Integrated Voltage VAR (IVVC) Decentralized

Version 3.1

May 14th, 2010

1 Descriptions of Function

A Controlled Volt-VAR Control (CVVC) system operates in a distributed logical architecture as opposed to a fully integrated, centralized environment. CVVC manages voltage along the entire distribution circuit, establishing a voltage profile that is preset to minimize demand. The demand reduction results in a corresponding reduction of energy, primarily from reduced energy consumption, but also through improved system efficiency. The CVVC also optimizes power factor as a secondary objective.

1.1 Function Name

IVVC Decentralized

1.2 Function ID

IECSA identification number of the function

1.3 Brief Description

The decentralized CVVC system makes executes logic on a Volt-VAR Controller (VVC) at a station with control of devices on several circuits. The VVC is interfaced with the D-SCADA through an RTU.

1.4 Narrative

The decentralized ***Volt-VAR Controller*** system here makes reference to the fact that in this decentralized implementation, the ***Volt-VAR Controller*** system is in a standalone mode and interacts with the ***RTUs***, getting status information from the ***RTU*** (which in turn interacts with the controllers of the capacitor banks, reclosers , volt meters, voltage regulators). The ***Volt-VAR Controller*** will process the data obtained for the ***RTUs*** and create an optimal configuration for each devices and then pass commands and sequences to the ***RTU*** for configuration of the various devices it interacts with. The ***RTU*** will then pass the configuration information back to the ***D-SCADA*** which then populates the ***Historian*** system.

