IVVC Centralized

Version 3.1

May 14th, 2010

1 Descriptions of Function

An Integrated Volt-VAR Control (IVVC) system operates in a centralized environment as opposed to decentralized VVC which is implemented in distributed logic architecture. IVVC manages voltage along the entire distribution circuit, establishing a voltage profile that is optimized to reduce demand. The demand reduction results in a corresponding reduction of energy, primarily from reduced energy consumption, but also through improved system efficiency. The IVVC also optimizes power factor as a secondary objective.

1.1 Function Name

Centralized IVVC

1.2 Function ID

IECSA identification number of the function

1.3 Brief Description

The centralized IVVC system is an integral part of the Distribution SCADA (D-SCADA) environment. One central system manages and controls all VVC devices on the regional distribution network.

1.4 Narrative

The centralized ***Volt-VAR Controller (VVC)*** makes reference to the fact that in this centralized implementation, the ***Volt-VAR Controller*** is completely integrated to ***D-SCADA*** and can only perform commands controlled by the ***D-SCADA*** system, (the intelligence of the IVVC lies within the ***D-SCADA*** system). . The ***VVC*** devices inform the ***D-SCADA*** system of various measurements and statuses and the ***D-SCADA*** systems aggregate this information with ***RTU*** data it acquired from the field. ***D-SCADA*** then computes and prepares commands and sequences that it sends to the ***RTU***s. The ***RTU***s then interacts with various field devices (reclosers, capacitor banks, and volt meters, voltage regulators) to pass configuration information that optimizes power distribution and minimizes loss. The ***D-SCADA*** system passes the information to the ***Historian*** environment for future analysis.

