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Message Bus Refactor Using RabbitMQ

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Shwetha Niddodi
Software Engineer

VOLTTRON™

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Agenda

- Need for message bus upgrade
- Difference between ZeroMQ VOLTTRON and RabbitMQ VOLTTRON
- RabbitMQ VOLTTRON overview
- Connecting to remote platform using CSR
- Deployment use case example
- Integration with third party tools

Message Bus Upgrade

- VOLTTRON's ZeroMQ based message bus has been key for meeting the security and interoperability goals of the platform
- At the same time, RabbitMQ has become more mature as it has seen major investment by commercial companies.
  - Rabbit Technologies, now part of Pivotal Technologies (VMWARE spin-out). $105 million investment by GE in 2013.
  - Used by: Instagram, Indeed.com, Google Cloud Platform, Tesla …
- Goals of the Refactor:
  - Maintain essential features of current message bus and minimize transition cost
  - Leverage an existing and growing community dedicated to the further development of RabbitMQ
  - Move services provided currently by VOLTTRON agents to services natively provided by RabbitMQ
  - Decrease VOLTTRON development time spent on supporting message bus which is now a commodity technology.
  - Address concerns from community about ZeroMQ
- View this effort as essential to the long-term future of the platform
  - Working with heavy users in the community to get feedback
  - Reduce long term costs of platform by moving message bus development out of core
  - Maintain support for ZMQ short term (3 – 5 years) as funding allows

ZeroMQ Based VOLTTRON vs RabbitMQ Based VOLTTRON

ZeroMQ Based VOLTTRON	RabbitMQ Based VOLTTRON
Platform acts as the broker and is responsible for routing the messages	Separate broker running outside the platform and all agents connect to that broker. Exchanges are responsible for routing.
Authentication is based on ZAP protocol using Elliptical Cryptographic Curve Key	SSL based authentication using TLS X509 certificates
Remote agent authentication is by adding public key of remote agent to auth.json	Remote agent authentication is through Certificate Signing Request operation
Custom agents such as forward historian agent for forwarding messages from one platform to another	Shovel plugin can be used for same purpose
VOLTTRON specific implementation for multi-platform connection	Federation plugin can be used for same purpose
Custom agents to connect to third party tools such as MQTT historian agents	Easy integration with third party tools - MQTT - ElasticSearch
Need to build custom agent that monitors status of message bus	Monitor message bus status such as message rates, resource usage of queue and data rates of client connections
Scalable multi-platform connections	Highly scalable – does not require $O(n^2)$ connections between n brokers
Less flexibility in deployment compared to RabbitMQ	Flexibility in deployment