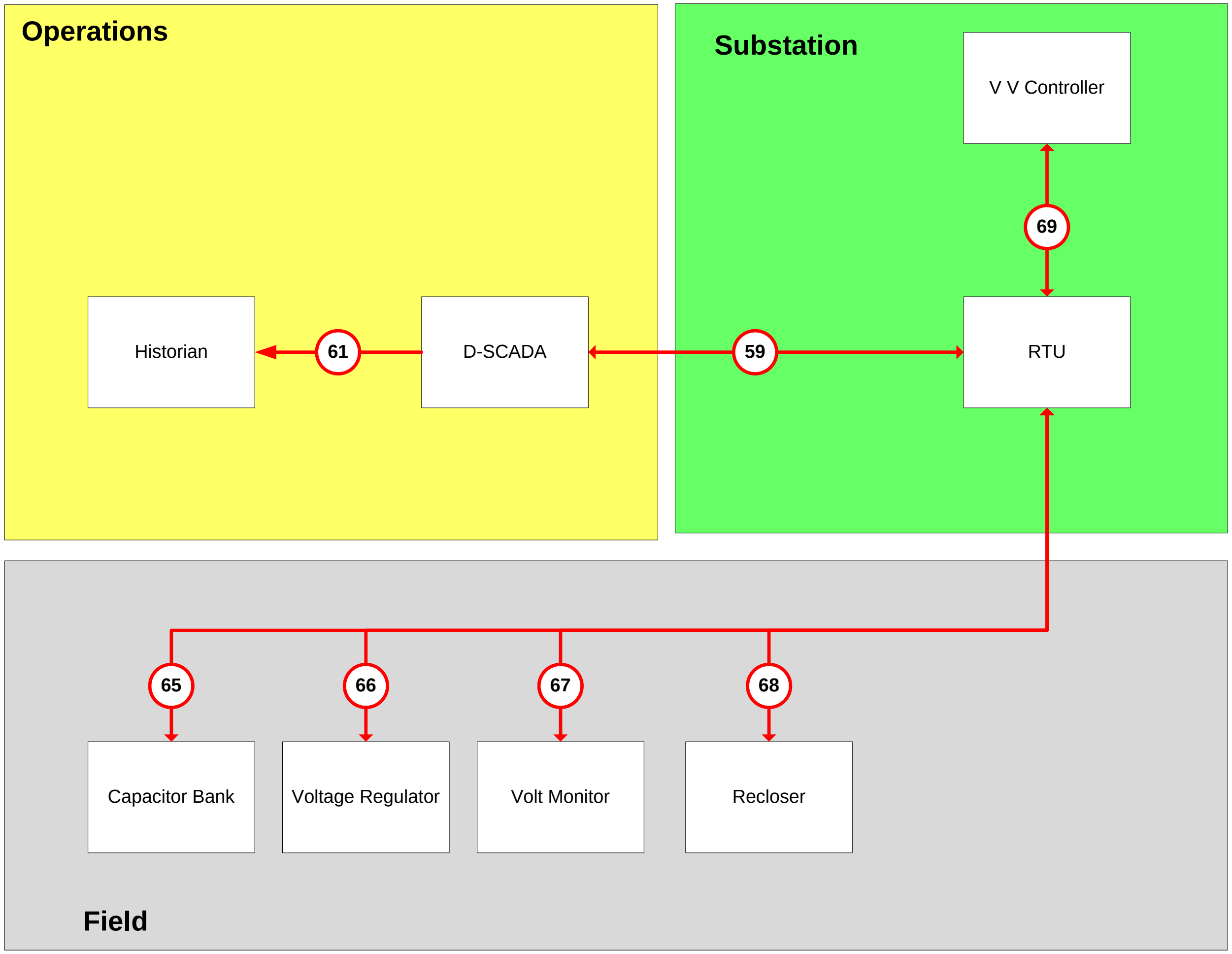


Figure 1-1
Context Diagram for De-Centralized Integrated Volt/VAR Control

1.5 Actor (Stakeholder) Roles

Grouping (Community) '		Group Description
Actor Name	Actor Type (person, device, system etc.)	Actor Description
D-SCADA	System	Distribution Supervisory Control and Data Acquisition System. D-SCADA is a sub-system of the DMS.
Recloser Control	Device	A protective element that can operate the circuit recloser. In DA it is a source for voltage and current measurement on the circuit.
Capacitor Bank Controller	Device	The controller is a two-way terminal for control of distribution line capacitors.
Voltage Regulator Controllers	Device	The voltage regulator regulates voltage on the feeder and sends messages to the RTU.
RTU	Device	Remote Terminal Unit – RTUs are end-points within a SCADA system that sends and receives various measurements and statuses.
VVC	Device	In a decentralized implementation, Volt-VAR Control is a smart device that interacts with RTUs
Voltage Monitor	Device	Field device that monitors and measures voltage and sends to the RTU (for VVC).
Historian	System	Repository of time series data coming mainly from the DMS system

1.6 Information exchanged

Information Object Name	*Information Object Description*
System Monitoring Data	Current System Data supplied by devices on the line or at the substations.
Data from RTU database	Polled system data collected from devices out on the line or in the substations
Optimal Configuration	Calculated configuration for optimal voltage var control
Status Update	Status update from field or substation equipment
System Data	

1.7 Activities/Services

Activity/Service Name	*Activities/Services Provided*

1.8 Contracts/Regulations

Contract/Regulation	*Impact of Contract/Regulation on Function*

Policy	*From Actor*	*May*	*Shall Not*	*Shall*	*Description (verb)*	*To Actor*

Constraint	*Type*	*Description*	*Applies to*

2 Step by Step Analysis of Function

Describe steps that implement the function. If there is more than one set of steps that are relevant, make a copy of the following section grouping (Steps to implement function, Preconditions and Assumptions, Steps normal sequence, Post-conditions) and provide each copy with its own sequence name.

2.1 Steps to implement function – Name of Sequence

Name of this sequence.

2.1.1 Preconditions and Assumptions

Actor/System/Information/Contract	*Preconditions or Assumptions*
	Interoperability between AMI and real time grid management is challenged. Currently metering standards and DNP3 are not compatible and AMI performance does not meet requirements of real time grid management
	For State Test the VV Controller and RTU functions will both be performed by the GE D20.
	Work is still underway to see if the communications will be synchronous or asynchronous. This use case will portray the communications as asynchronous. It may need to be changed at a later date.

