A Converter-Based Hardware Testbed Hybrid Microgrid Emulator of a Flexible Manufacturing Plant

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INTRODUCTION

- Increasing interest in DC microgrids has grown, due to the high demand for electronics and other high-tech loads that requires DC power.
- Most of the existing infrastructure, including power generation and distribution, is based on AC.
- 24% of the total energy was consumed by the manufacturing sector in the U.S in 2018.
- A hybrid microgrid combining DC and AC sub-grids for an example flexible manufacturing plant (FMP) is examined using a hardware testbed (HTB).
- The deployed converter HTB will model the FMP system.

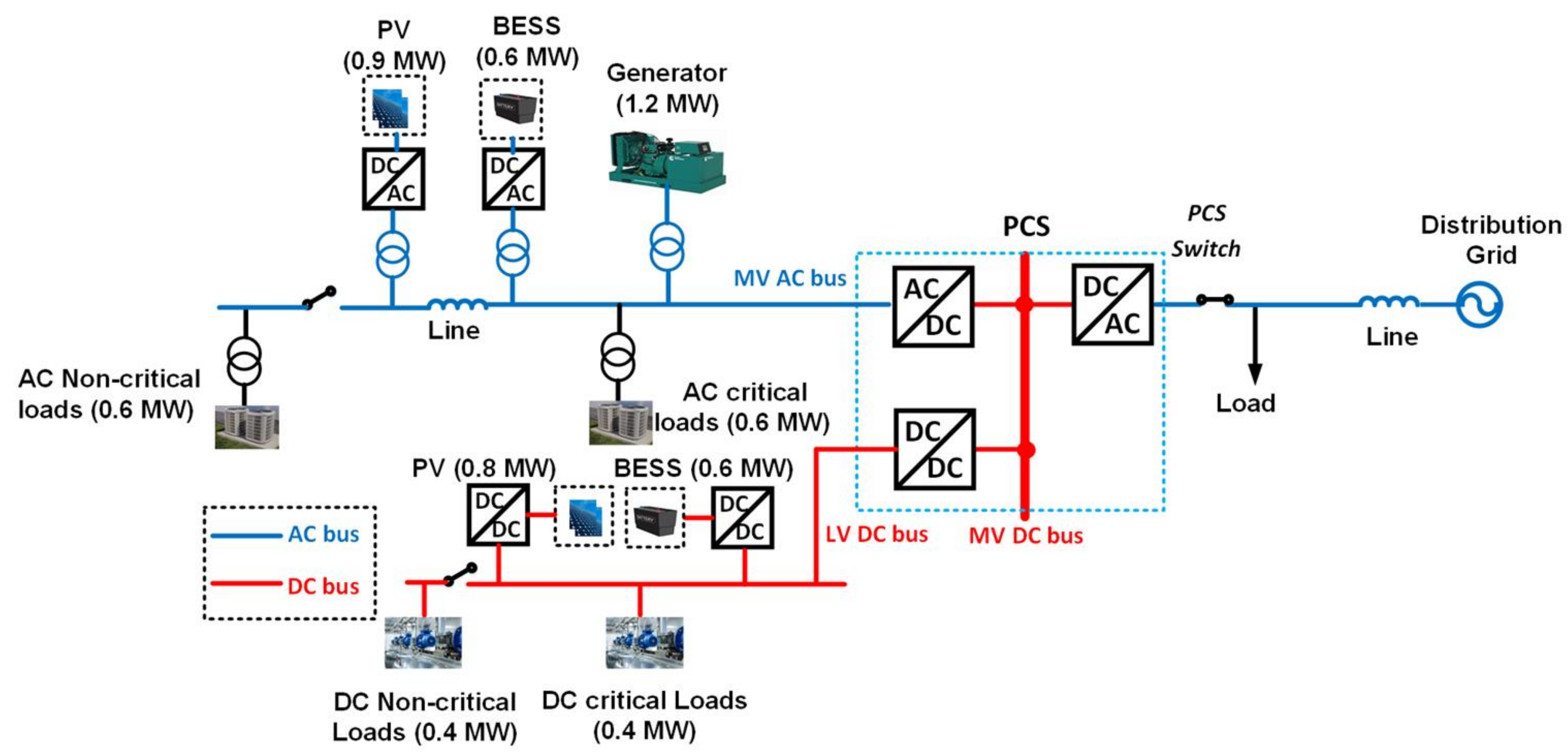

Fig. 1. Example FMP system