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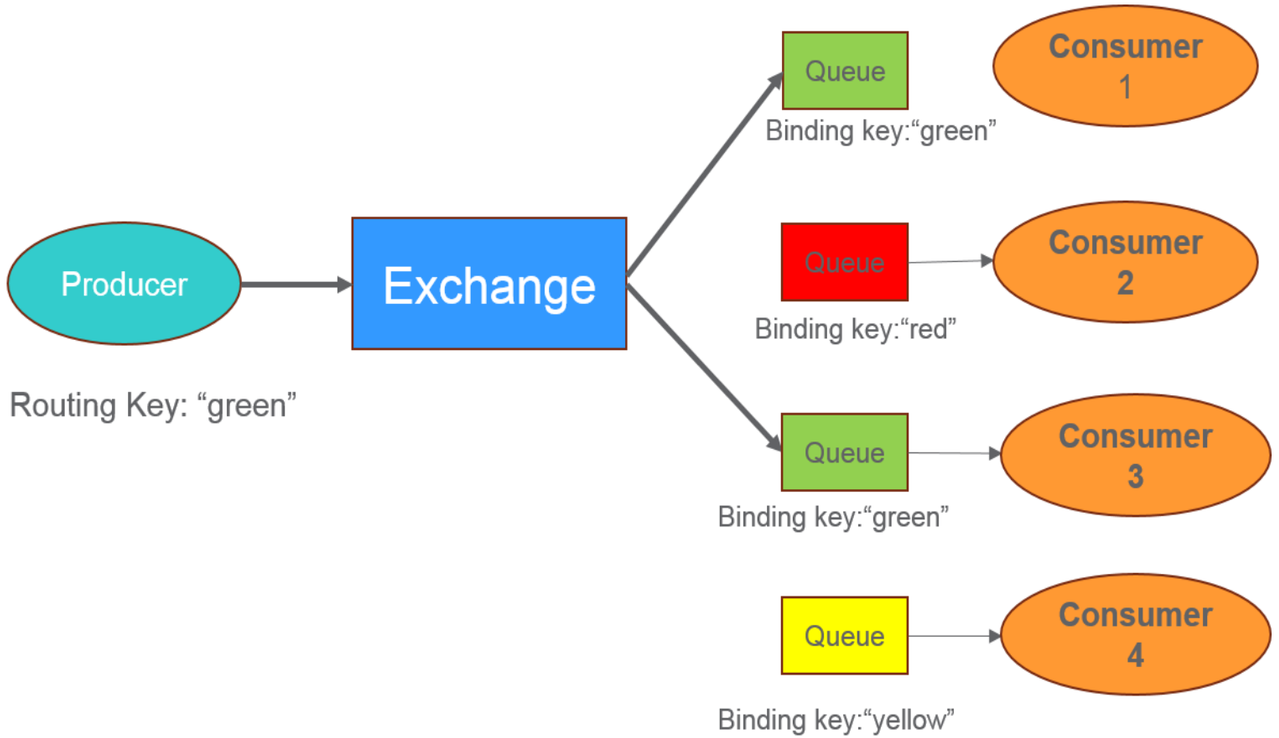
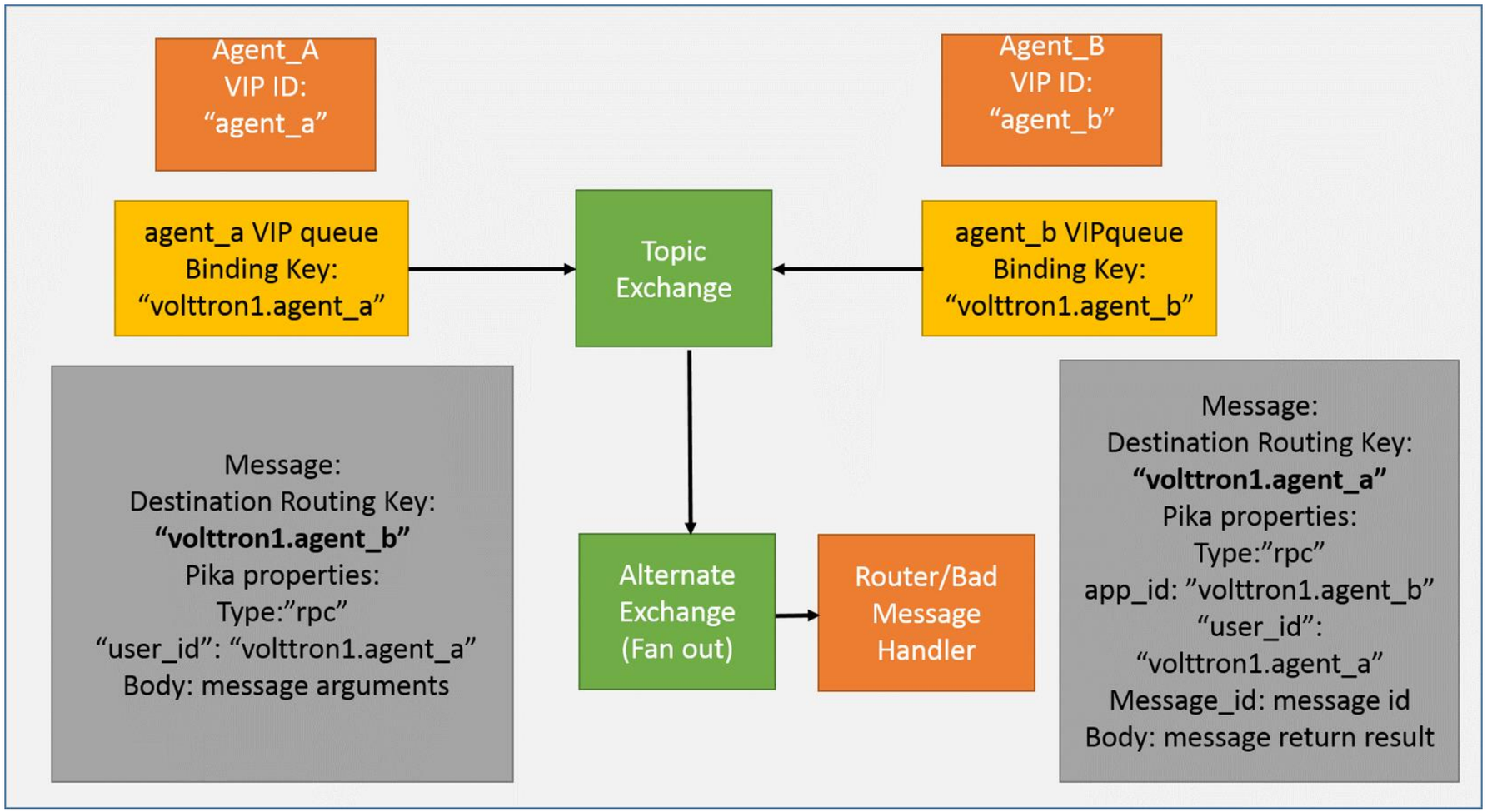
RabbitMQ Overview