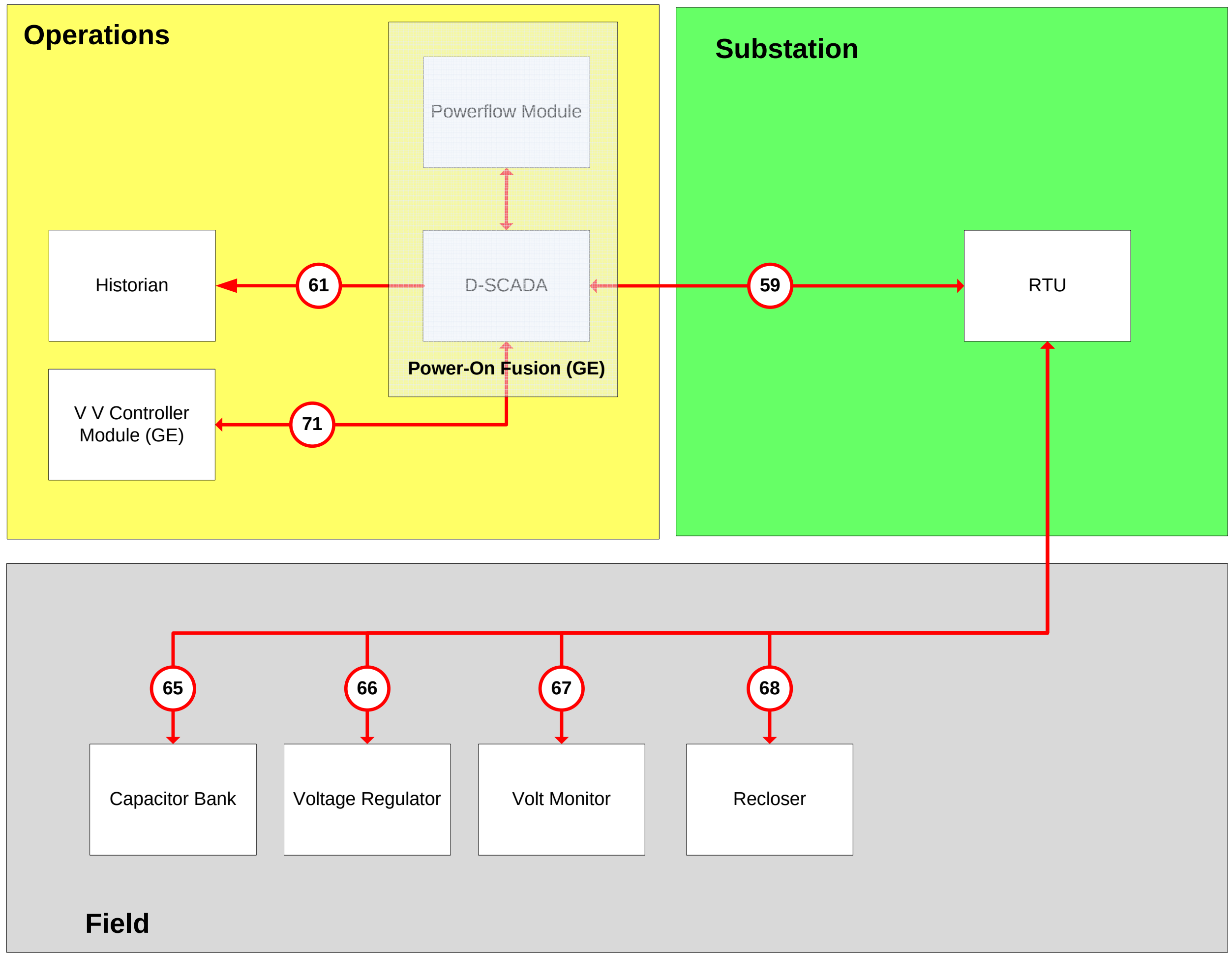


Figure 1-1
Context Diagram for Centralized Integrated Volt/VAR Control

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.
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 Controller	Device	The voltage regulator regulates voltage at a fixed point 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.
Volt Monitors	Device	Field device that monitors and measures voltage and sends to the RTU (for VVC).
VVC – Voltage & VAR Controller	Sub-system	VVC is a module of the D-SCADA which performs supervisory logic to perform IVVC.
Historian	System	Repository of data coming from the D-SCADA system
PowerFlow	Sub-system	PowerFlow (also called Loadflow) is a sub-system of the D-SCADA that analyzes power flow and estimates voltages within distribution system.

Grouping (Community) '		*Group Description*
Actor Name	*Actor Type (person, device, system etc.)*	*Actor Description*
		system.

1.6 Information exchanged

Information Object Name	*Information Object Description*
Poll of RTUs	Poll of the RTUs
Poll of Specified Devices	Poll of specified field equipment
System Monitoring Data	Monitoring data from the system
System Monitoring Data from DSCADA	DSCADA monitoring data from the system
System Data	System data
Optimal Configuration	Optimal configuration calculated
Communications Acknowledgements	Data confirming that a communication was received error free.
Device Control/Commands	Commands for field equipment
Status Poll	A poll to request current equipment status
Status Update	Update of the current status of the field equipment

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
	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.
Powerflow Module	Powerflow Module is up to date with the current as operated system configuration.

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 section0.*	*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 section0.*	*What other actors are primarily responsible for Receiving the information? Actors are defined in section0.* *(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.*
1.1.1	DSCADA will poll RTU.	DSCADA	Scheduled polling of status	DSCADA will Poll of RTUs of specified devices	DSCADA	RTU	Poll of RTUs	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
1.1.2	Periodic RTU Polling	RTU	Scheduled polling of status	On a predetermined frequency RTU will Poll of Specified Devices	RTU	RTU	Poll of Specified Devices	DNP/IP DNP serial	
1.1.3		Voltage Regulator Controllers	Voltage Regulator Control sends data	Voltage Regulator Control sends System Monitoring Data to RTU	Voltage Regulator Controllers	RTU	System Monitoring Data	DNP/IP DNP serial	
1.1.4		Capacitor Bank Controllers	Capacitor Bank Control sends data	Capacitor Bank Control sends System Monitoring Data to RTU	Capacitor Bank Controllers	RTU	System Monitoring Data	DNP/IP DNP serial	
1.1.5		Volt Monitors	Volt Monitors sends data	Volt Monitors sends System Monitoring Data to RTU	Volt Monitors	RTU	System Monitoring Data	DNP/IP DNP serial	
1.1.6		Recloser Controllers	Recloser Control sends data	Recloser Control sends System Monitoring Data to RTU	Recloser Controllers	RTU	System Monitoring Data	DNP/IP DNP serial	
1.1.7	VVC Module receives data from DSCADA	VVC Module	VVC Module receives data	VVC Module receives System Monitoring Data from DSCADA	DSCADA	VVC Module	System Monitoring Data from DSCADA	proprietary	
1.1.8		RTU	DSCADA receives data	DSCADA receives Status Update from RTU dataset	RTU	DSCADA	Status Update		