2.1.2 Steps – Name of Sequence

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environment
#	*Triggering event? Identify the name of the event.*[1]	*What other actors are primarily responsible for the Process/Activity? Actors are defined in section1.5.*	*Label that would appear in a process diagram. Use action verbs when naming activity.*	*Describe the actions that take place in active and present tense. The step should be a descriptive noun/verb phrase that portrays an outline summary of the step. "If …Then…Else" scenarios can be captured as multiple Actions or as separate steps.*	*What other actors are primarily responsible for Producing the information? Actors are defined in section1.5.*	*What other actors are primarily responsible for Receiving the information? Actors are defined in section1.5.* *(Note – May leave blank if same as Primary Actor)*	*Name of the information object. Information objects are defined in section 1.6*	*Elaborate architectural issues using attached spreadsheet. Use this column to elaborate details that aren't captured in the spreadsheet.*	*Reference the applicable IECSA Environment containing this data exchange. Only one environment per step.*
1.1	Periodic RTU Polling	RTU	Scheduled polling of status	On a predetermined frequency RTU will poll specified devices	RTU	RTU		DNP/IP DNP serial	
1.1 A.1		RTU	System Monitoring Data	Voltage Regulator Control sends System Monitoring Data to RTU	Voltage Regulator Controllers	RTU	System Monitoring Data	DNP/IP DNP serial	
1.1 B.1		RTU	System Monitoring Data	Capacitor Bank Control sends System Monitoring Data to RTU	Capacitor Bank Controllers	RTU	System Monitoring Data	DNP/IP DNP serial	
1.1 C.1		RTU	System Monitoring Data	Volt Monitors sends System Monitoring Data to RTU	Volt Monitors	RTU	System Monitoring Data	DNP/IP DNP serial	

[1] Note – A triggering event is not necessary if the completion of the prior step – leads to the transition of the following step.

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environment
1.1 D.1		RTU	System Monitoring Data	Recloser Control sends System Monitoring Data to RTU	Recloser Controllers	RTU	System Monitoring Data	DNP/IP DNP serial	
1.2		RTU	Data from RTU	VVC receives data from RTU Database	RTU	VVC	Data from RTU database	proprietary	
1.3		VVC	VVC identifies Optimal Configuration	VVC identifies an Optimal Configuration for the circuit and commands sequence to be initiated	VVC	VVC	Optimal Configuration		
1.4		DSCADA	DSCADA polls RTU	DSCADA polls RTU for Status Update	DSCADA	RTU	Status Update		
1.5		DSCADA	DSCADA	DSCADA sends System Data to Historian on predetermined interval	DSCADA	Historian	System Data		

2.1.3 Post-conditions and Significant Results

Actor/Activity	*Post-conditions Description and Results*

3 Step by Step Analysis of Function

Describe steps that implement the function. If there is more than one set of steps that are relevant, make a copy of the following section grouping (Steps to implement function, Preconditions and Assumptions, Steps normal sequence, Post-conditions) and provide each copy with its own sequence name.

3.1 Steps to implement function – Name of Sequence

Name of this sequence.

3.1.1 Preconditions and Assumptions

Actor/System/Information/Contract	*Preconditions or Assumptions*
	Interoperability between AMI and real time grid management is challenged. Currently metering standards and DNP3 are not compatible and AMI performance does not meet requirements of real time grid management
	For State Test the VV Controller and RTU functions will both be performed by the GE D20.
	Work is still underway to see if the communications will be synchronous or asynchronous. This use case will portray the communications as asynchronous. It may need to be changed at a later date.