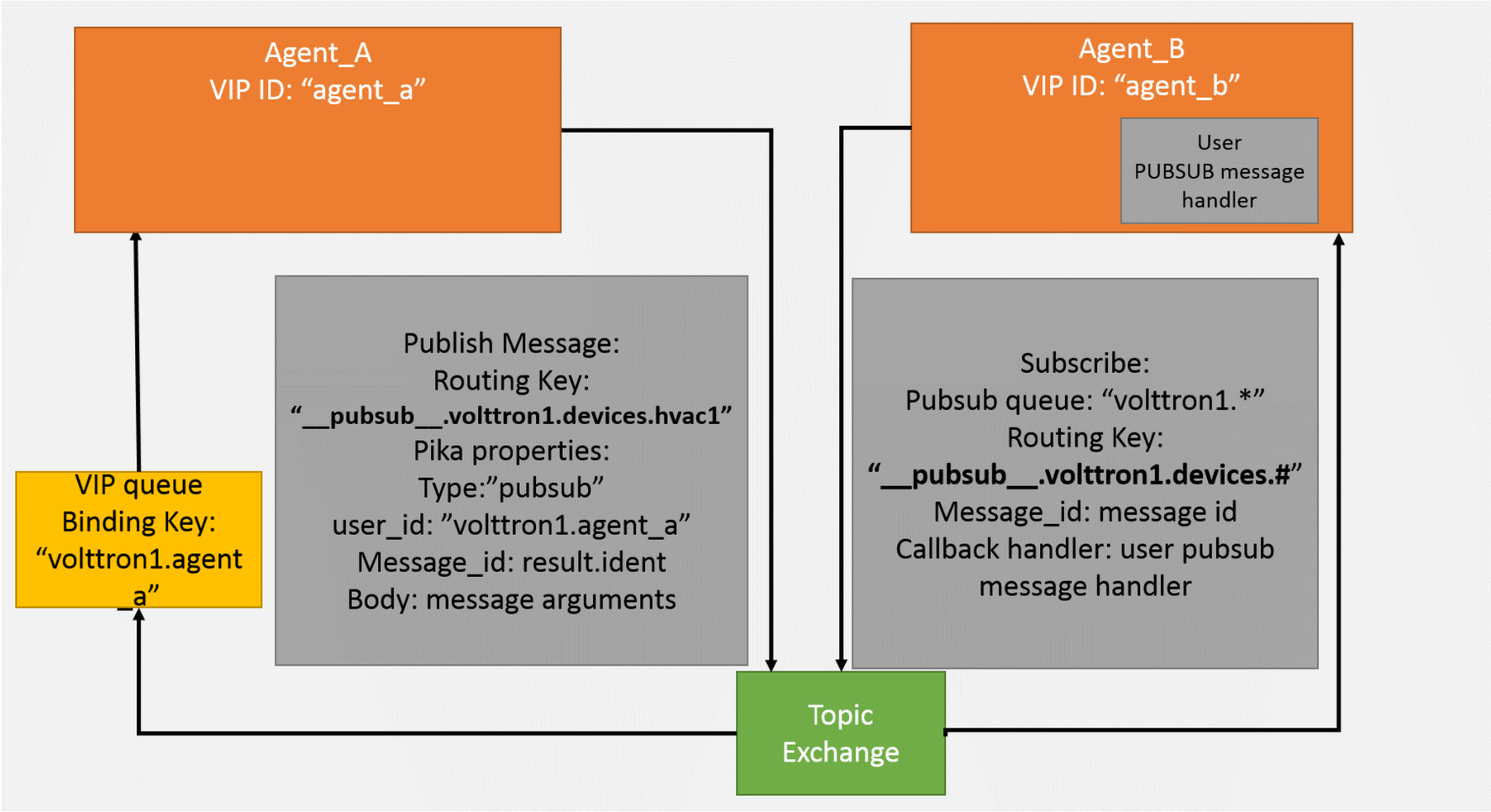
- RabbitMQ uses RabbitMQ uses AMQP (Advanced Message Queuing Protocol)
- Exchanges – Responsible for routing of messages to Queues.
- Queues - Buffer that stores the messages until consumed by consumer.
- Bindings – Queues bind to the exchange with binding keys
  - Messages are routed based on bindings