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environment
1.2		DSCADA	DSCADA sends data to Historian	DSCADA sends System Data to Historian on predetermined interval	DSCADA	Historian	System Data		
1.3		Powerflow Module	Powerflow Module exchanges data	Powerflow Module exchanges System Data with DSCADA	Powerflow Module	DSCADA	System Data		
1.4		Powerflow Module	Powerflow Module exchanges data	Powerflow Module exchanges System Data with VVC Module	Powerflow Module	VVC Module	System Data		
1.5		VVC Module	VVC Module calculates an Optimal Configuration	VVC Module calculates an Optimal Configuration for the circuit and commands sequence to be initiated	VVC Module	VVC Module	Optimal Configuration		

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 Ohio Test the VVC 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 section0.*	*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 section0.*	*What other actors are primarily responsible for Receiving the information? Actors are defined in section0.* *(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.*
2.1.1	VVC – Voltage & VAR Controller determines control required to optimize volt var	VVC – Voltage & VAR Controller	VVC – Voltage & VAR Controller	VVC – Voltage & VAR Controller issues Device Control/Commands to DSCADA.	VVC – Voltage & VAR Controller	D-SCADA	Device Control/Commands		
2.1.2		D-SCADA	D-SCADA sends control/commands	D-SCADA sends Device Control/Commands to RTU	D-SCADA	RTU	Device Control/Commands		
2.1.3A.1		RTU	RTU	RTU issues Device Control/Commands to Voltage Regulator Controller.	RTU	Voltage Regulator Controller	Device Control/Commands	Raise Lower Go To Neutral Change Setpoints	DNP/IP DNP serial

[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
2.1.3A.2		Voltage Regulator Controller	Voltage Regulator Controller sends and acknowledgement	Voltage Regulator Controller sends a Communications Acknowledgements to RTU	Voltage Regulator Controller	RTU	Communications Acknowledgements		
2.1.3A.3		Voltage Regulator Controller	Voltage Regulator Controller functions accordingly	Voltage Regulator Controller functions accordingly	Voltage Regulator Controller	Voltage Regulator Controller	Device Control/Commands		
2.1.3A.4		RTU	RTU polls	RTU polls Voltage Regulator Controller for status	RTU	Voltage Regulator Controller	Status Poll		
2.1.3A.5		Voltage Regulator Controller	Voltage Regulator Controller responds	Voltage Regulator Controller responds to status poll	Voltage Regulator Controller	RTU	Status Update		
2.1.3B.1		RTU	RTU will poll specified devices	RTU issues Device Control/Commands to Capacitor Bank Controller	RTU	Capacitor Bank Controller	Device Control/Commands	Open Close Change Setpoints	DNP/IP DNP serial
2.1.3B.2		Capacitor Bank Controller	Capacitor Bank Controller sends and acknowledgement	Capacitor Bank Controller sends a Communications Acknowledgements to RTU	Capacitor Bank Controller	RTU	Communications Acknowledgements		

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environment
2.1.3B.3		Capacitor Bank Controller	Capacitor Bank Controller functions accordingly	Capacitor Bank Controller functions accordingly	Capacitor Bank Controller	Capacitor Bank Controller	Device Control/Commands		
2.1.3B.4		RTU	RTU polls Capacitor Bank Controller	RTU polls Capacitor Bank Controller for status	RTU	Capacitor Bank Controller	Status Poll		
2.1.3B.5		Capacitor Bank Controller	Capacitor Bank Controller responds to status poll	Capacitor Bank Controller responds to status poll	Capacitor Bank Controller	RTU	Status Update		
2.1.3C.1		RTU	RTU will poll specified devices	RTU issues Device Control/Commands to Volt Monitors	RTU	Volt Monitors	Device Control/Commands	Read	DNP/IP DNP serial
2.1.3C.2		Volt Monitors	Volt Monitors sends and acknowledgement to RTU	Volt Monitors sends a Communications Acknowledgements to RTU	Volt Monitors	RTU	Communications Acknowledgements		
2.1.3C.3		Volt Monitors	Volt Monitors functions accordingly	Volt Monitors functions accordingly	Volt Monitors	Volt Monitors	Device Control/Commands		
2.1.3C.4		RTU	RTU polls Volt Monitors for status	RTU polls Volt Monitors for status	RTU	Volt Monitors	Status Poll		