3.1.2 Steps – Name of Sequence

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environment
#	*Triggering event? Identify the name of the event.*[2]	*What other actors are primarily responsible for the Process/Activity? Actors are defined in section1.5.*	*Label that would appear in a process diagram. Use action verbs when naming activity.*	*Describe the actions that take place in active and present tense. The step should be a descriptive noun/verb phrase that portrays an outline summary of the step. "If …Then…Else" scenarios can be captured as multiple Actions or as separate steps.*	*What other actors are primarily responsible for Producing the information? Actors are defined in section1.5.*	*What other actors are primarily responsible for Receiving the information? Actors are defined in section1.5.* *(Note – May leave blank if same as Primary Actor)*	*Name of the information object. Information objects are defined in section 1.6*	*Elaborate architectural issues using attached spreadsheet. Use this column to elaborate details that aren't captured in the spreadsheet.*	*Reference the applicable IECSA Environment containing this data exchange. Only one environment per step.*
2.1	VVC determines control required to optimize volt var	VVC	Device Control/Command	VVC issues Device Control/Command to RTU.	VVC	RTU	Device Control/Command		
2.1 A.1		RTU	Issues Device Commands	RTU issues Device Control/Command to voltage regulator control.	RTU	Voltage Regulator Controllers	Device Control/Command	Raise Lower Go To Neutral Change Setpoints	DNP/IP DNP serial
2.1 A.2		Voltage Regulator Controllers	Sends a Communication Acknowledgement	Voltage Regulator Controllers sends a Communications Acknowledgement to RTU	Voltage Regulator Controllers	RTU	Communications Acknowledgement		

[2] Note – A triggering event is not necessary if the completion of the prior step – leads to the transition of the following step.

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environment
2.1 A.3		Voltage Regulator Controllers	Functions Accordingly	Voltage Regulator Controllers functions accordingly	Voltage Regulator Controllers	Voltage Regulator Controllers	Device Control/Command		
2.1 A.4		RTU	Poll for Status	RTU polls for status	RTU	Voltage Regulator Controllers	Status		
2.1 A.5		Voltage Regulator Controllers	Respond to Status Poll	Voltage Regulator Controllers responds to status poll	Voltage Regulator Controllers	RTU	Status		
2.1 B.1		RTU	Isuues Device Commands	RTU issues Device Control/Command to Capacitor Bank Controllers	RTU	Capacitor Bank Controllers	Device Control/Command	Open Close Change Setpoints	DNP/IP DNP serial
2.1 B.2		Capacitor Bank Controllers	Sends a Communication Acknowledgement	Capacitor Bank Controllers sends a Communications Acknowledgement to RTU	Capacitor Bank Controllers	RTU	Communications Acknowledgement		
2.1 B.3		Capacitor Bank Controllers	Functions Accordingly	Capacitor Bank Controllers functions accordingly	Capacitor Bank Controllers	Capacitor Bank Controllers	Device Control/Command		
2.1 B.4		RTU	Poll for Status	RTU polls for status	RTU	Capacitor Bank Controllers	Status		
2.1 B.5		Capacitor Bank Controllers	Respond to Status Poll	Capacitor Bank Controllers responds to status poll	Capacitor Bank Controllers	RTU	Status		

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environment
2.1 C.1		RTU	Isuues Device Commands	RTU issues Device Read Command to Volt Monitors	RTU	Volt Monitors	Device Read Command	DNP/IP DNP serial	
2.1 C.2		Voltage Monitor	Sends a Communication Acknowledgement	Voltage Monitors sends a Communications Acknowledgement to RTU	Voltage Monitor	RTU	Communications Acknowledgement		
2.1 C.3		Voltage Monitor	Functions Accordingly	Voltage Monitors functions accordingly	Voltage Monitor	Voltage Monitor	Device Read Command		
2.1 C.4		RTU	Poll for Status	RTU polls for status	RTU	Voltage Monitor	Status		
2.1 C.5		Voltage Monitor	Respond to Status Poll	Voltage Monitor responds to status poll	Voltage Monitor	RTU	Status		

