Automated Management of Libera SPARK Module IOCs in SPEAR3

SLAC NATIONAL ACCELERATOR LABORATORY

F. Toufexis, S. Condamoor, D. A. Morataya Campos, C.S. Ramirez, J. J. Sebek, C. Wermelskirchen, J. Corbett, SLAC, Menlo Park, CA 94025
P. Leban, M. Znidarcic, I-Tech, Solkan, Slovenia

Abstract

We are actively upgrading BPM processors in the SPEAR3 accelerator complex as several of the existing systems are reaching end-of-life. To consolidate the resources required for development and maintenance we have evaluated and installed several processors from the Libera SPARK hardware series. We found that two common deployment methods typically used with these modules, micro-SD card and network boot, are either hard to maintain or lack flexibility. Instead we have developed an automated method based on a network boot scheme where an external EPICS soft IOC manages the assignment of specific SPARK modules to physical BPMs in the accelerator. Each module queries the soft IOC at boot time to determine which BPM it is assigned to and then starts its IOC with the appropriate BPM prefix for the PV names. This deployment method allows for quick, seamless swapping of SPARK modules by machine operators or physicists. It addition, it allows us to bring additional modules online for testing, or to move modules to different locations with a different PV prefix for the new location. This method is applicable to other EPICS-enabled devices where the device hardware also hosts an IOC.

SPEAR3 Overview

- 3 GeV / 500 mA 3rd Gen. Synchrotron
  - Commissioned in 2004
  - Injector commissioned in 1990
  - Several systems near end of life

- SPEAR3 BPM System:
  - Bergoz processors for operations and FOFB (no upgrade intention)
  - In-house Echotek TbT processors for AP are reaching end of life
  - 1 SPARK-ERXR for Accelerator Physics

- Booster BPM System:
  - Single BPM processor and multiplexers to switch BPMs
  - Currently have 2 + spare SPARK-ERXR in the booster
  - Designing a multiplexer system to replace legacy multiplexers

- Transport Line BPM Systems:
  - 1990's-era Bergoz BPM processors with ~300 um resolution
  - Last two BTS BPMs have SLAC uTCA processor with ~50 um res.
  - Last two BTS BPMs physically different than the rest
  - Recently purchased 2 + spare SPARK-EL to replace uTCA

Considerations for Deployment

- SPEAR3 operates with a very small team
- Most Operators do not have the skills to log in and configure modules
- **We need an Operator to be able to swap a failed module in the middle of the night with only guidance over the phone**
- We want to be able to bring spares online and move modules to different locations while having the correct PV prefixes for the location

