Utility Network Operational Manual

Innovatec Utility Software System Organization and Requirements

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Open Issues

What type of location information will we use (e.g., lat, long, elevation, pole #) for gateways, relays and meters?
What tool will we adopt for network RF planning, and how will we interface the rest of the system to it?

Introduction

The Enterprise Network and Internet Communications (ENICS) system is a set of software applications that allow either utilities or Innovatec acting as a service bureau to manage and operate an Innovatec communications network. The functions required include the ability to read meters, monitor network operation, install, decommission, swap and test all elements in the communications network and handle alarms. In addition, Innovatec must have a means of planning and laying out communications networks, training users and demonstrating the system to prospective customers. For development it is desirable to have some means of exercising the communications network in a more intensive manner than we have been able to in the past. It will be necessary to update and possibly gather data from databases that are not part of the Innovatec system. For example, a utility may have a billing database (and applications that use it) already in place. Data from scheduled reads might be placed into this billing database.

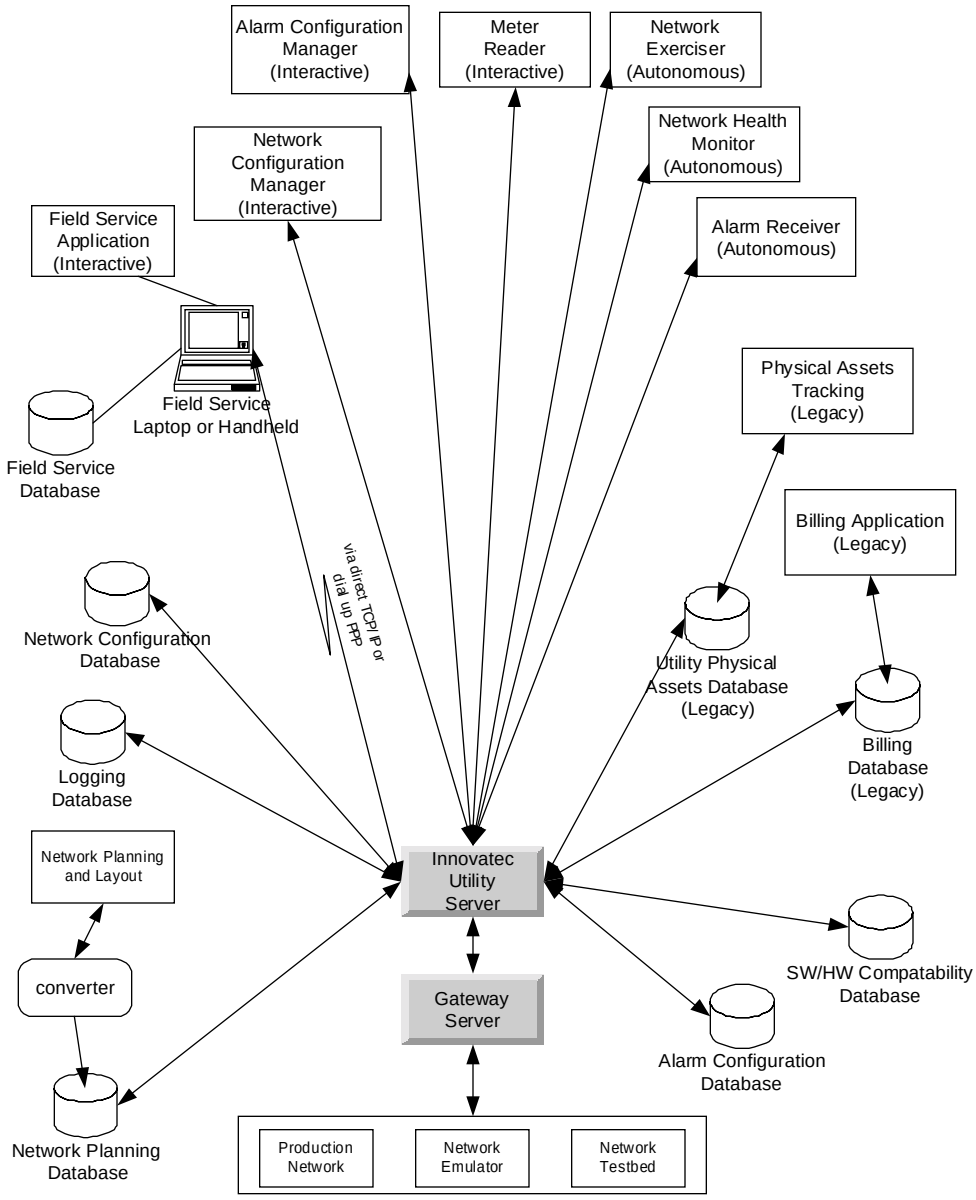


Figure 1: High level schematic for the Innovatec utility software system

Primary Requirements
Primary requirements are those that ultimately come from the customer or are dictated by the basic nature of the application.

