

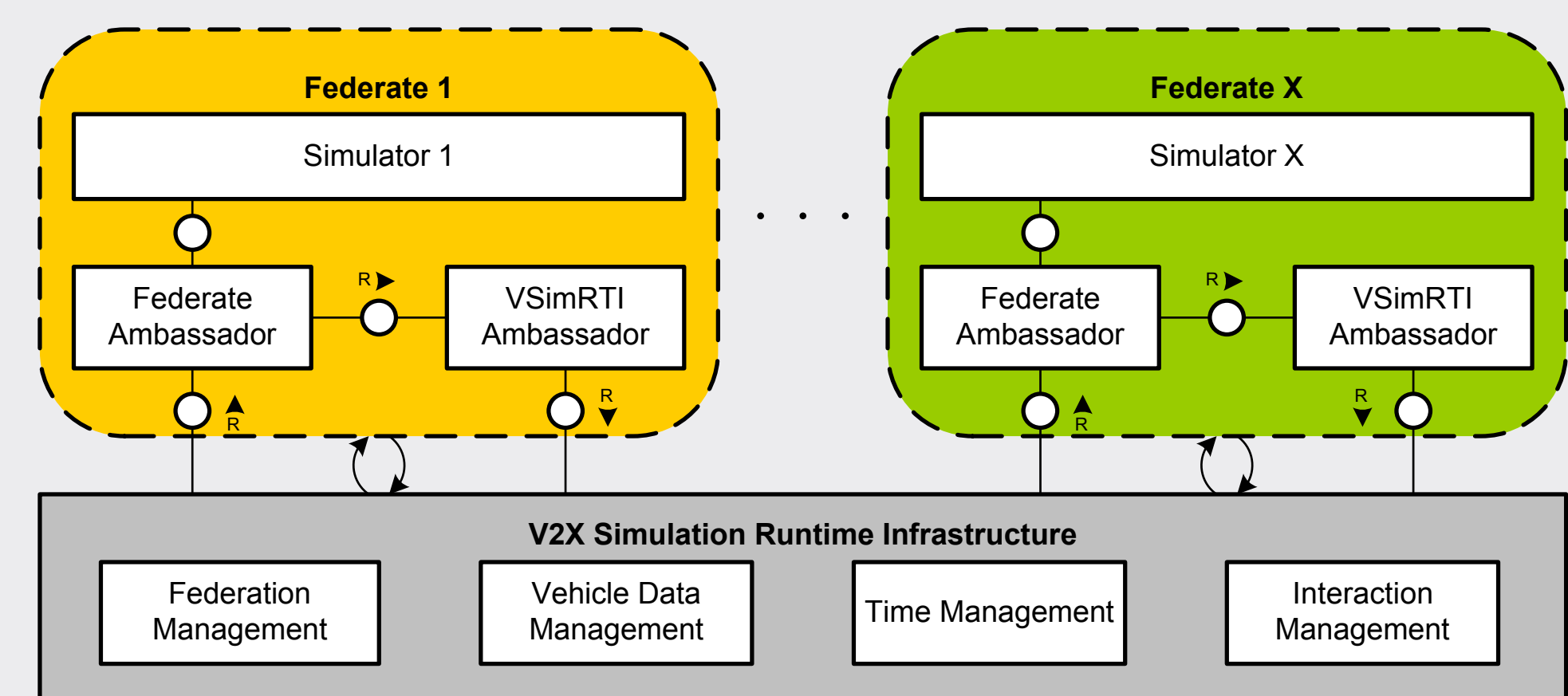
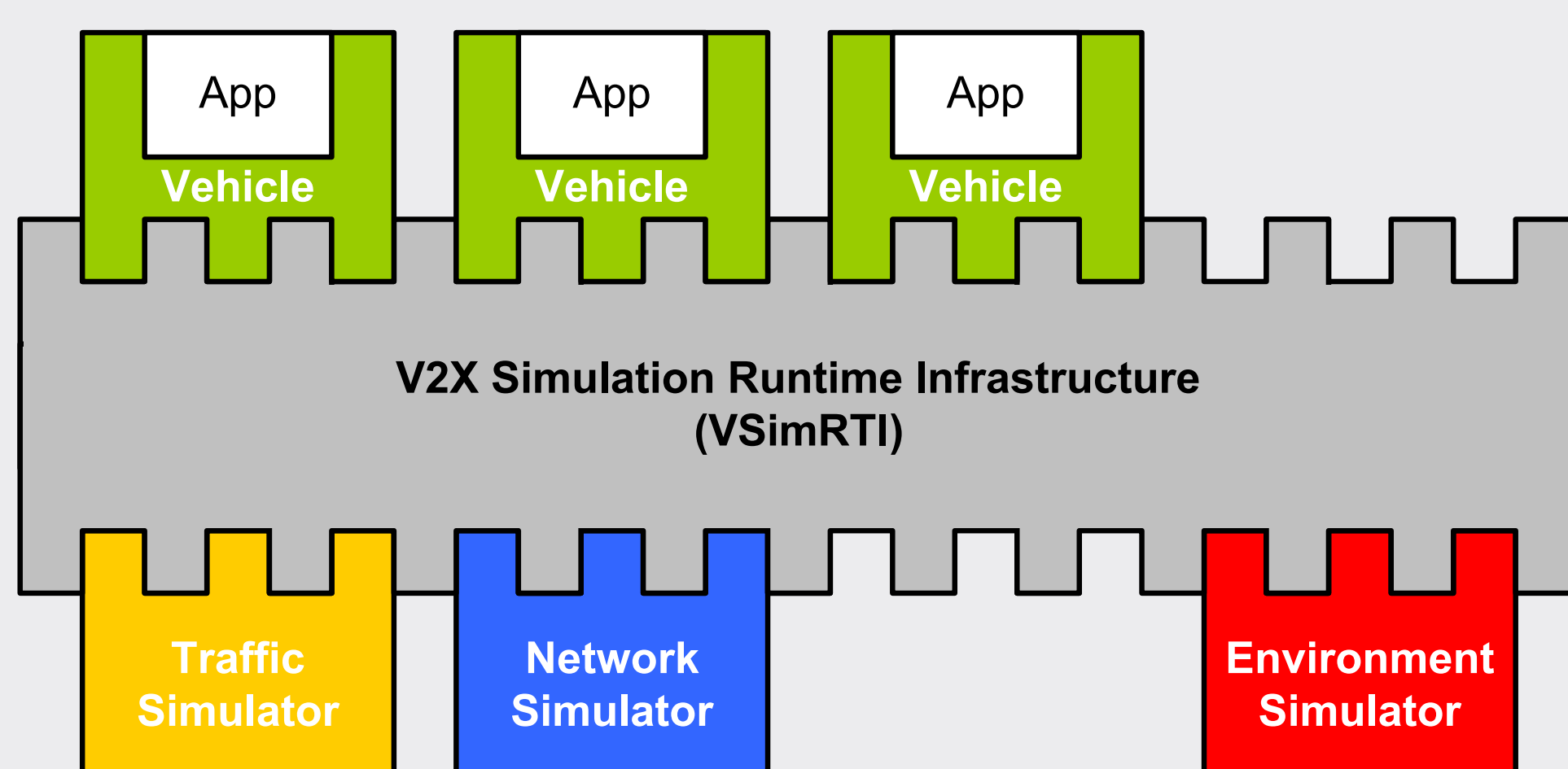
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To enable realistic simulations of Vehicle-2-X Communication applications, different kinds of simulators have to be coupled dynamically. In this work, the runtime infrastructure VSimRTI is presented allowing a flexible combination of time-discrete simulators for Vehicle-2-X simulations. Based on the requirements of a concrete scenario, arbitrary simulators can be plugged onto the VSimRTI and are executed simultaneously.