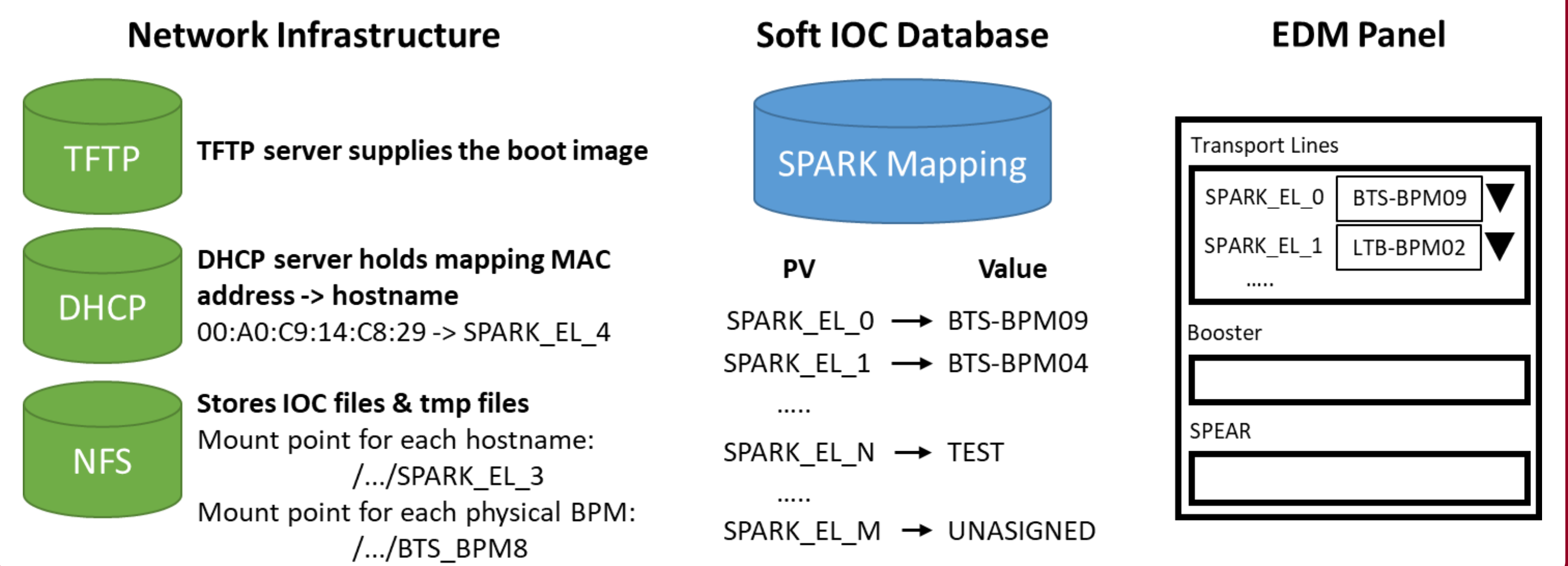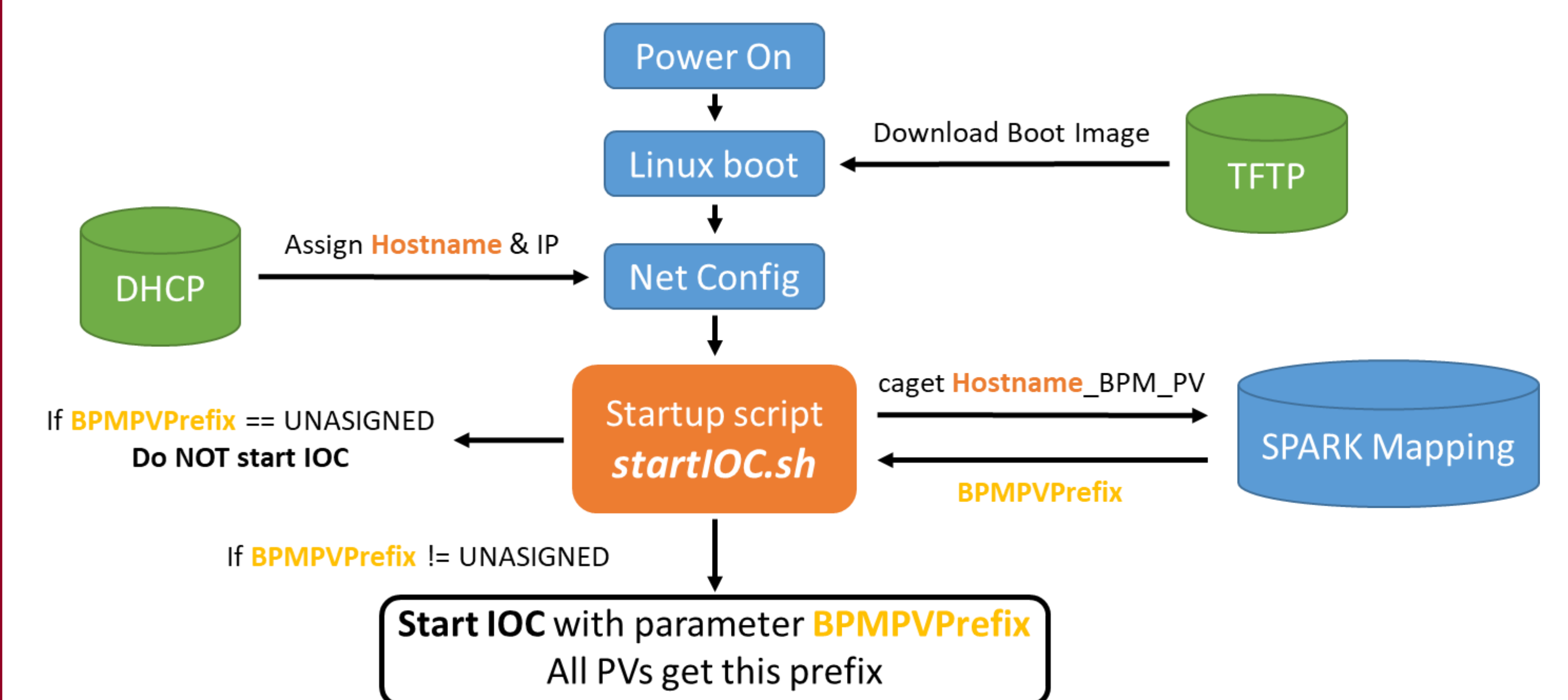| uSD-based Deployment:	Network boot-based Deployment:
Easy to swap modules	Easy to maintain and upgrade
uSD spares hard to maintain	Need to involve the network group to swap modules
Need 2 uSD per BPM	
Hard to upgrade firmware	Cannot bring spares online
Cannot bring spares online	

