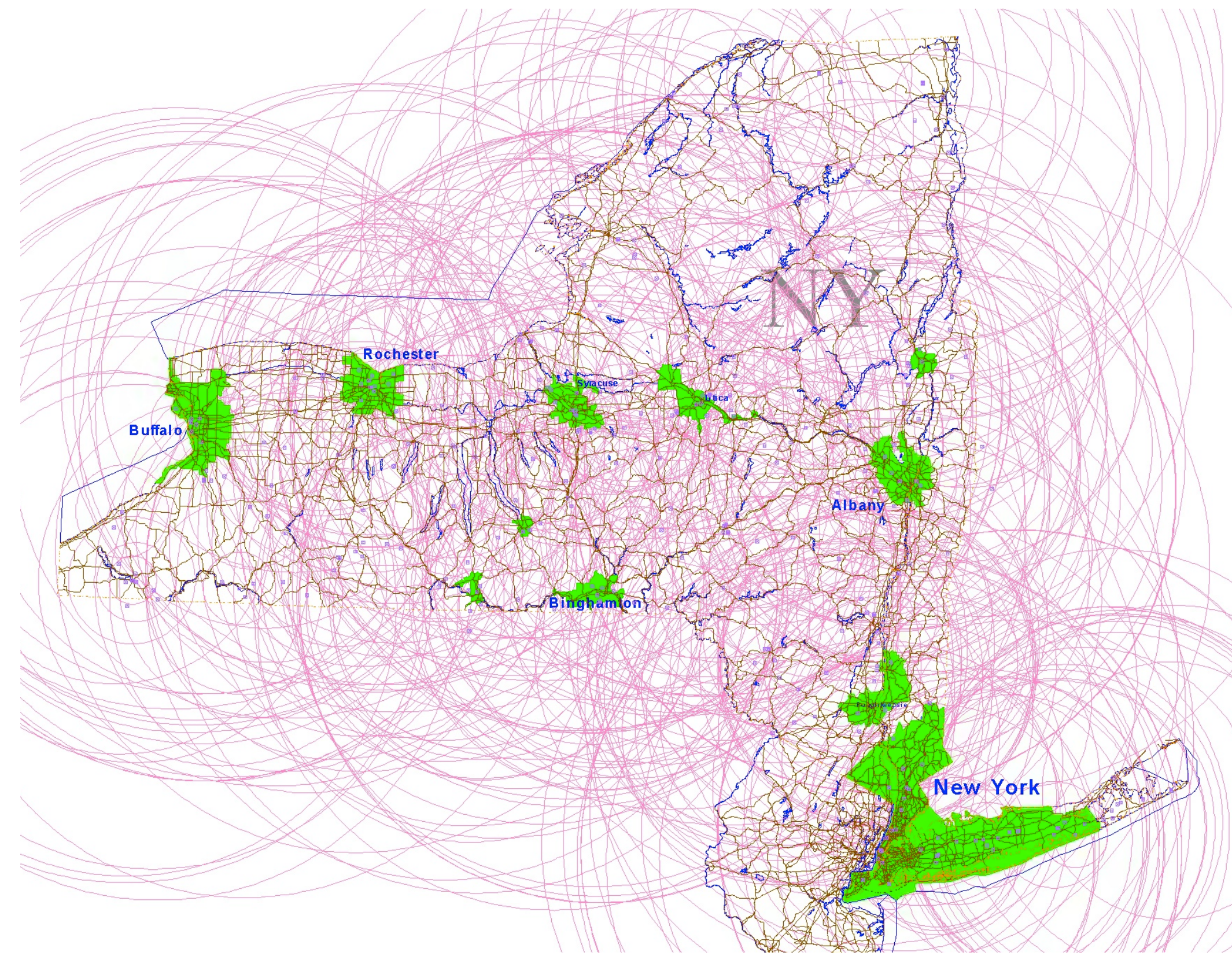


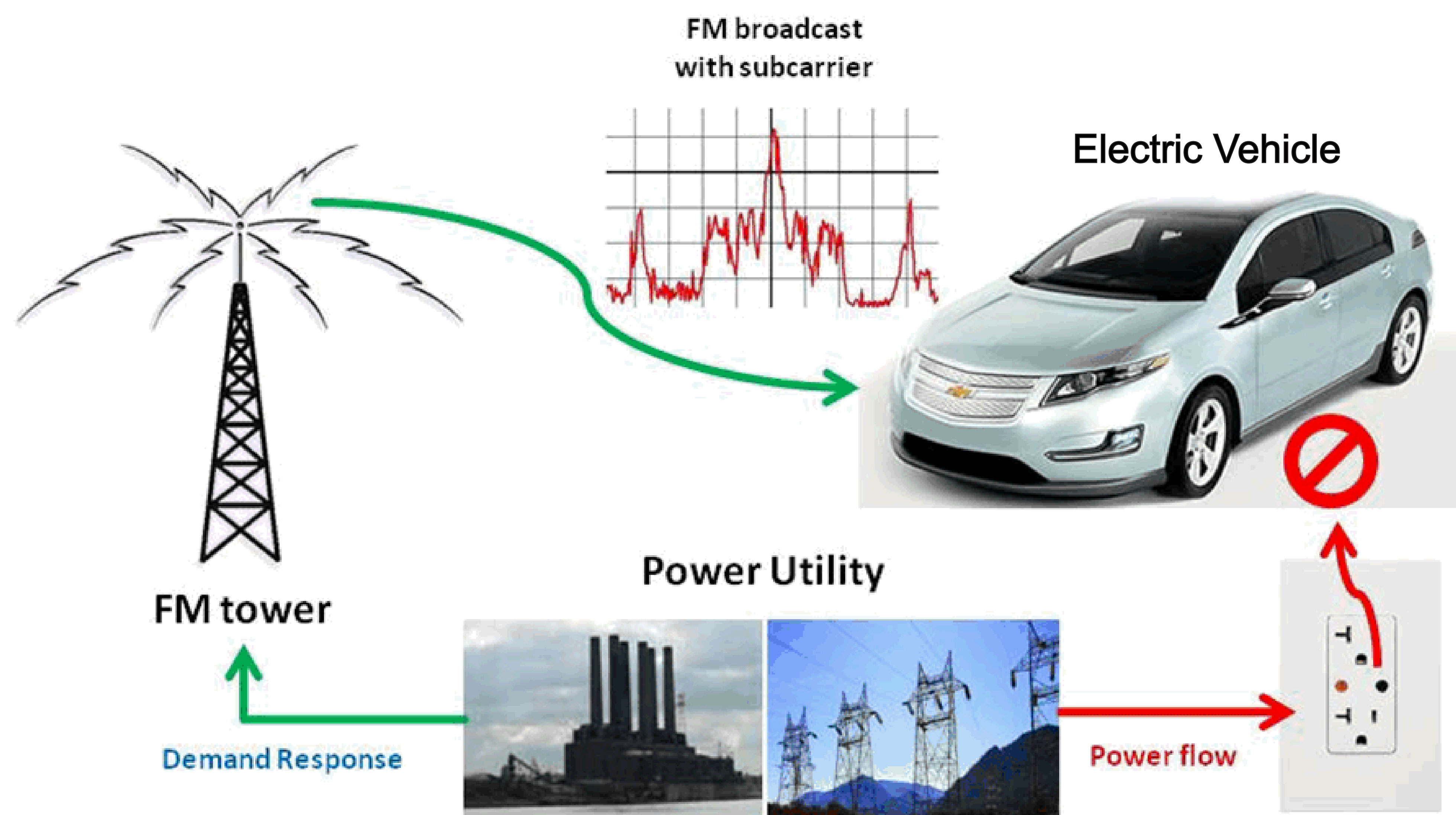
FM RDS for Smart Charging of PEVs

1. Motivation



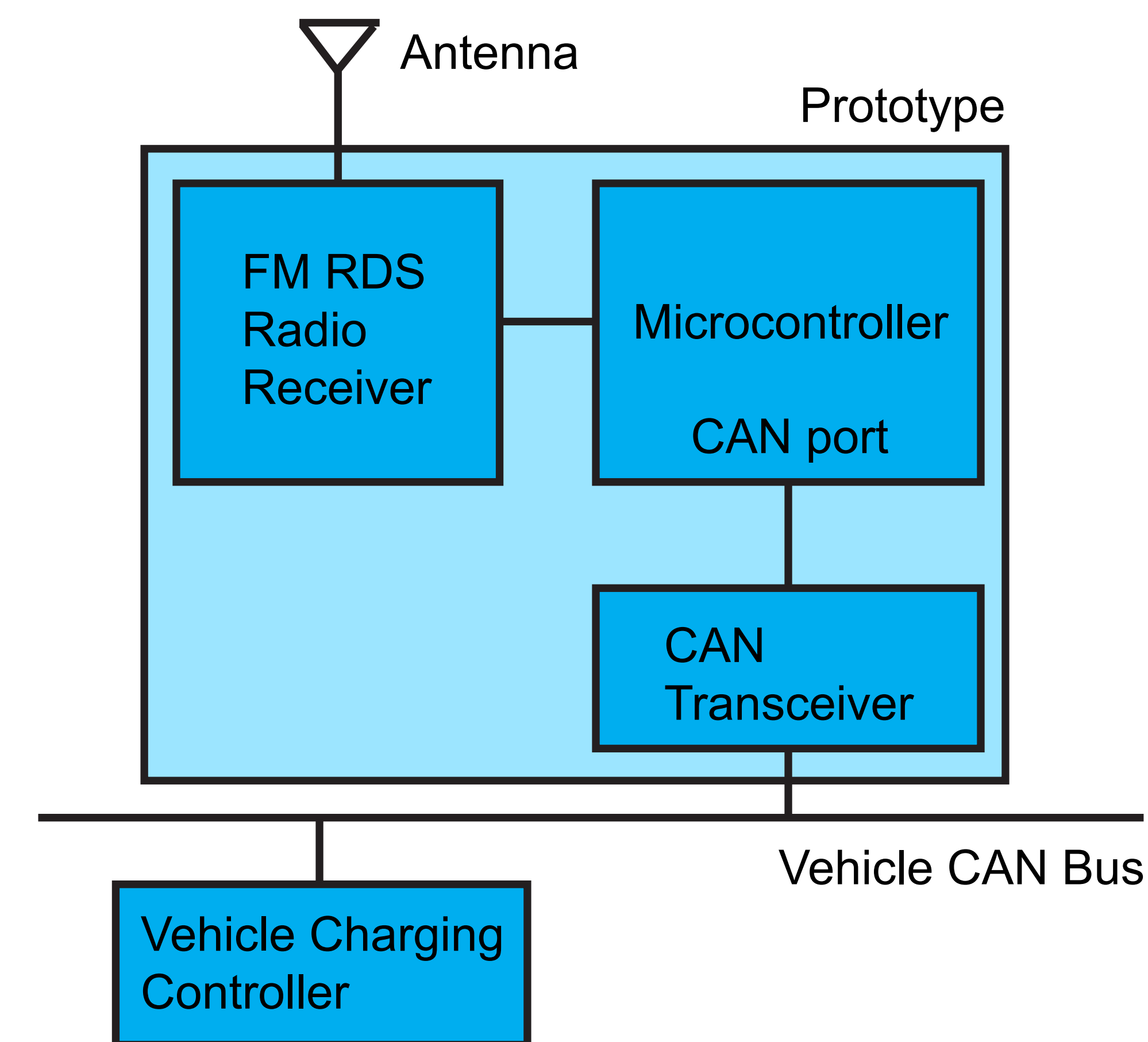
- Road vehicles already have an optimized and pre-established communication channel in place: FM radio broadcast receivers
- Many new FM radio head units have the Radio Data System (RDS) hardware and software built in
- Coverage and infrastructure installation cost issues facing other technological standards are addressed by large public FM Radio networks, such as the Public Radio Satellite System (PRSS) in the U.S., the CBC in Canada, and the BBC in the UK as well as privately-owned FM networks that offer additional and redundant coverage of most geographic markets
- The coverage of New York State shown here is an example of extensive coverage already in existence

