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Introducing the power sequencing subsystem

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There is a class of physical devices that contain several discrete modules in a single package but which are represented in the kernel as separate entities. An example of such devices is the Qualcomm WCN/QCA family of WLAN/Bluetooth adapter chipsets.

Typically the WLAN and Bluetooth modules will have their own device-tree nodes - one under the PCI bridge (WLAN) and one under the serial node (Bluetooth). The relevant drivers will bind to these devices and consume assigned resources (which are usually already reference counted).

The problem arises when the two modules packaged together have interdependencies - for instance: a chipset may require a certain delay between powering-up the Bluetooth and WLAN modules (an example: Qualcomm QCA6490). In this case, reference counting alone is not sufficient and we need more fine-grained serialization.

In order to support such devices, a new driver subsystem has been proposed: the power sequencing framework[1]. It allows to abstract the shared powering-up/-down operations for multiple devices into a separate power sequence provider which knows about any possible interactions between the modules it services. The new subsystem allows for a flexible representation of the underlying hardware (e.g.: the power management unit of the WCN/QCA chips is the device node to which the power sequencer binds but on the device-tree it is represented as a PMIC exposing a set of regulators consumed by WLAN and Bluetooth nodes).

This talk will present the idea behind the new subsystem, the provider and consumer programming interfaces for drivers and how we enabled WiFi and Bluetooth support upstream for several Qualcomm platforms with the first driver based on the pwrseq framework.

[1] https://lore.kernel.org/netdev/20240528-pwrseq-v8-0-d354d52b763c@linaro.org/

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