Supported Databases
For the purposes of this specification, the databases in the system are classified into internal and external databases. Internal databases are those that will be built into a stand alone Innovatec system. External (or legacy) databases are those that are supplied by a particular Innovatec customer or a particular 3rd party application. An interface to an external database may be supplied as part of the customization for a particular customer, but the information contained in these databases is not required to run the Innovatec system. Internal databases are specified in section 0.

External Databases
While it is possible for the set of external databases to be composed, in principle, of anything or nothing, we anticipate that the external databases will typically consist of the following for each utility.

Database	*Record Type*	*Item*	*Comment*
Billing	Basic account information	Account number Customer name Customer address	
	Meter information for a customer	Account number Meter type Meter name	May be multiple records for each customer
Physical Assets	Data for each meter	Account number Meter name Meter type Meter Model Factory number Meter brand Meter size Zone Installation date Installer Installation time Location information	

Multiple Database Set Support
One of the uses of the utility server software will be Innovatec acting as a service bureau. In order to support this type of operation, the utility server software shall support multiple sets of independent databases, one for each utility Innovatec supports. It shall be the responsibility of the Innovatec Utility Server to distinguish between sets of databases for different utilities, given an appropriate utility specification from the various applications.

Logging
It shall be possible to log events of interest into an internal database. These events shall include, but are not limited to, message transmissions and receptions. It shall be possible for users to configure the number and the age of events to be maintained in the log. All attempts by a client application to log into the ENICS system or a remote configuration server to initially contact an ENICS configuration server or a remote redistribution server to initially contact an ENICS server should be logged, whether the attempt is successful or not.

Architectural Constraints

It shall be possible to distribute user interface, database and server functions over multiple machines. It shall be possible for users to remotely access the interactive utility programs from remote desktop computers. It shall be possible to site the WAN interface hardware on a machine that is physically separate from the machine(s) that host the databases and are generally used for network maintenance and other functions.

Server data maintenance

To the extent that is consistent with maintaining the integrity of the various databases, user visible data shall not be lost if a server or server machine suffers an ungraceful shutdown.

External Data Distribution

In addition to interacting with an Innovatec communications network, it shall be possible for the ENICS system to distribute data to and/or receive data from another ENICS system. This will allow a utility that does not actually own the meters for a particular customer to gather data about a meter from the utility that does own the meter. The interactions supported in this mode are limited to scheduled reads, on demand reads, informational alarms, informational alarm configuration and basic meter status information. Informational alarms include low flow threshold, prepay alarms and other alarms that indicate usage violations but that are not associated with a possible physical failure. Alarms that do indicate a physical failure (such as runaway alarms), shall not be configurable by an external utility and shall not be distributed to an external utility. It shall be possible to configure access permission for an external utility on a meter by meter basis. It shall be possible to configure which alarms may be distributed to or configured by an external utility on an alarm by alarm and meter by meter basis. If an external utility has been granted configuration permission for a particular alarm on a particular meter, then the utility that grants that permission will no longer be able to configure or receive that alarm for that meter. Note that the owner utility will still need to keep track of the alarms that have been configured by an external utility, in case the meters associated with the external utility or the gateways associated with those meters are physically modified, reconfigured or replaced. Both the hosting and receiving ENICS servers shall keep track of the number and types of data sent/received to/from the remote distribution server for billing purposes.