2. Architecture



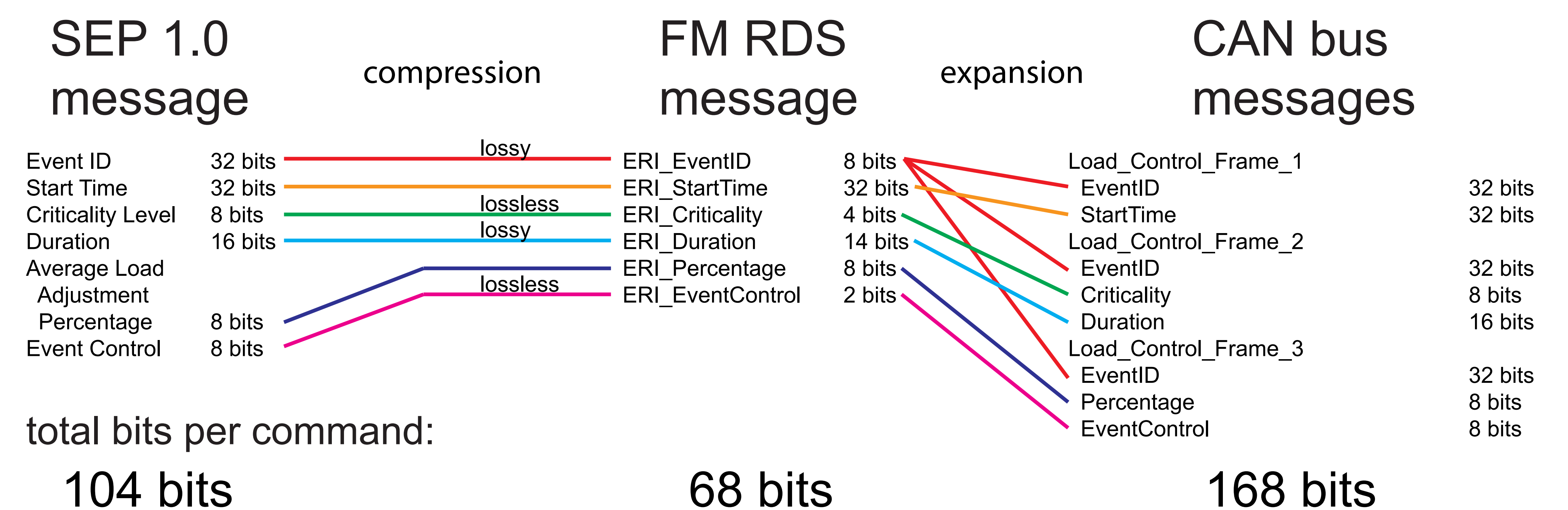
- Electricity pricing and load control information originates at the power utility or an independent system operator (ISO) and is sent, for example, by OpenADR XML to the e-Radio aggregator server
- e-Radio translates the utility/ISO Smart Energy Profile (SEP 1.0 was implemented on the prototype due to availability) messages using a mapping and compression algorithm into a format suitable to one-way low bandwidth broadcasting (e-Radio FM RDS Utility Message Channel or UMC) and directs those messages to the e-Radio data-casting network
- Messages are distributed to the FM broadcasters via terrestrial and/or satellite networks to where the FM RDS data is embedded within 57kHz subcarrier of the existing FM transmission
- FM RDS capable receivers capture the signal and data within the large coverage area of the station transmitter; however, only the e-Radio prototype is capable of decoding the EV-specific commands for the vehicle

3. Design of the Prototype



- The prototype is executed as an on-board stand-alone FM RDS gateway that plugs into the existing vehicle Controller Area Network (CAN) bus via a diagnostic port connector
- The dedicated e-Radio FM RDS receiver allows other broadcast data applications to reach the vehicle bus in addition to EV charging control protocol (like emergency notifications)
- The gateway prototype expands the compressed messages from e-Radio FM RDS format to CAN bus frames after reception
- The gateway CAN interface also manages the necessary flow-control parameters for multipart messages and the responses to messages on the bus
- Existing standards for EV charging including SEP 1.0, SAE J2847/1 and SAE J2836/1 provided the basis for the prototype CAN bus messages

4. Message Mapping / Compression



5. Summary

- FM RDS was successfully demonstrated as a viable solution for control of EV charging
- Load control (an immediate reduction in charging power usage) and update of time-of-use pricing tables (affecting both current and future charging schedules) were both successfully demonstrated using a basic set of EV charging control messages in accordance with SEP 1.0, SAE J2847/1 and SAE J2836/1 via a live FM RDS channel (CBC in Toronto) to an EV in the field
- e-Radio plans to undertake real-world validation of the smart-grid impact (economically and technically) of FM RDS in cooperation with utilities, standards bodies and broadcasters