Integration Of RabbitMQ With VOLTTRON



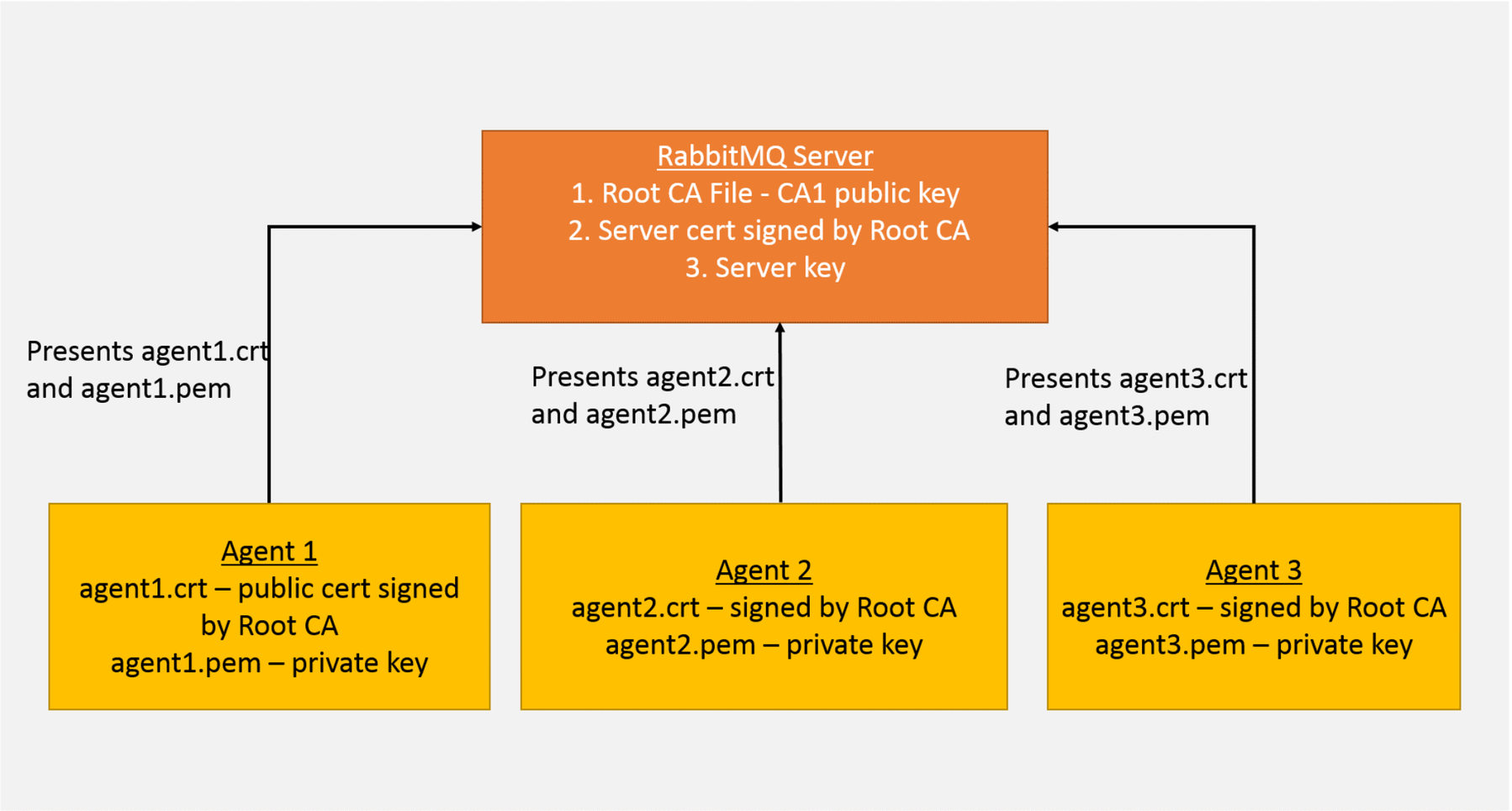
Pubsub in RabbitMQ VOLTTRON



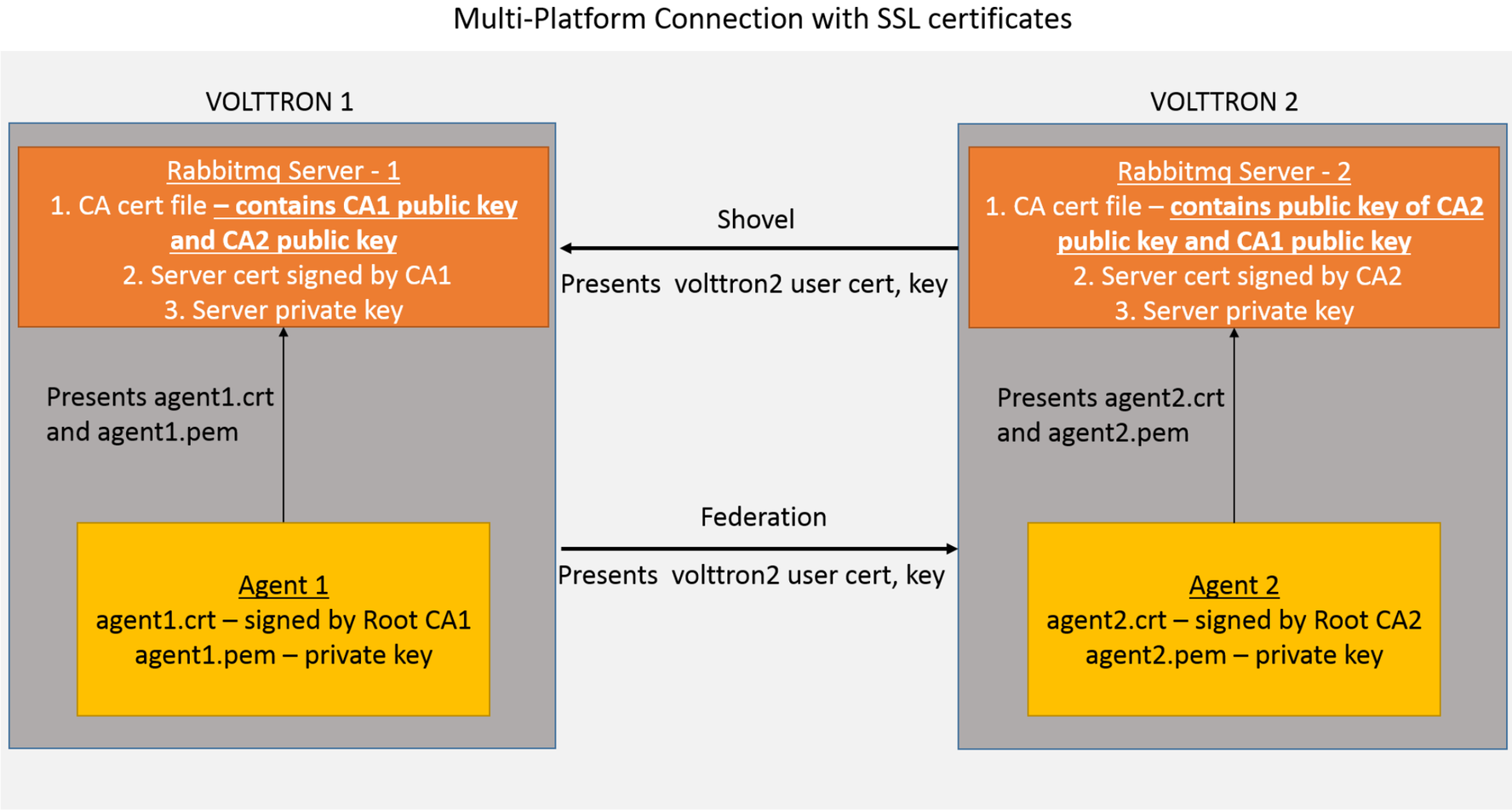
Security Feature With RabbitMQ VOLTTRON

- RabbitMQ supports multiple authentication mechanisms