Security

Security considerations for the ENICS system fall into the following four areas:
Authentication (is the user or utility really who he, she or it says they are)
Authorization (is the user or utility allowed to perform the operation they are requesting)
Confidentiality (prevent an outside observer from viewing data that the utility doesn't want them to view)
Auditing (leave a trail so that attempts to compromise the system are tracked for later analysis)

The other two areas that are often of concern for browser users in a networked environment, containment and nonrepudiation, are not of much concern to users who may run ENICS applets or applications since all such applets, applications and servers come from a trusted source. Authentication is a concern in two areas. The first is that only people authorized by the utility run the ENICS applets/applications, such as the interactive meter reader, the field service application or the network configuration manager. The second is that data distributed to an outside utility is sent only to systems that have been explicitly authorized to receive such data. Authentication in the ENICS system consists of two elements. The first is password authentication. All users shall be required to enter a password before using any ENICS application/applet with a user interface. Passwords shall be stored internally in a form that is cryptographically secure. The second is host identification. It shall be possible for system administrators to allow access to the ENICS system from an application/applet or a third party using the external data distribution capability only from some designated set of hosts. Thus a user attempting to log in using a valid password from a host that is not in the designated set of hosts would be denied access to the system (with an appropriate reason given). There shall be a means to indicate that access from any host are allowed.

Authorization shall be supported by access control lists. It shall be possible to assign permissions on a user by user, utility by utility (for external data distribution) and application by application basis. Thus, a user might be allowed full access to the interactive meter reader, but no access to the network configuration manager. All ENICS applications shall consult the access control list before performing any operation that might be forbidden by the access control list. Applications/applets should provide a visual indication of forbidden operations (e.g., grayed out controls) if a set of operations is not allowed for a user.

Confidentiality shall be supported through encryption of any communication between ENICS servers (for external data distribution) or between ENICS servers and applications/applets that involved confidential data. If private key exchange is required (e.g., to use a DES algorithm), then the private keys shall be encrypted when they are exchanged (e.g., with a public key encryption technique).

Auditing shall be supported by the logging facility. All attempts to access (i.e., log into) the system by a user or by an external agent shall be logged, whether they are successful or not. As much data as possible should be captured, particularly for unsuccessful logins, including the login name and the machine name from which the login attempt is made.

Firewalls

It is anticipated that an ENICS system will typically operate behind a firewall. The firewall is set up to deny access to unauthorized users contacting the system from outside the local network (e.g., through the Internet). ENICS applications, applets and servers are neither required nor encouraged to defeat firewall security using HTTP tunneling or other techniques. This implies that it will be necessary for ENICS system administrators to explicitly allow firewall access to outside users on specified ports. It shall be possible for an ENICS system administrator to configure the port number(s) used to contact enics servers. This does not imply that such configuration necessarily must be done on a server by server basis.

Attack Methods

The following potential attacks should be considered in the design of the ENICS software:

Monitoring. A cracker could monitor the data stream in an attempt to find authorized user names and passwords. A utility competitor could attempt to monitor the stream of meter reads to determine which customers could be "cherry picked". Monitoring can be defeated through encryption of the data stream, including any interactions in which passwords are passed.

Password guessing, dictionary or exhaustive scan (particularly if driven by a computer program). Password choice rules plus the use of a reasonably large salt (to complicate reverse dictionary construction by an insider) should make this very difficult. Note some part of the enforcement of good password choices (e.g., don't use your wife's maiden name) must be addressed by internal utility processes.

A legitimate user attempts operations that he or she is not authorized to perform. This is addressed by access control permissions.

A legitimate user attempts operations from a suspicious location (e.g., a disgruntled former employee who was a network administrator tries to shut down the Innovatec communications network by deregistering all the meters from the gateways and erasing them from the utility database from his home computer). This is addressed using host identification in addition to passwords. Note that internal utility processes are responsible for making sure that only correct hosts are identified as legitimate sources to the ENICS system.

A computer cracker attempts to gain access to the ENICS system by running an applet or application that claims to be a standard ENICS applet. This is handled by keeping password and host identification contained on the server (any authentication contained in a client would have been bypassed because a real ENICS client isn't being used).

A computer cracker attempts to gain access to the ENICS system by running an applet or application that claims to be an ENICS configuration server portal. This is handled by host identification. The cracker may attempt to defeat host identification by assigning his machine the same host address as a legitimate ENICS server. This can be defeated by configuring a firewall to refuse incoming packets from a host that has the same address as an internal ENICS server.

A computer cracker attempts to gain access to meter data and some alarm configuration capability by running an applet or application that claims to be a ENICS server that is set up for external data distribution. This is handled using host identification. The cracker may attempt to defeat host identification by assigning his machine the same host

address as a legitimate machine that is the target for external data distribution. This cannot be defeated using firewall configuration, since external access for on-demand reads and alarm configuration is necessary. *There is currently no effective answer in these specifications for this form of attack. There is no potential for harm to the source utility databases or the Innovatec communications network, however meter data that was set up for external data distribution could be monitored.*

A computer cracker runs a program that bombards the ENICS system with random packets or bogus login attempts. By using up the available bandwidth, access to the ENICS system by legitimate users is prevented (i.e., a denial of service attack). There is no way to automatically defeat this type of attack. Rejects of improper access attempts to the ENICS system should be logged, including the host name of the source of the attempt. Care should be taken that repeated illegal access attempt by the same source do not fill up the logging database. This log will aid in tracking down the offending party.