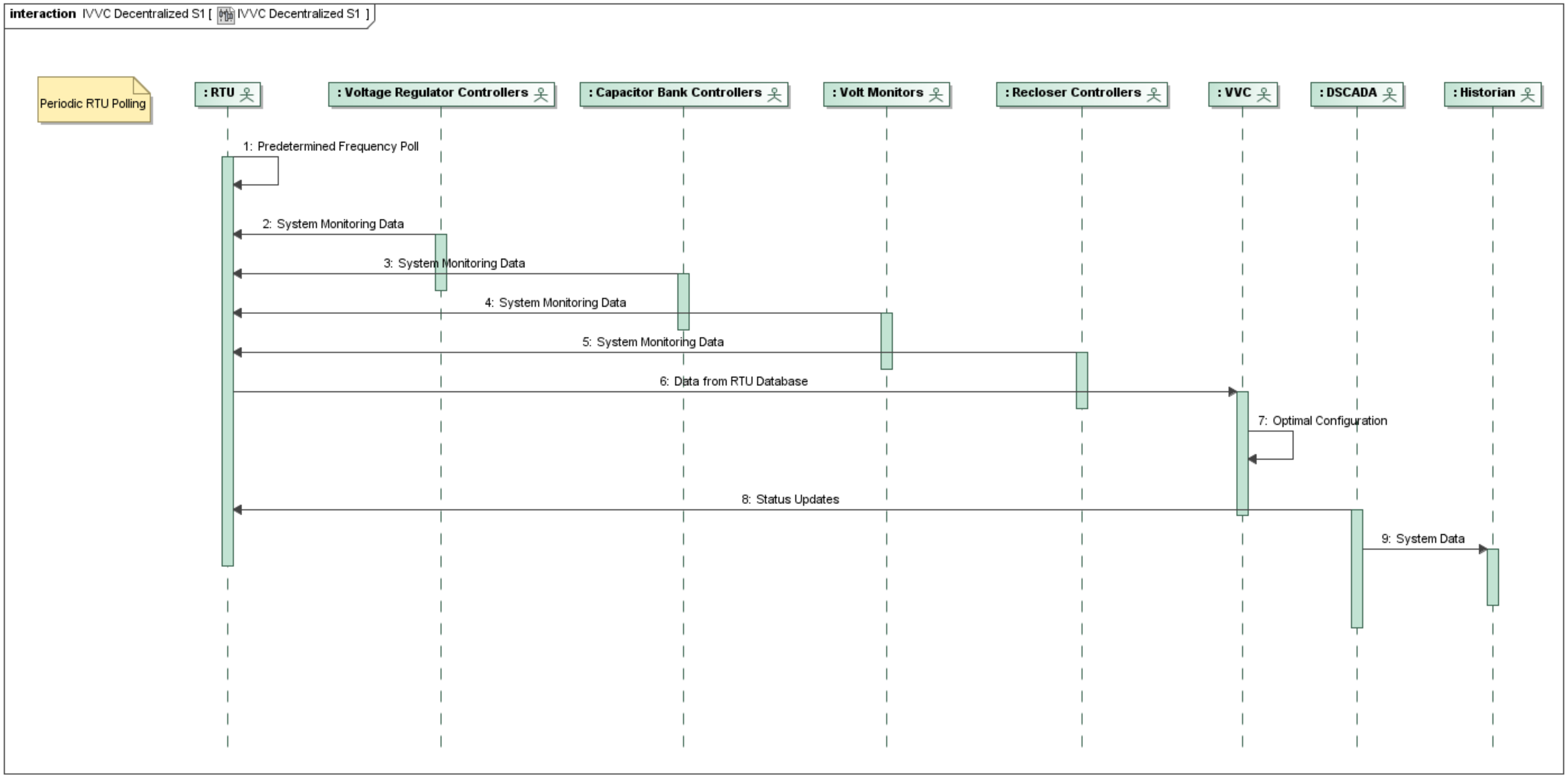
3.1.3 Post-conditions and Significant Results

