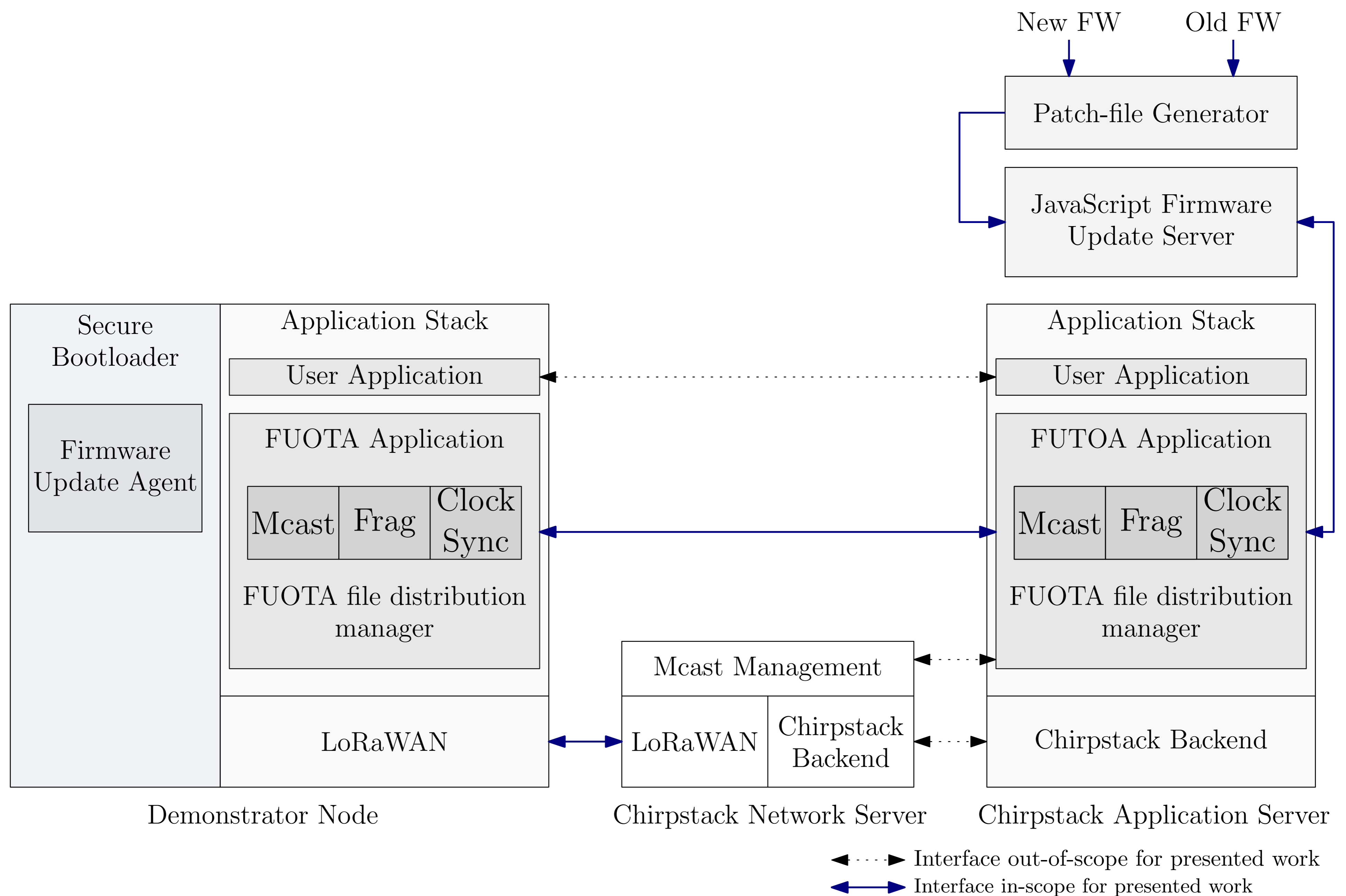
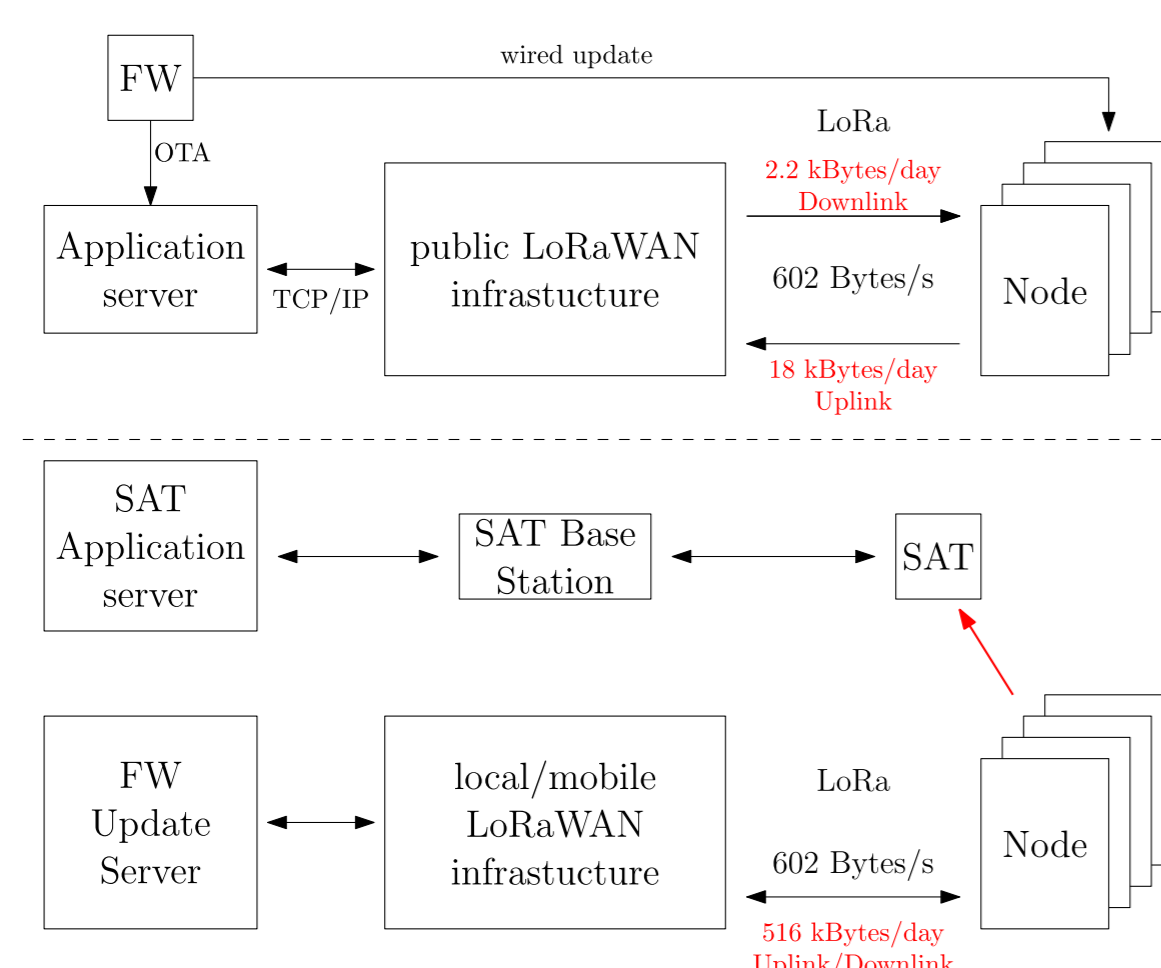