Export Restrictions

Some of the strong cryptographic algorithms that we plan to use to protect data confidentiality are export restricted. This means that if an ENICS system is deployed outside of the borders of the United States that it may be necessary to plug in a different set of weaker algorithms to meet export restrictions. The software shall be structured in such a way that it is possible to easily produce an export version that uses different cryptographic algorithms than the regular ENICS software.

Internationalization

There are no plans to export the ENICS software to non English speaking countries. Internationalization of the ENICS servers, applications or applets is not required.

Factory/Depot/Installation Work Flow

IMUs, relays and gateways are expected to follow a certain work flow during their lifetimes, as shown in Figure 2. IMUs, relays and gateways are assembled at the factory. At this point IMUs and relays are assigned a Utility Serial Number (i.e., pin #) and a channel. Gateways should have their WANs activated, if possible. IMUs, relays and gateways should be tested via the RF and (in the case of gateways) via the WAN interface (*see Gateway Node Noninvasive Test Procedure Specification*). The tool used to perform these functions is the Factory Commissioning and Test tool.

IMUs, relays and gateways are manufactured in response to projected demand, rather than for a specific utility order. Therefore, at the factory utility serial numbers (i.e., pin numbers) are assigned sequentially, but not associated with any specific Innovatec customer.

IMUs, relays and gateways are forwarded to a utility depot. At this point they must be associated with a certain customer (for IMUs) or a certain location and set of IMUs (for relays and gateways), the association loaded into the network configuration database and work orders generated and IMUs registered with their respective gateways. These functions are preformed (directly or indirectly) using the Depot Commissioning tool. In addition, the units may be tested again using the Field Maintenance and Diagnosis tool.