OBJECTIVES

- Accurately depict the system behavior to demonstrate different power flow scenarios.
- Allow for real-time measurements and flexibility in testing.
- Test control strategies and algorithms to address challenges before system deployment.
- Provide grid support to help maintain efficiency and stability of the distribution grid.

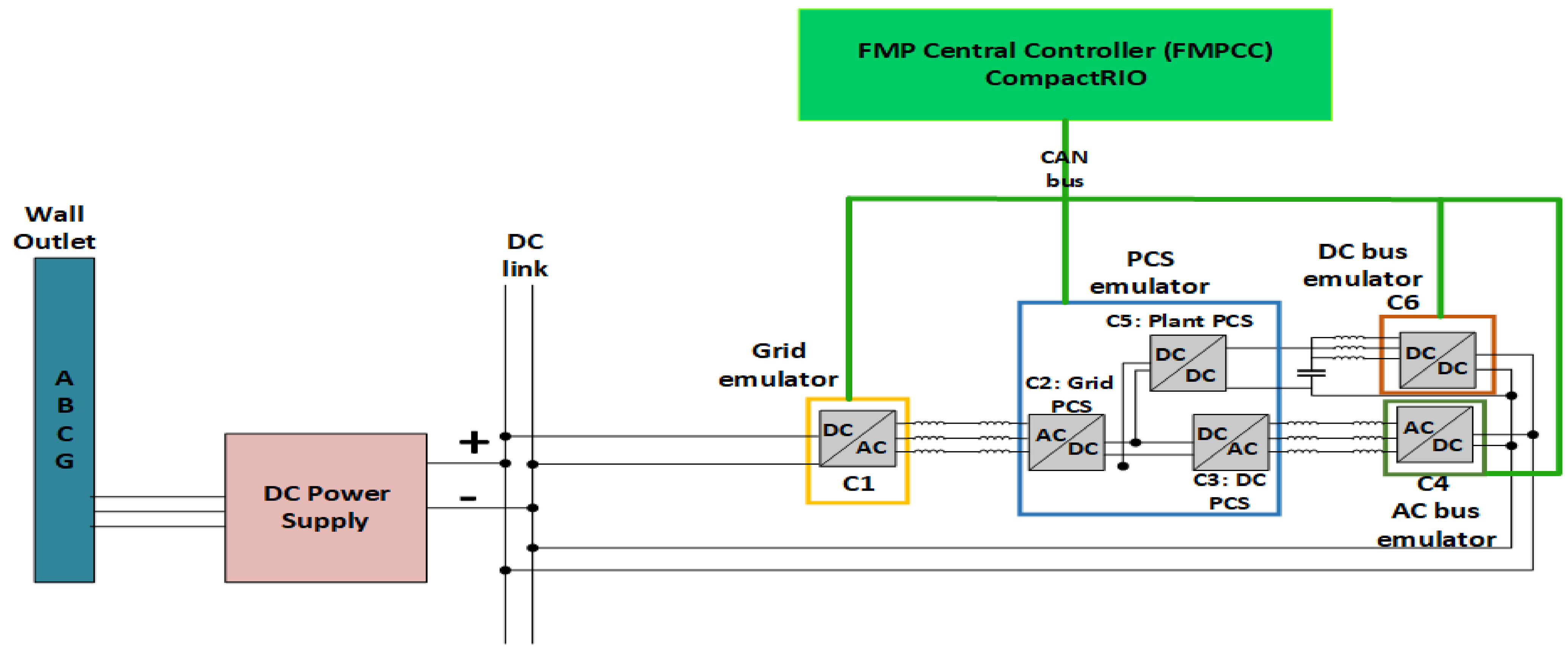

Fig. 2. Flexible manufacturing plant hybrid microgrid HTB architecture

HARDWARE TESTBED SETUP

- Six two-level, three phase converters are used to emulate the FMP system.
- A DC power supply is used to form the DC link and supplies the power losses of the system.
- A CAN bus communication protocol is used between the central controller and the local controllers.