  - For VOLTTRON we use SSL peer verification using with x509 certificates
- SSL certificates of interest
  - Root CA
  - Server certificate signed by Root CA
  - Client certificate signed by Root CA

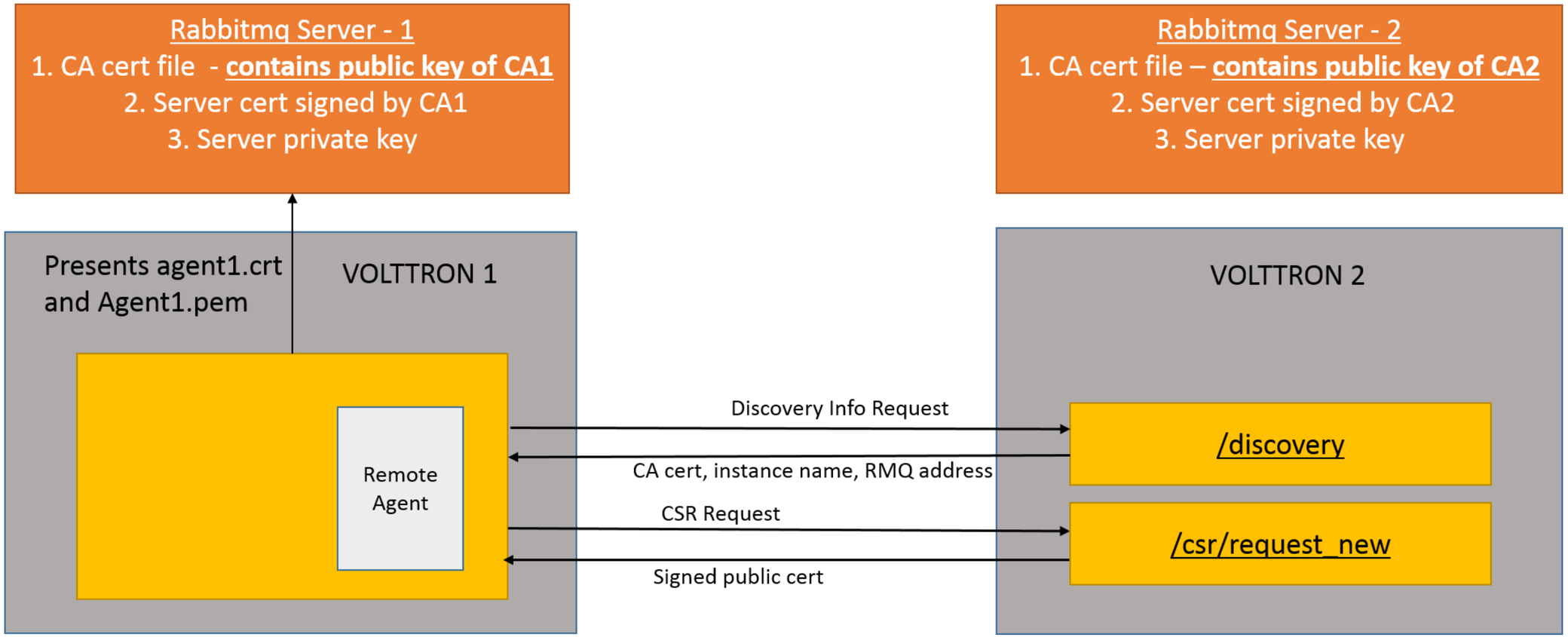
RabbitMQ-VOLTTRON Authentication Using SSL