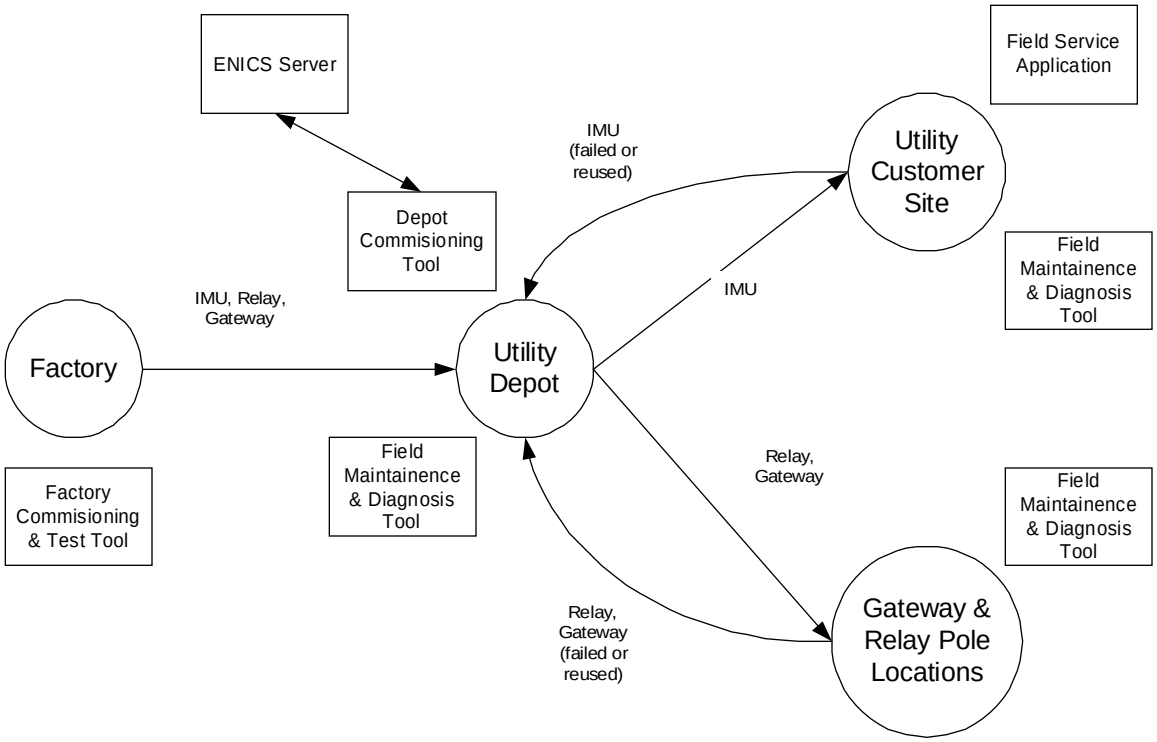


Figure 2: IMU, Relay and Gateway work flow

Gateways and relays will move from the depot to their pole locations. Gateways and relays are installed and tested using the Field Maintenance and Diagnosis tool. Once gateways and relays have been installed, the IMUs move from the depot to customer sites, where they are installed, tested and their installation in the gateways verified using the Field Service Application tool. At some point in their lives IMUs, relays or gateways may be replaced due to suspected failure or other reasons. These units go back to the depot. Suspected failures may be explored using the Field Maintenance and Diagnosis tool. While both the depot commissioning tools and the network configuration manager modify the network configuration database, the depot commissioning tool is limited to filling in id (e.g., IMU utility serial number) and address fields (e.g., WAN addresses) for units that have already been entered into the network configuration database. This implies that a unit must have already been added into the system by the network configuration manager before the depot commissioning tool can be used to modify its data, and that a null entry for certain fields must be allowed in the network configuration database for IMUs, relays and gateways that are marked as not installed.

Derived Requirements

Derived requirements are those that are driven by the primary requirements, but are imposed on ourselves.

Supported Applications

For those applications whose user interfaces are implemented using Java applets, designers/implementers should strive to keep the applets small, and implement any heavy duty operations in the servers rather than in the applets themselves.

Supported Interactive Applications

Interactive applications are those whose functions are primarily driven by an explicit user request, such as a meter read or a request to upload a database from a field service application. The Innovatec utility server system implements services for the following user visible applications. These “applications” are not necessarily implemented as monolithic applications in the traditional sense, but they appear that way to end-users.

"Application"	*Purpose*	*Required server functionality*
Field Service Application	Install, decommission, swap, calibrate, and test meters in the field. The primary users are field service people. Operates on a field service laptop or handheld computer that may be out of communication with the rest of the system for long periods of time.	Specify set of service orders for a particular service person (or service id). Specify what is to be done for each service order. Allow basic IMU communications parameter configuration (e.g., set the channel number). Perform basic tests of meter communication. Check that necessary network setup has been completed to allow service order function to proceed for a given meter. Download service orders to individual service laptops. Upload modified information from individual service laptops and integrate it into the databases at the utility end. Calibrate water meters
Field Monitoring and Diagnosis Tool	Monitors RF traffic. Performs diagnostic tests of meters, relays and gateways.	Display all RF messages received (should we allow for filtering parameters?) Invoke diagnostic tests for IMUs, relays and gateways via the RF interface. Reprogram IMU communications parameters (e.g., meter utility id, channel number, power). Query for all meters on a channel. Scan channels for a meter Download gateway error and event logs via RF. Perform pings via the WAN from a gateway to the utility (for WAN problem diagnosis), invoked via the RF interface?
Factory Commissioning & Test tool	Checks IMUs and relays to make sure they're properly programmed with the correct Utility Serial Number, produces factory log, performs noninvasive gateway testing.	Checks IMUs and relays for correctly programmed Utility Serial Number and default channel Performs noninvasive gateway test. Generates factory log. If the meter supports an internal record of factory commissioning, update that record once tests and configuration have been completed.
Depot Commissioning tool	Connects specific IMU, relay and gateway ids to customer accounts and locations. Permits gateways, relays and IMUs to be replaced with identical units.	
Interactive Meter Reader	Query meter readings and status interactively. The primary users are utility customer service people.	Isolate particular customer/meter Read meter Query meter status Inform user when result of operation is available.