Actor/Activity	*Post-conditions Description and Results*

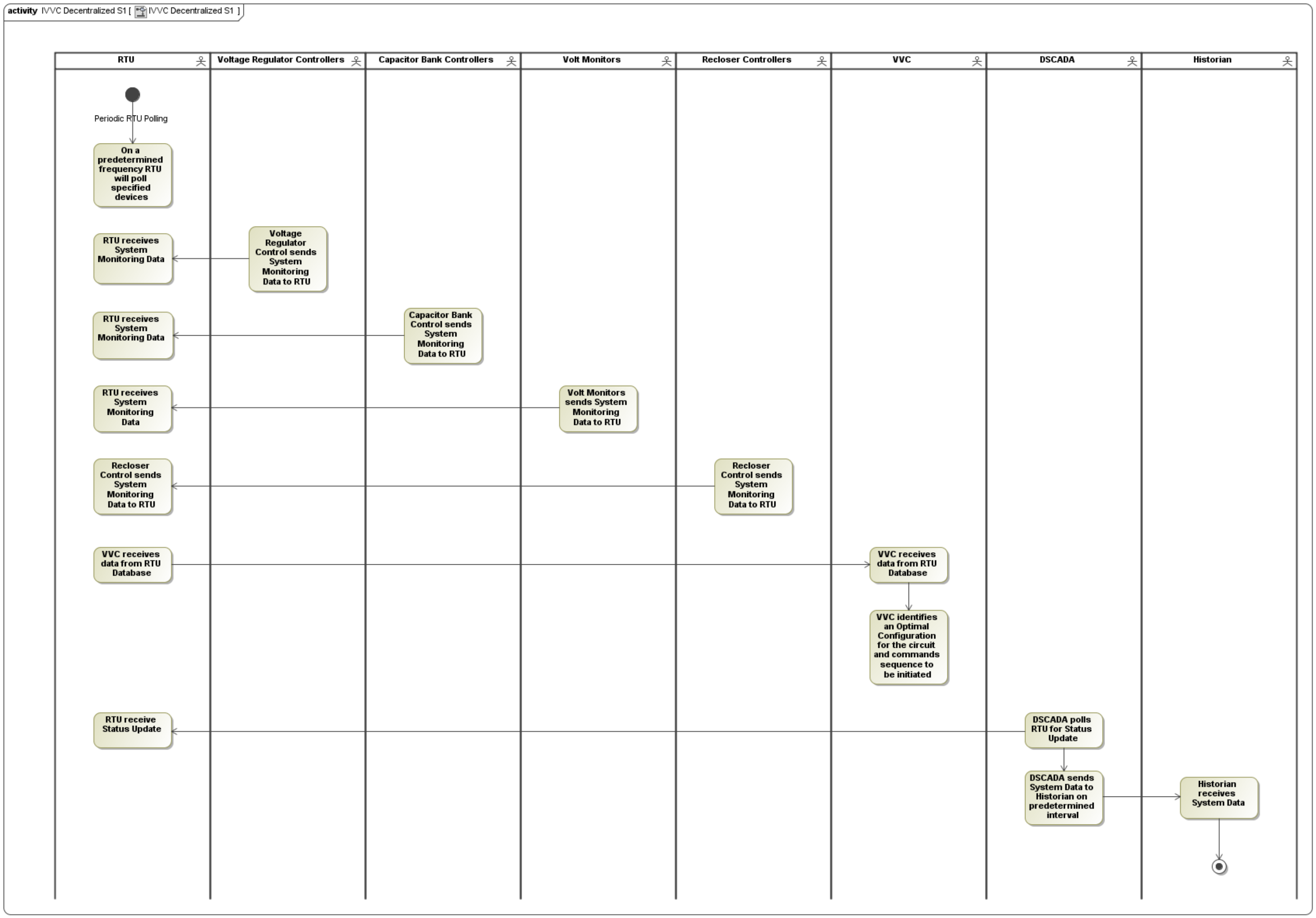
3.2 Architectural Issues in Interactions

Elaborate on all architectural issues in each of the steps outlined in each of the sequences above. Reference the Step by number.