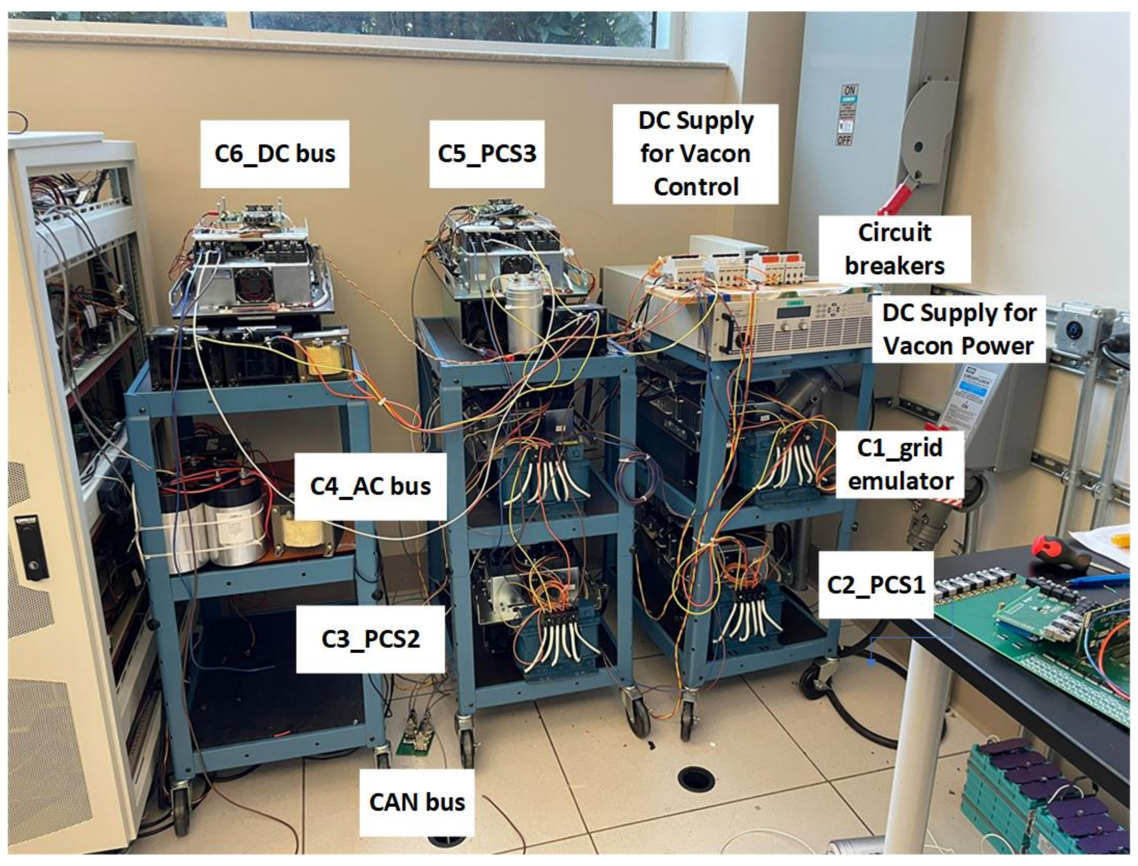

Fig. 3. Physical HTB.