"Application"	*Purpose*	*Required server functionality*
Network configuration manager	Configure Innovatec communications network, perform network diagnostics, manage hardware and software versions, support field service operations. The primary users are network maintainers at the utility.	View network logically. Supply data relating to characteristics of a communications path. Supply meter and gateway statistics and logged history. Set up service orders Integrate modified service order data into databases.
Alarm configuration manager	Configure which alarms should be recognized for specific IMUs.	Activate/deactivate alarm notification. Specify notification method (e.g., on screen, hip pager).
Network Emulator	Emulates an Innovatec communications network. Allows the introduction of alarms or fault conditions (e.g., WAN link goes down) interactively. Primary users are utility trainers and Innovatec sales people.	Replaces the gateway server's gateway agent. Reads network configuration from a network configuration database. Displays logical view of the network. Allows a trainer or sales person to interactively introduce alarms and fault conditions.
System administration tool	Allows a system administrator to view, configure and control the ENICS servers and clients.	View server configuration information View active clients Startup/shutdown servers and clients Add new hosts to ENICS system, add or rearrange utility servers in ENICS system. View loading statistics. Add or delete users. Add or delete remote redistribution servers.
Event log viewer	Allows data in the event log tables to be viewed. Allows archived event log data to be viewed.	Filters events by type, date and auxiliary characteristics specific to the event type.
Network Planning and Layout tool	Contains RF propagation models that allow an Innovatec communications network to be laid out (e.g., site gateways and relays given meter locations, taking into account RF propagation characteristics). Primary users are network planners. This tool will be bought rather than built.	Off the shelf tool will have its own file formats and views.
Network Planning Database converter	Converts from the file formats used by the network planning and layout tool and imports the data into the internal Innovatec Network and Planning database.	

Supported Autonomous Applications

An autonomous application is one that runs without significant user intervention, such as the automatic health monitor.

Application	Purpose	Required server functionality
Network exerciser	Test the network software and gateway server, in house. The primary users are developers and testers	Accepts set of messages and timing from a script file. May be possible to purchase this tool rather than build it.
Network health monitor	Determines when an element of the network hasn't been heard of in some time. Pings elements of the network that may not be responding.	Ability to associate IMUs with relays and gateways. Ability to send ping messages to the communications network. Ability to notify users when problems are detected.
ENICS Health Monitor	Periodically scans the event log looking for suspicious patterns of activity, such as multiple blocked login attempts. Monitors the internal health of ENICS processes/threads to determine if a malfunction has occurred.	Tells the alarm receiver when a suspicious pattern of activity is detected or a malfunction occurs.
Message Monitor	Moves journaled sent/received messages from the gateway server into the logging database for subsequent use by other applications.	Ability to access record of all messages sent and received.
Logged Event Pruner	Deletes data from the logging database that is older than some configurable maximum age. The data may optionally be logged to an external medium such as CD-ROM or tape, rather than deleted.	Ability to do queries and deletes on the logging database.
Gateway Logged Event Gatherer	Periodically gathers up the error and event logs maintained in the gateway nodes.	
Alarm receiver	Acts when an alarm is received. Notified when an internal ENICS component wants to raise an alarm.	Ability to cause alarm display applet to be updated. Ability to cause 3rd party devices (such as hip pagers) to be activated.

Supported Databases

While the general set of data present in the internal databases is derived from the primary requirements, its partition into specific databases is a high level architecture decision.

Internal Databases

The utility server software shall support access to and maintenance of the following internal databases, independently for each utility supported. The databases referred to in this section are abstract entities introduced for the purposes of requirements analysis and will not necessarily be implemented as databases in the sense of an JDBC (or other protocol) database entity. The assignment of data to specific tables and the assignment of tables to specific databases will be done in part in the system architecture design and in part in the utility server design.

Database	Record Type	Item	Comment
Network Configuration, Network Planning	Gateway	Gateway id. Gateway WAN Type Hardware revision number Software revision number Operating system revision number Gateway application (gw.zip) revision number Classes.zip revision number Patch file contents and revision numbers Location information	Patch file may be a separate record type or even in a separate table. Location information may include lat, long, elevation and pole #.
	Relay	Relay id Relay hardware revision number Relay software revision number Location information	Location information may include lat, long, elevation and pole #.
	Meter	Utility Id (AKA utility serial number, pin number) Meter type Location information Calibration Factor (for water meters)	Location information may include lat, long, elevation and pole #.
	Supported WANs	WAN type designation WAN PIN number	
	Gateway-IMU association information	Gateway id IMU id that is registered with gateway Option relay id that IMU is registered with	
Software/Hardware version compatibility	Use to keep track of which gateways, relays and meter versions are compatible with other versions.		This is intended to act as an error checking mechanism. This database is static from the utilities point of view, and would be supplied by Innovatec each time a new gateway, relay or IMU version came out.
Alarm configuration	Alarm activity information	IMU id Alarm type Alarm active or inactive Time of last activation (or should this be an alarm history?)	
	Alarm notification information	IMU id Alarm type Notification type specification	