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environment
2.1.3C.5		Volt Monitors	Volt Monitors respond to status poll	Volt Monitors respond to status poll	Volt Monitors	RTU	Status Update		

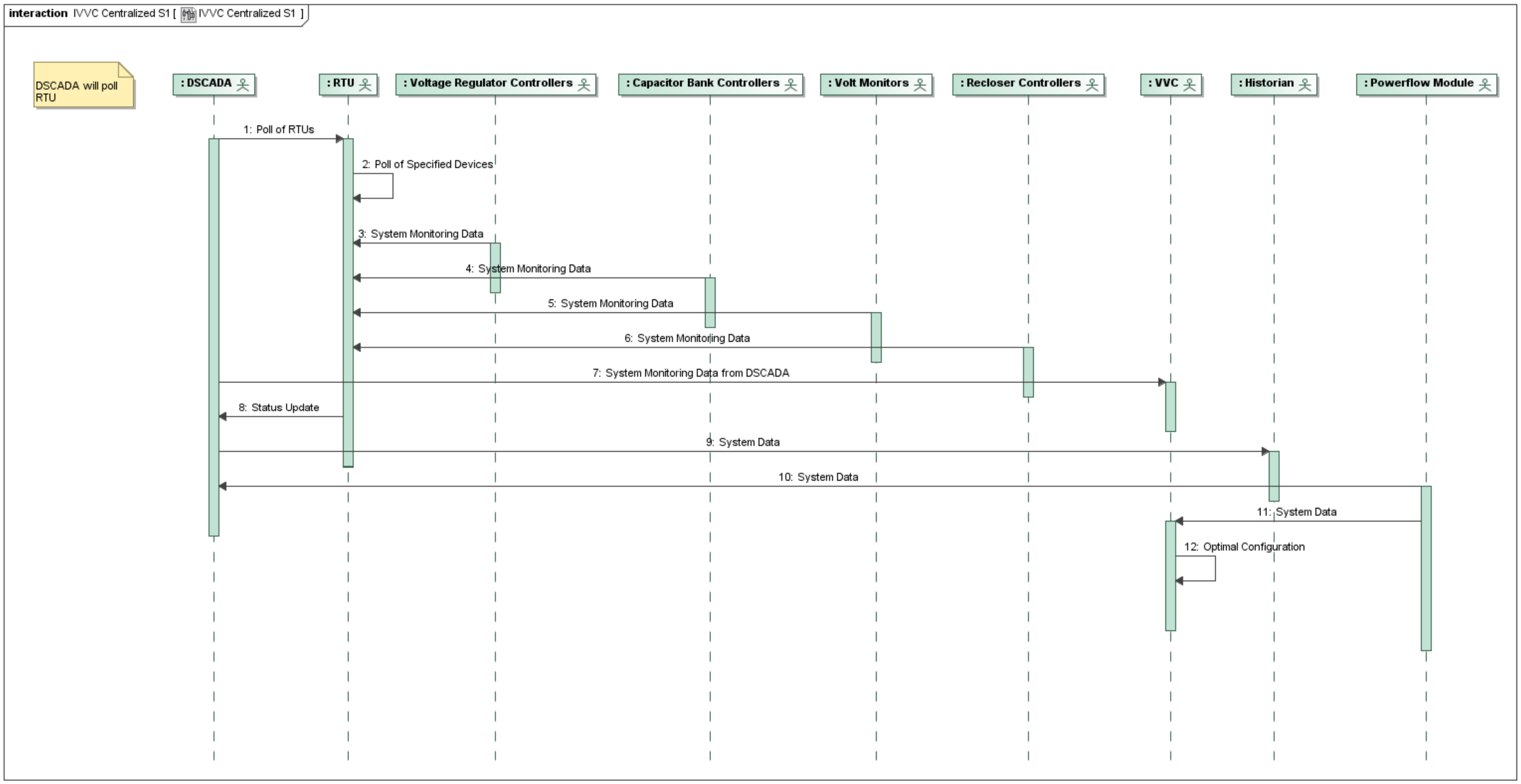
3.1.3 Post-conditions and Significant Results