Multi-Platform Connection With SSL Certificates



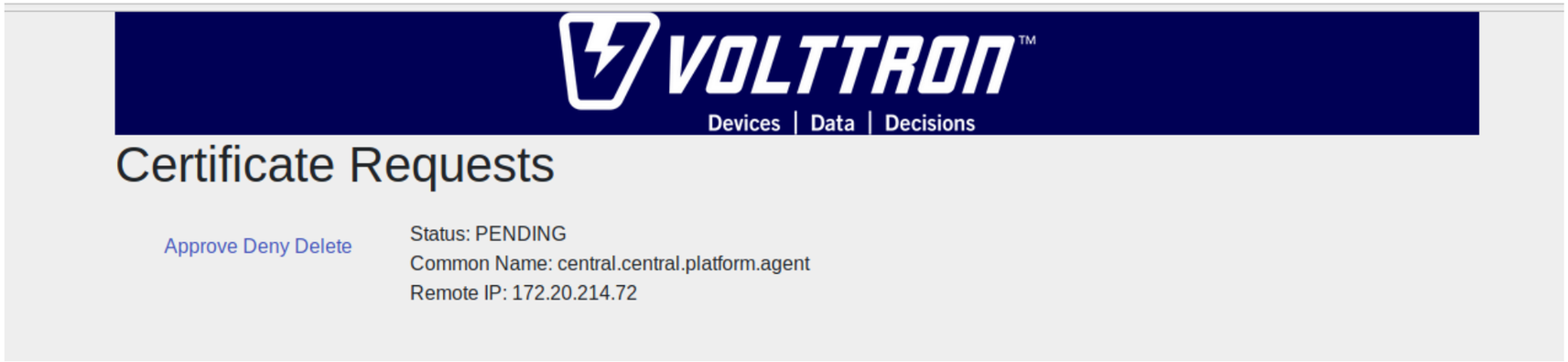
Connecting To Remote Platform Using CSR



CSR Admin

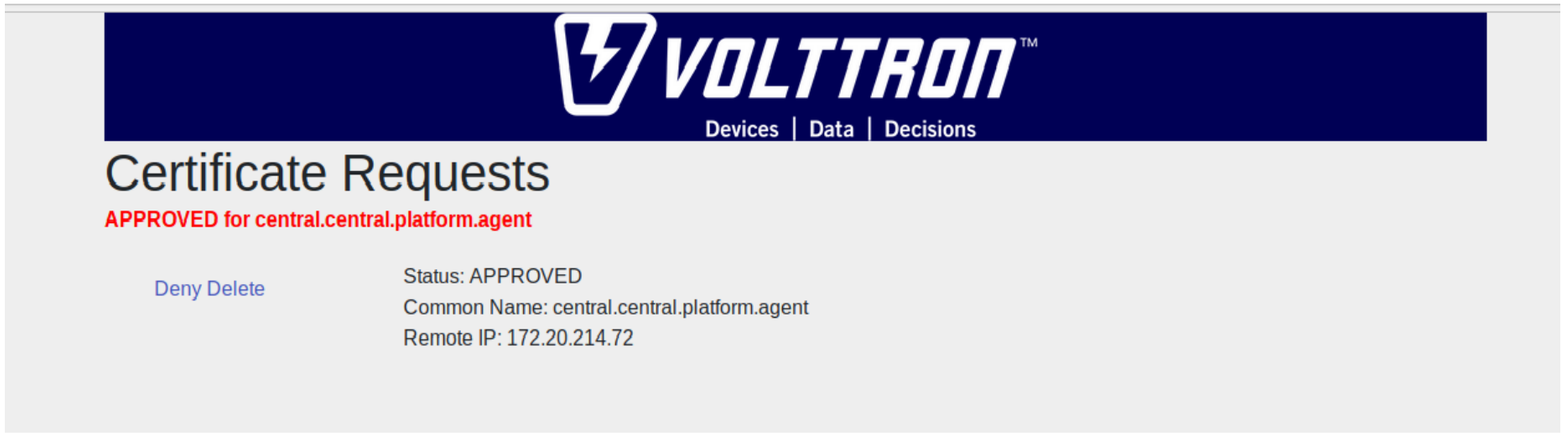
- CSR Admin Login – URL: https://<hostname>:8443

