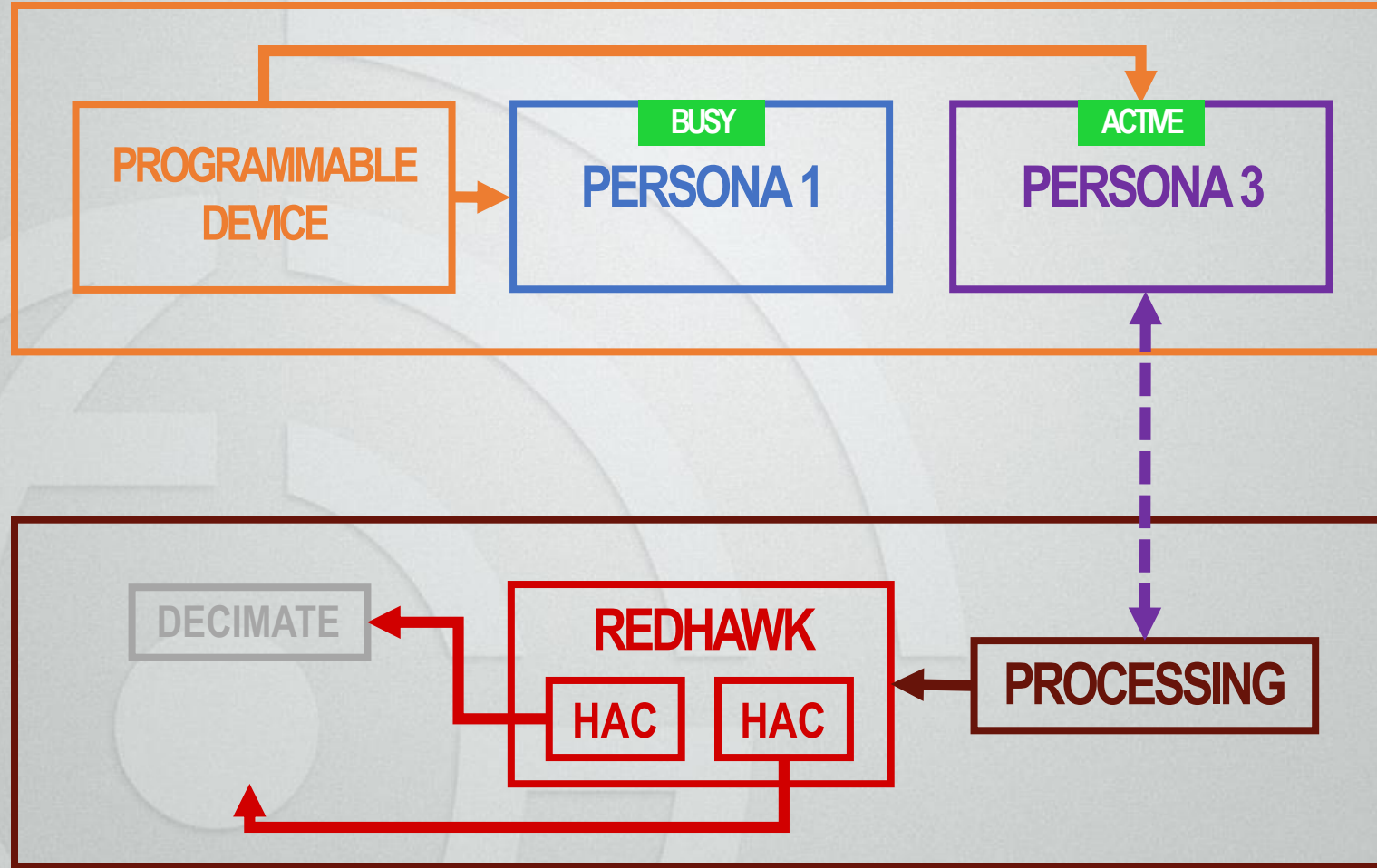
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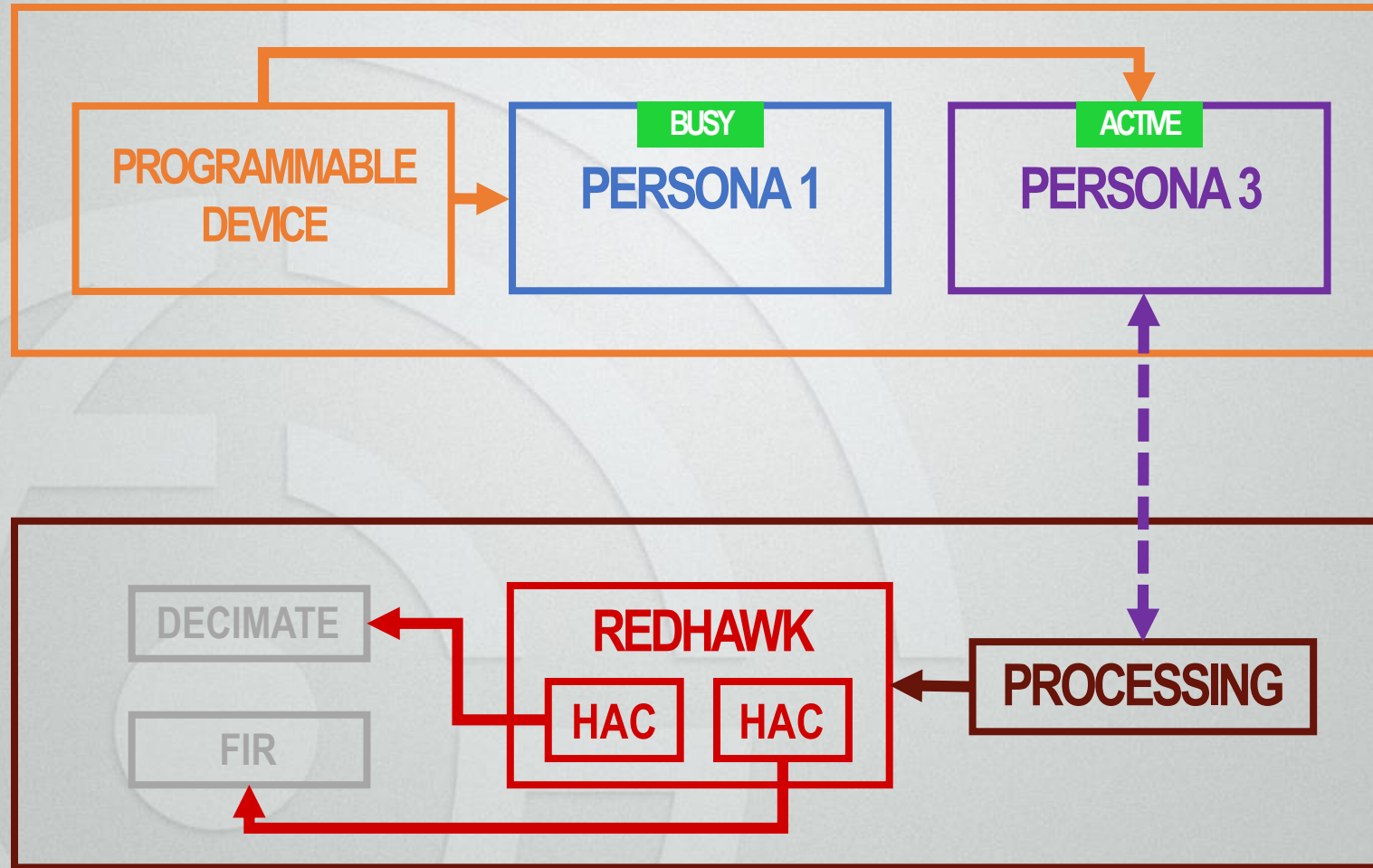
HARDWARE ACCELERATED COMPONENT



HARDWARE ACCELERATED COMPONENT



HARDWARE ACCELERATED COMPONENT



Demo



Moving Forward

- Upgrades
 - REDHAWK 2.1.x
 - RF-NoC
- Fix Host to FPGA capability
- Allow for multiple streamers
- Code generator for HAC developers
- Documentation

Special Thanks

- Trevor Plumley

Questions?