Actor/Activity	*Post-conditions Description and Results*

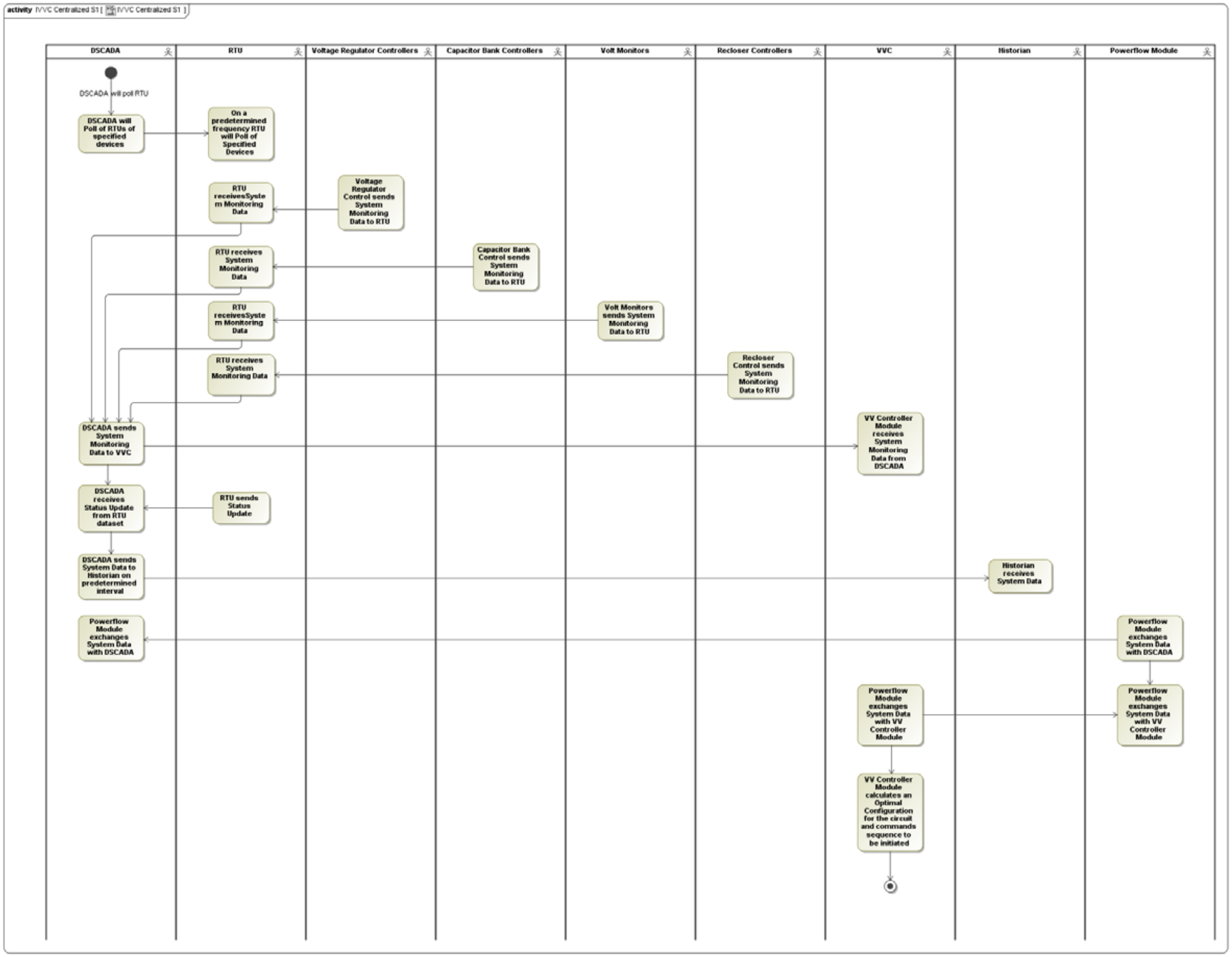
3.2 Architectural Issues in Interactions