## Simulation Framework

### Idea

- Provide the flexibility to exchange simulators.
- Offer interfaces for the integration of arbitrary but specific simulators, e.g. for network, traffic, and environment simulations.
- Synchronization of and the communication among all components.
- Use concepts defined in the IEEE Standard for Modelling and Simulation (M&S) High Level Architecture (HLA).



### Design

- VSimRTI offers services handling synchronization and communication of the federates, the management of global data, and the lifecycle management of federates.
- One federate for each participating simulator.
- The original simulator is connected to its Federate Ambassador and to an instance of a VSimRTI Ambassador.
- Each federate provides an ambassador offering an interface that is used by VSimRTI to control the simulator and the interactions with other federates.

## VSimRTI: Architecture Overview

### Traffic Simulator SUMO

- Offers runtime interface TraCI to control the vehicle behaviour.
- Corresponding ambassador converts messages and management commands into a TraCI compatible format.
- Traffic generated by SUMO is used as input for the network simulator JiST/SWANS.

### Network Simulator JiST/SWANS

- Extensions allow to synchronize the internal scheduler, to modify node positions, and to send and receive packages using a socket interface.
- Corresponding ambassador connects these extensions with our simulation infrastructure.

### Environment Simulator eWorld

- Imports real road map data from OpenStreetMap.org.
- Enhances data with location-based information, like slippery roads.
- Ambassador requests location-based information at runtime of a simulation to emulate the sensors of a vehicle.

### Vehicle Application Container

- Offers the same interfaces that the runtime environment of a real vehicle provides.
- Real V2X Communication applications can be integrated without modifications.