Experimental Results

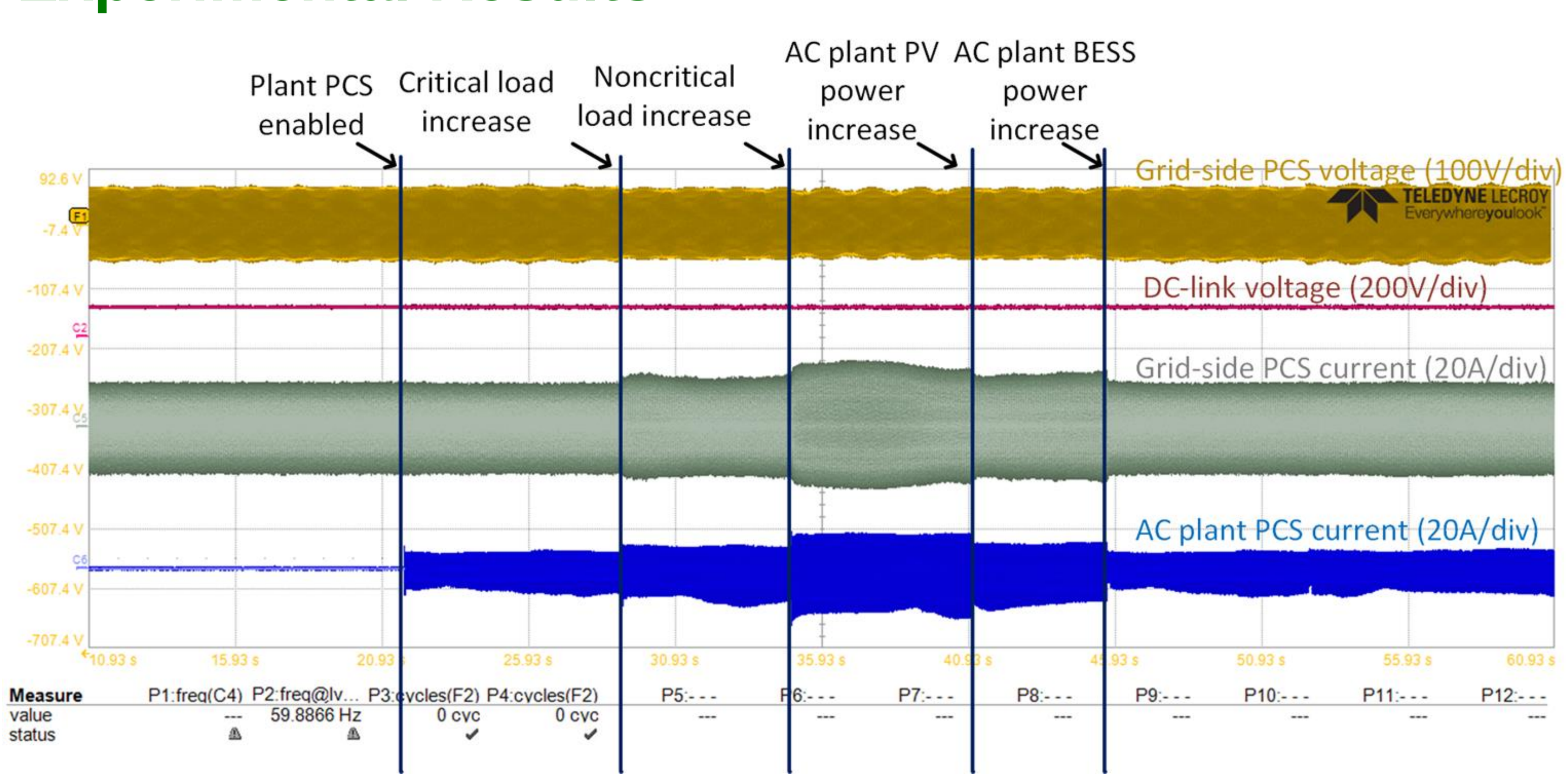

Fig. 4. AC bus in grid-connected mode

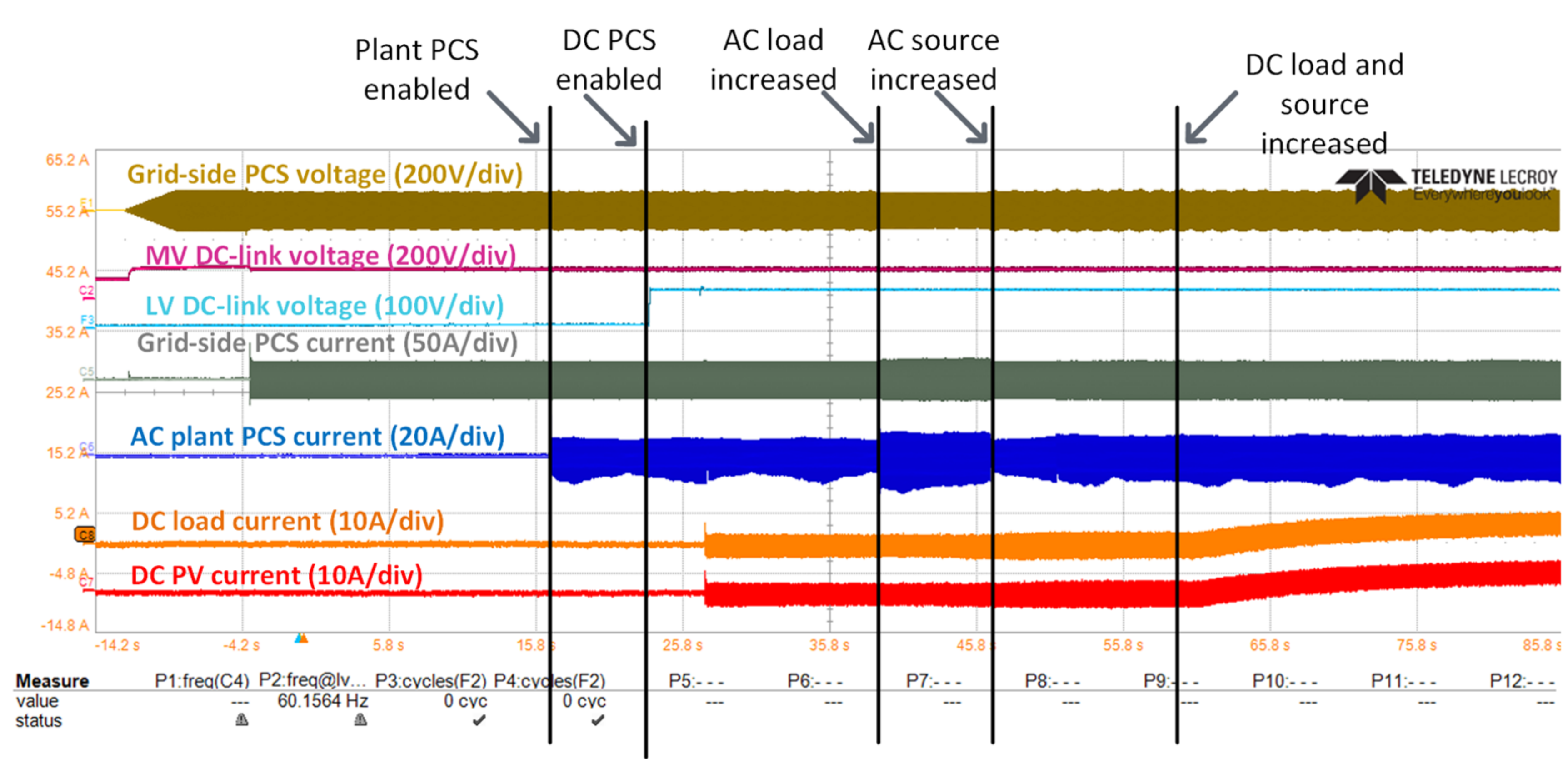

Fig. 5. FMP system in grid-connected mode

Conclusion

- An example FMP hybrid microgrid concept is introduced.
- A hardware testbed was designed and built.
- Experiments were performed to achieve grid-connected steady state operation.

Future Work

- Achieve steady-state operation in islanded mode.
- Provide grid support.
- Fault ride through capability.
- Facilitate planned and unplanned transitions.