These VCUs would then run on a specialized version of the VMware ESXi virtualization layer inside the head unit, which becomes the centerpiece and provides the compute power. The sensors and actuators, which in the classical approach are connected to the ECU, would then have to be connected to a simple and universal controller, called the Remote Sensor and Actuator Module, or R-SAM. It ideally provides several analog and digital inputs as well as outputs for light or motor control, which can be configured in a way analogous to LEGO toy building bricks. These modules then communicate with their virtualized counterparts through a redundant high-speed bus, possibly even fiber optics, whereby the communication between the components is secured by micro-segmentation and firewalls. This approach to security will make it extremely difficult for attackers to hijack the systems even if they do gain access to the vehicle's systems. While this architecture might not be immediately viable for systems concerned with driving safety (such as anti-lock braking system [ABS], power-train control module [PCM], or airbag control unit [ACU]), it will certainly be able to replace most of the systems used today in the area of passenger convenience, entertainment, and navigation. Besides a radically simplified cabling and logical design allowing for lower failure rates, the benefits provide savings by reducing the number of copper-based busses, such as controller area network (CAN). Furthermore, easier software updates are possible because the software is now running on a virtualized platform for which proven update mechanisms exist. This also enables the introduction of new features to the aftermarket. Another benefit of virtualization is that various operating systems can run side by side on one head unit, providing much higher flexibility for the manufacturer to pick and choose. An additional level of safety can be introduced by having a secondary head unit residing in a physically different location, such as the trunk. Standard mechanisms within the virtualization layer would then provide seamless failover in case one of the head units is destroyed or fails for other reasons.

Figure 8. Redundancy for Better Reliability in the Software-Defined Car
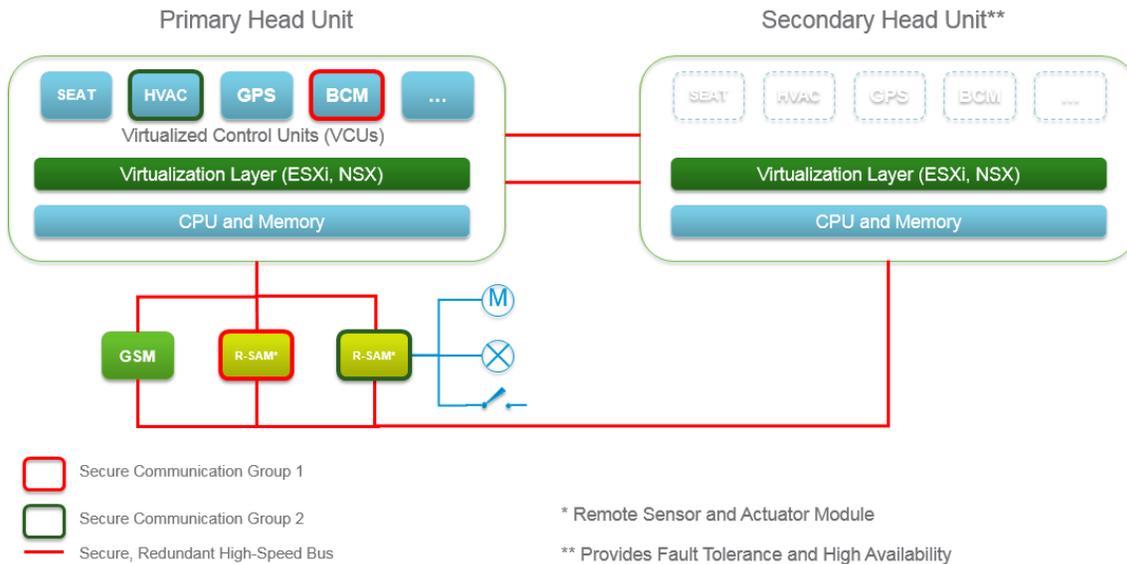
Key Takeaway 6: Proven approaches and concepts from the software-defined data center are worth being explored in the area of connected cars.