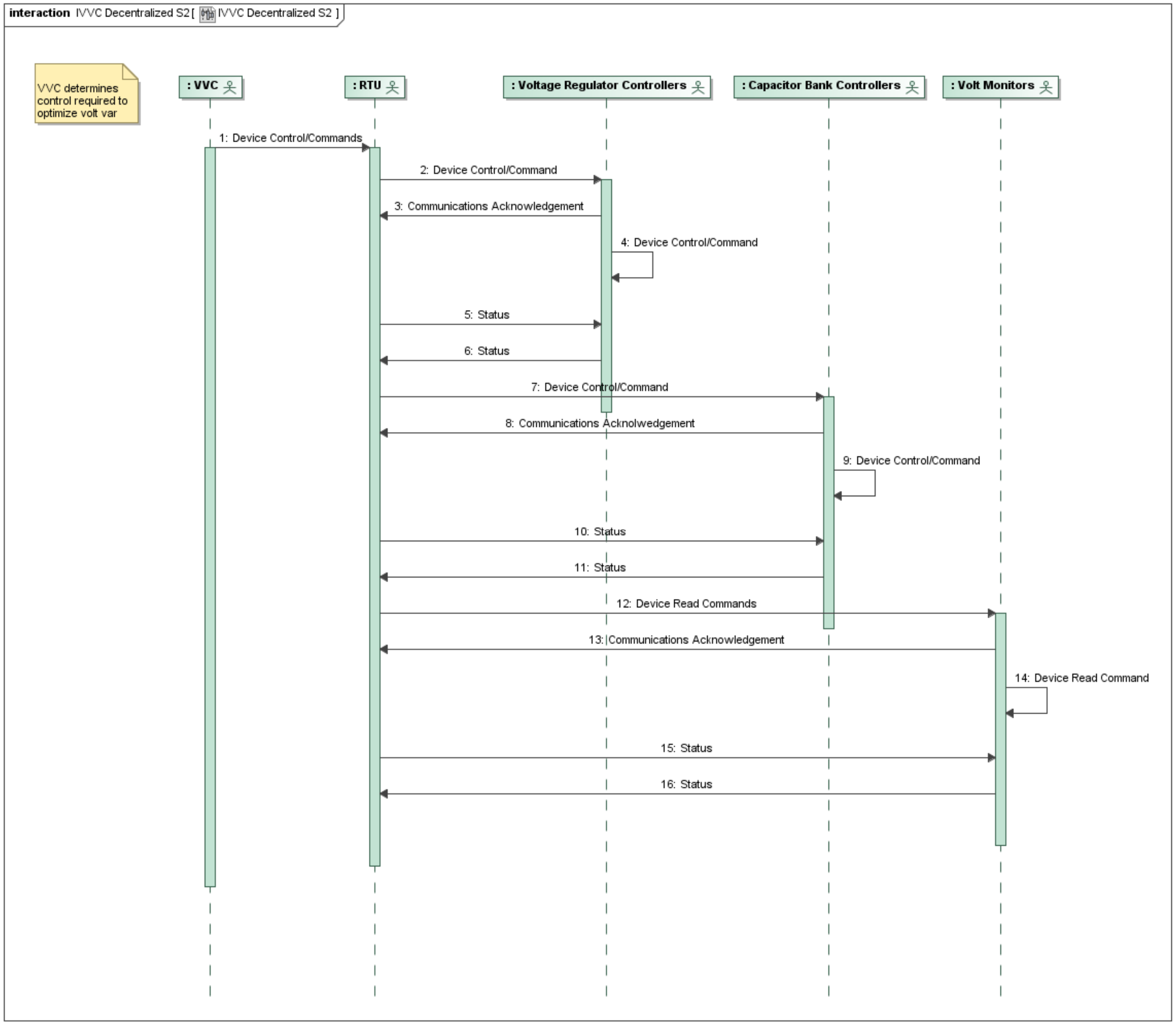
3.3 Diagrams



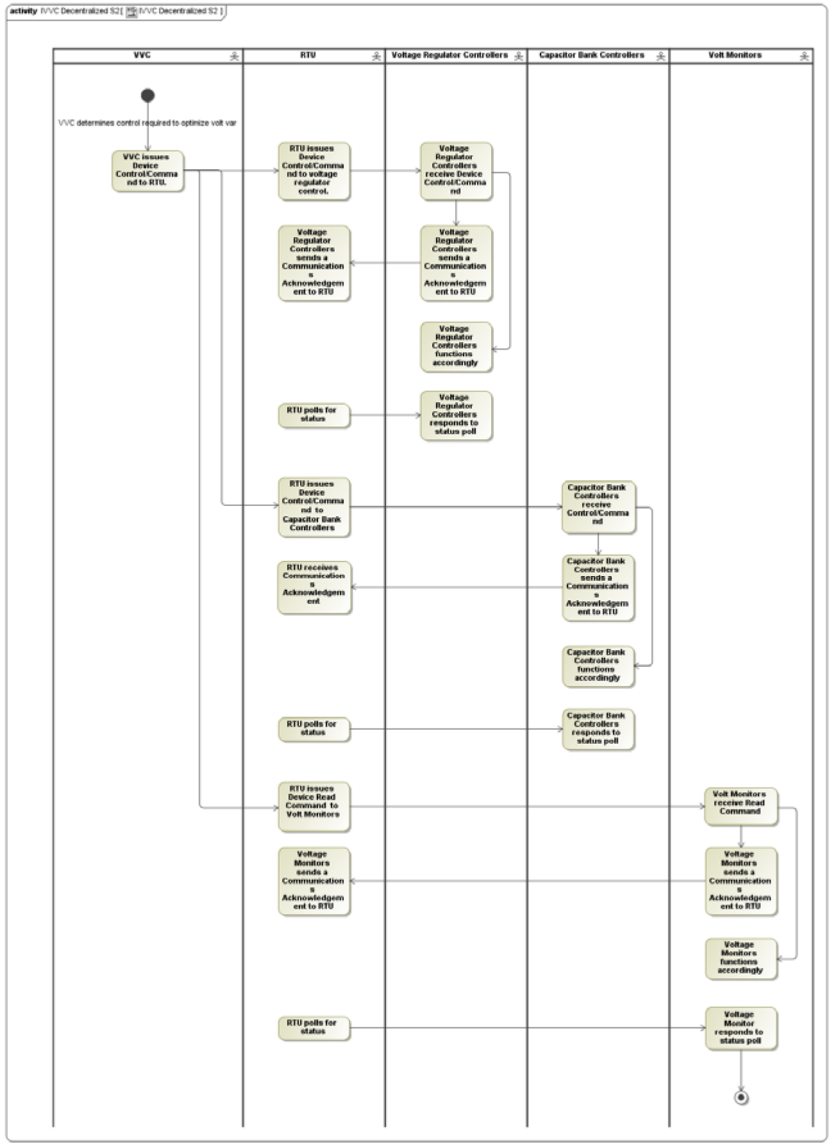
IVVC Decentralized Scenario 1 Sequence Diagram



IVVC Decentralized Scenario 1 Activity Diagram



IVVC Decentralized Scenario 2 Sequence Diagram



IVVC Decentralized Scenario 2 Activity Diagram

4 Auxiliary Issues

4.1 References and contacts

ID	Title or contact	Reference or contact information
[1]		

4.2 Action Item List

ID	Description	Status
[1]		

4.3 Revision History

No	Date	Author	Description
1.1	4-8-2010	Brian D. Green	Original Use case
2.0	4-9-2010	J.R. Cote	Updated Narrative and description
2.1	4-12-2010	John Simmins	Updated steps
2.2	4-12-2010	Brian D. Green	Clean-up
3.0	5-12-2010	Brian D. Green	Revisions and add diagrams
3.1	5-14-2010	Brian D. Green	Utility Revisions