Network Boot with Hostname/PV Prefix DB

- Perform Network boot
- Hostnames based on BPM Processor model + Number, e.g. SPARK_EL_5
  - No connection with a physical BPM
- BPM Processor to Physical BPM mapping:
  - Handled with a Soft IOC
  - Startup script on BPM Processor queries Soft IOC **which BPM am I assigned?**
  - Soft IOC also handles settings
- **If module fails in the middle of the night:**
  - Operator assigns a spare processor to the BPM with failed module in EDM panel
  - Physically swaps the modules & powers up the new module
  - Network group updates a repaired module in DHCP when convenient
- We can bring spare modules online to check them without affecting ops

Infrastructure

Network Infrastructure

- TFTP — TFTP server supplies the boot image
- DHCP — DHCP server holds mapping MAC address -> hostname
  00:A0:C9:14:C8:29 -> SPARK_EL_4
- NFS — Stores IOC files & tmp files
  Mount point for each hostname: /.../SPARK_EL_3
  Mount point for each physical BPM: /.../BTS_BPM8

Soft IOC Database — SPARK Mapping

PV	Value
SPARK_EL_0 →	BTS-BPM09
SPARK_EL_1 →	BTS-BPM04
.....	
SPARK_EL_N →	TEST
.....	
SPARK_EL_M →	UNASSIGNED

EDM Panel

Transport Lines

SPARK_EL_0	BTS-BPM09 ▼
SPARK_EL_1	LTB-BPM02 ▼
.....	

Booster

SPEAR

SPARK Boot Sequence (simplified)

Power On → Linux boot (Download Boot Image ← TFTP) → Net Config (DHCP: Assign **Hostname** & IP) → Startup script **startIOC.sh** (caget **Hostname**_BPM_PV → SPARK Mapping → **BPMPVPrefix**)

If **BPMPVPrefix** == UNASSIGNED **Do NOT start IOC**

If **BPMPVPrefix** != UNASSIGNED

Start IOC with parameter **BPMPVPrefix** — All PVs get this prefix

Current Status

- **We have demo'ed the boot process in the Transport Lines**
- 2 SPARK-EL installed in parallel with the uTCA with 10dB couplers
  - Working on network authentication, time, etc..
  - Need to port steering codes to use SPARK-EL PVs
- In the process of installing Beam Loss Monitors using the same scheme