# PARALLEL MULTI-DEVICE FIRMWARE UPDATE OVER THE AIR WITH A LORAWAN NETWORK



### The Problem

As Internet-of-Things (IoT) devices take on increasingly important roles in industry, the security of these devices must be ensured. Devices that deliver incorrect data due to software errors or devices that are deliberately manipulated, must be able to be updated through software patches. There is always the possibility to update such devices physically. But regarding the fact, that usually these devices are installed in non-urban areas the approach to update them over the air is crucial. This includes the possibility to update devices, which deliver their data unidirectional via a satellite network.



### Implementation Concept

In the scope of this thesis, a demonstrator infrastructure was developed as a proof-of-concept, which can demonstrate the process of a firmware update over the air in a LoRaWAN network to several nodes simultaneously. Besides a self-developed hardware, which simulates the nodes in the field and a Firmware-Over-The-Air-Update server (FUOTA), a protocol was developed that allows to send firmware patches in parallel to a group of nodes using predefined specifications of the LoRa-Alliance. A specially developed bootloader can then merge these patches with the current firmware to create a new firmware version. The final version of the developed demonstrator includes a FUOTA server, LoRaWAN network server, gateway and a LoRaWAN node. The demonstrator is one of the first complete example implementations of the concept of firmware update over the air in a LoRaWAN network and can serve as a basis for future developments and research.

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