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

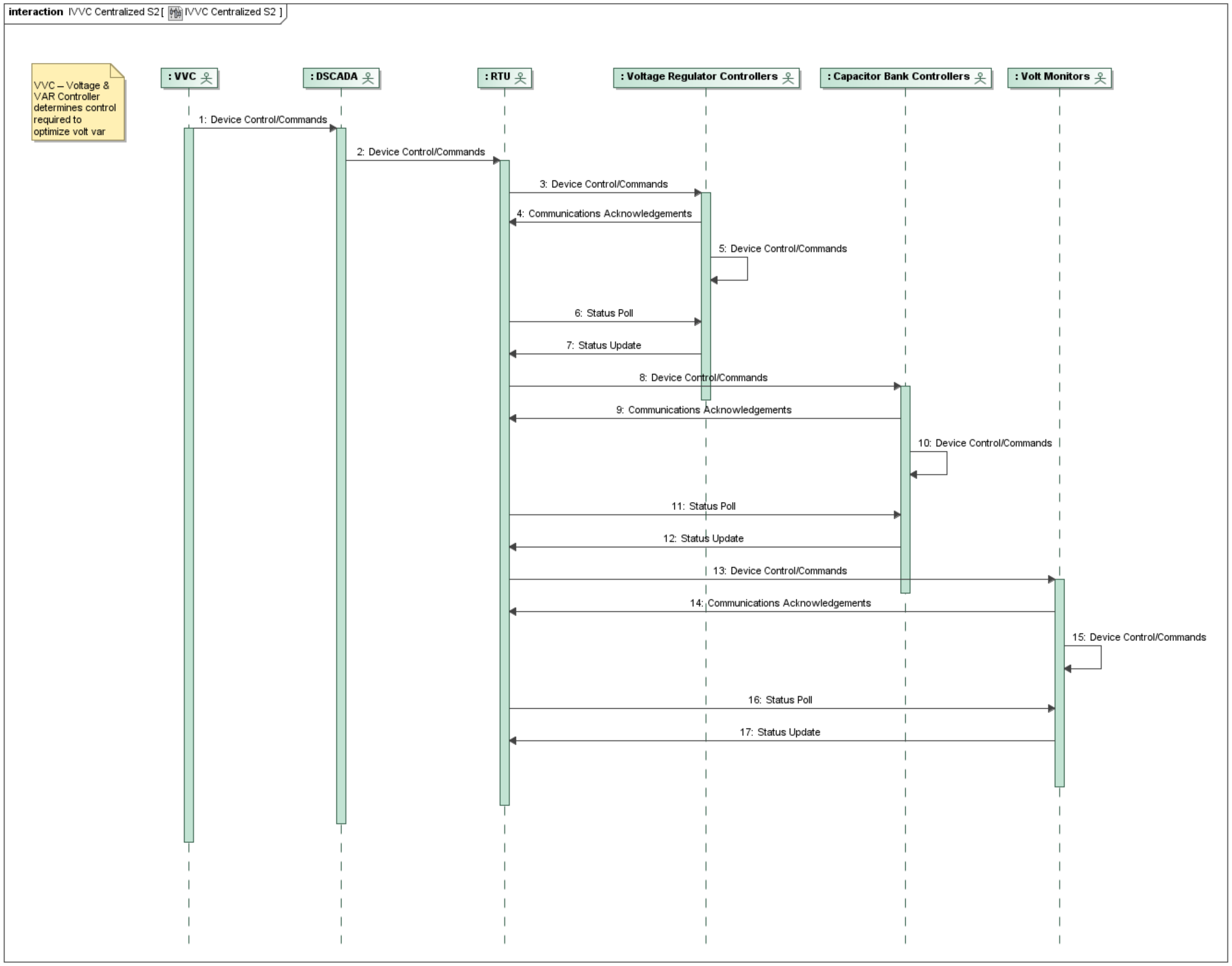
3.3 Diagrams



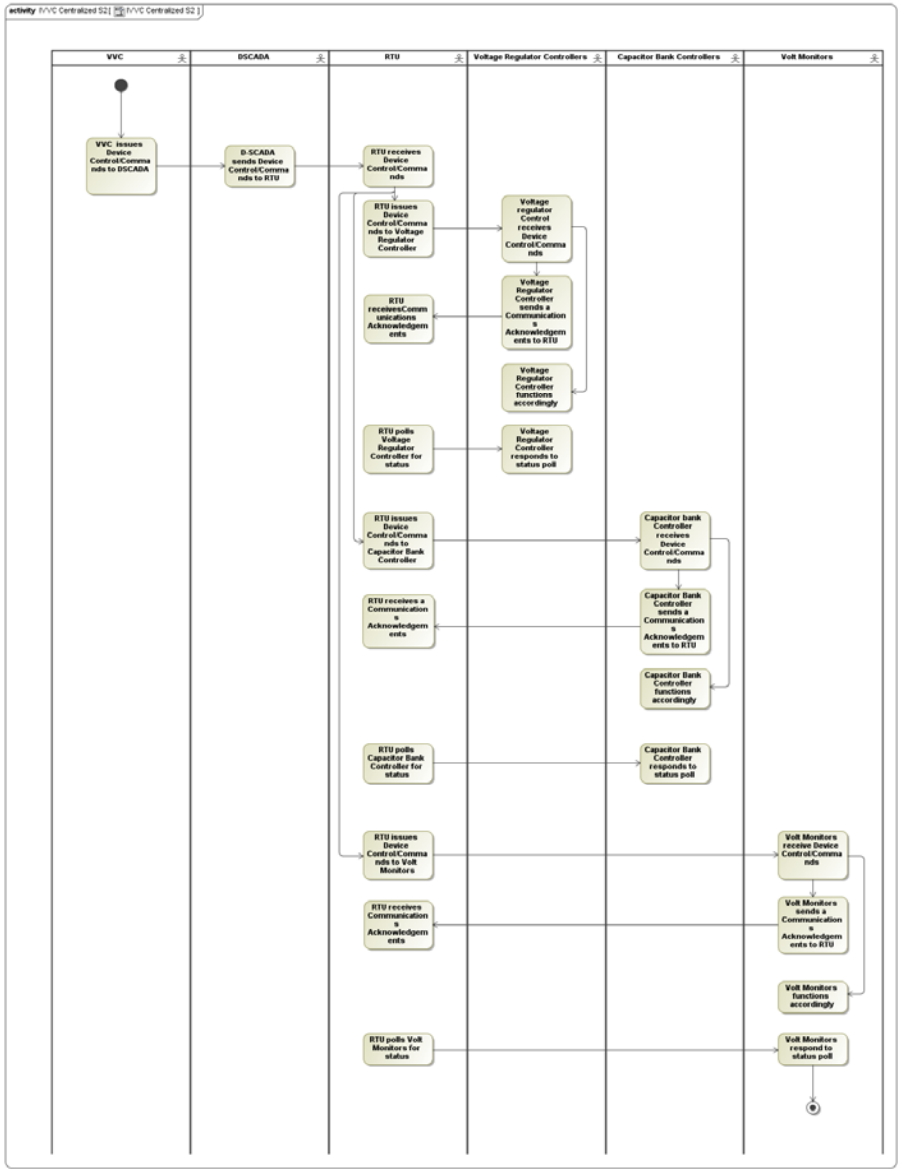
IVVC Centralized Scenario 1 Sequence Diagram



IVVC Centralized Scenario 1 Activity Diagram



IVVC Centralized Scenario 2 Sequence Diagram



IVVC Centralized 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
2.0	4-10-2010	John J. Simmins	Complete sections and fill in blanks.
3.0	5-13-2010	Brian D. Green	Revisions and add diagrams
3.1	5-14-2010	Brian D. Green	Utility Revisions