- CSR Request

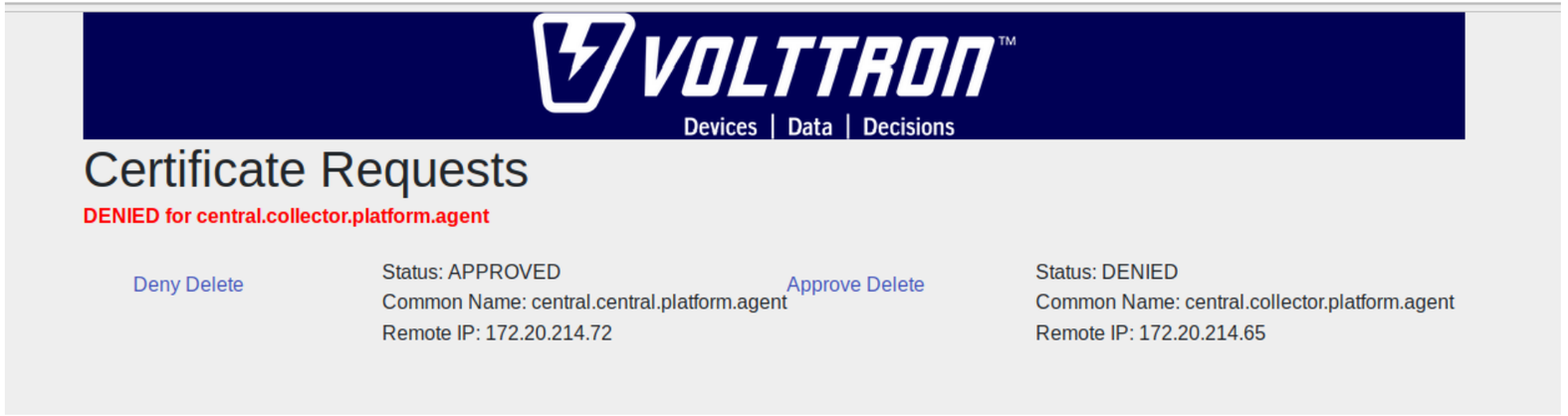


CSR Admin

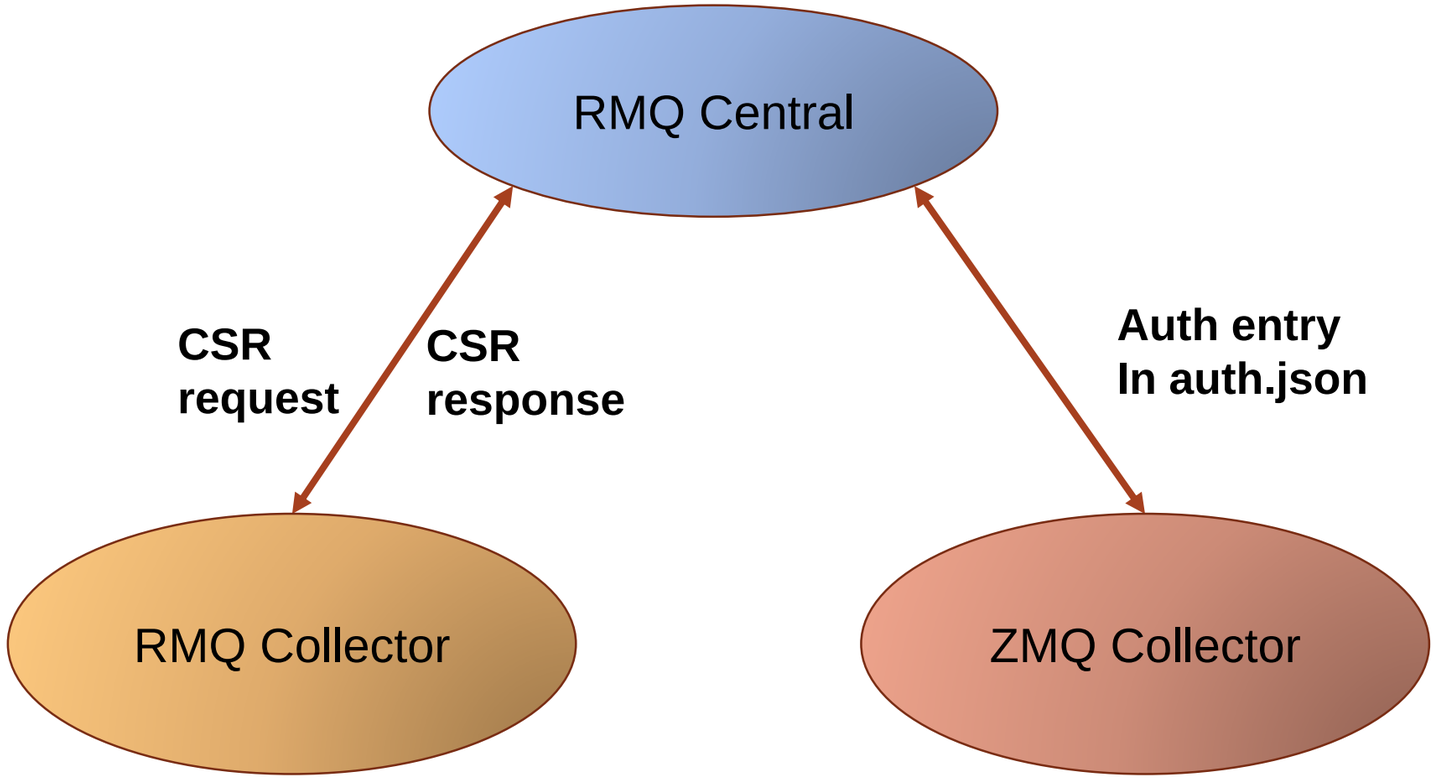
- CSR Approved



- CSR Denied



Multi-Platform Multi-Bus Connection



VC, Historian

Forwarder, VCP, Master driver

Forwarder, VCP, Master driver

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Volttron-ctl Commands For Creating Certificates

- Create a volttron public cert and private key for a new client

  volttron-ctl certs create-ssl-keypair jackpot

  New public cert will be $VOLTTRON_HOME/certificates/certs/<instance-name>.jackpot.crt

  New private key will be $VOLTTRON_HOME/certificates/private/<instance-name>.jackpot.pem

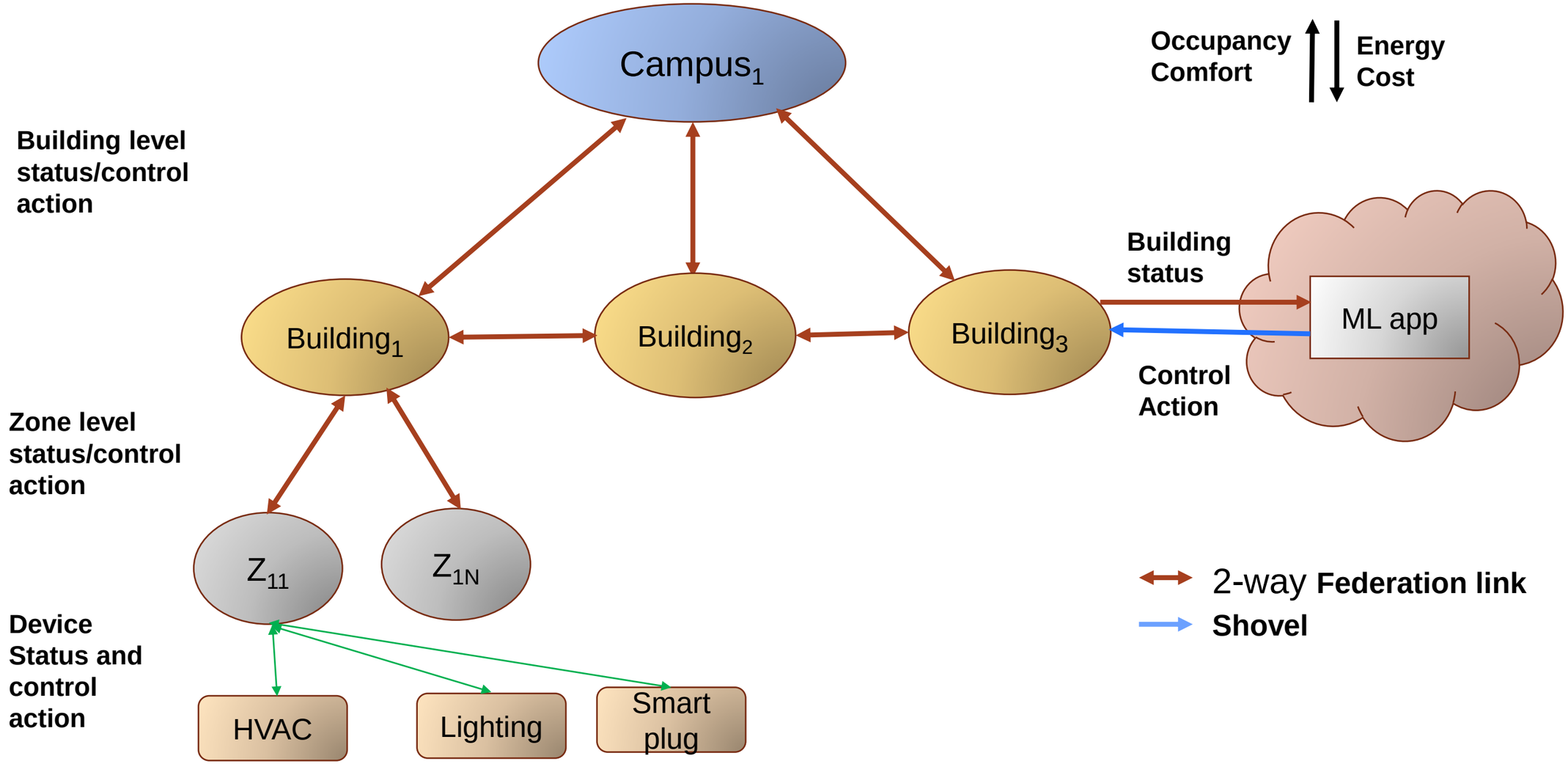
- Export the private key / cert into a PKCS12 format file

  volttron-ctl certs export-pkcs-12 jackpot jackpot.12

New Options For VOLTTRON Users

- Offers more flexibility in deployment
  - Federation
  - Shovel
  - Highly scalable
    - ✓ Connect numerous buildings spread over large geographical area.

Deployment Use Case Example



Integration with 3rd party tools/applications

- Integration with non VOLTTRON RabbitMQ clients
  - Client connected to same broker
  - Connected to different broker. Connection established using federation/shovel
- ElasticSearch – For data ingestion and to perform analysis
  - ElasticSearch – For data ingestion and to perform analysis
    - ✓ Cybersecurity – to detect anomalies in data etc.
    - ✓ Visual Analytics
  - MQTT – For cloud based applications
- Github link: https://github.com/VOLTTRON/external-clients-for-rabbitmq

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Next Steps

- Integrate federation and shovel setup with CSR
- Ease of deployment based on user feedback

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Thank you