Database	Record Type	Item	Comment
	Notification type record. Typically there'll be one of these for every notification destination/ destination type. E.g., one for each pager that could be notified that an alarm has arrived.	Notification type Device specific data (e.g., PIN number for a pager, display device for on screen notification)	
Logging	Keeps track of interesting events that happen in the system. This includes but is not restricted to message transmissions and receptions.	Time event was logged Event type Auxiliary information	The design of this database is not likely to be one monolithic table, as the "auxiliary information" may be used to do lookups in other tables.
Authorized users	Keeps track of authorized user names, passwords and authorized hosts.		
Authorized external data distribution targets.	Keeps track of other ENICS servers to which data may be distributed.		
Extern data distribution meter configuration table	Keeps track of what alarms and status are available to an external utility and what alarms may be configured.		
External data distribution target transaction log	Keeps track of the transactions performed by an external utility (e.g., number meter reads) for billing purposes.	Meter utility id Transaction type Number transactions	
Field Service Application Database	Keeps track of work orders that have been generated or uploaded	Service order number Installer Open/close dates IMU information Customer information IMU location information Time stamps for as found/as left changes	
Application Configuration Database	Keeps track of user settable options for the various applications (possibly on a per user basis, where that makes sense).	Application Name User name	It may make sense to keep this data in the NT registry on the server. However the interface the applets and applications see should be through a servant.

Permissions

Access control permissions (or just permissions) in the ENICS system apply to all applications (including both Java applications and applets) that may be initiated outside of the server environment. Applications that are initiated by and run under the control of the ENICS server environment (such as the network health monitor) do not require access permissions. Access permissions are assigned out of the available options on a user by user basis. Each application has three sets of permissions. The first "set" determines whether a user is allowed to access the ENICS server while running a particular application. For example, a user may be granted permission to run the Interactive Meter Reader, but not the Network Configuration Manager. This is not a security measure, since the only way the ENICS server has to know what application is being run is for the application to tell it. Thus, this sort of permission won't be able to deter a cracker who writes his or her own application, but it will give the system administrator control over who can run applications under normal circumstances.

The second set controls access to the various database tables in the system. An application may have read, modify and append permission for a table. Append is a restricted type of write access that allows an application to add new records to a table, but not to either modify or read records that already exist. Modify access implies both read and append access. For databases that contain information that is associated with particular users, users may be granted permission to read or modify data for themselves only or for all users.

The third set of permissions controls access to the communications network. The first access permission is "network use". This allows an application to interact with the communications network. If it is not set, then the application is not allowed to interact with the communications server. The second network access permission is IMU read/modify, which determine which types of messages that can get or set IMU information are allowed to be sent. The third network access permission is network read/modify, which determines which messages can be sent that may read information from or modify gateways and relays. Please note that even an application that has no explicit network access may invoke an operation that will cause the ENICS server to access the network.

COM Access

In order to support miscellaneous analysis and data gathering capabilities, a COM interface to the ENICS business objects shall be implemented. This will allow programs to be written in Visual Basic that can retrieve information from the ENICS system. The COM interface shall be design in such a way that it shall not be possible to compromise ENICS server or Innovatec network communications using the interface. A set of standard Visual Basic applications should be implemented for common operations such as gathering reads from a predefined group of meters and gathering time of use information. These standard applications will serve to get Innovatec customer's started using the more exotic functions of the system quickly and also server as examples for Innovatec customer IT departments that wish to implement their own data analysis programs.

Required Requirements

All application requirements documents shall include the following:

1. Startup
2. Shutdown
3. I/O interfaces, if any.
4. Required services.
5. Behavior in the event of errors, including but not limited to internal program errors, communications errors, database access errors and server access errors.
6. Mechanism for notifying users when a problem is detected (e.g., dialog box, logged event).
7. Which events should be logged (e.g., significant user actions)

Innovatec Look and Feel
Pluggable Look and Feel

All enics applications should implement the **com.innovatec.plaf.InnovatecLookAndFeel** look and feel.

```
import com.innovatec.plaf.InnovatecLookAndFeel;
...
static{
try{
UIManager.setLookAndFeel( new InnovatecLookAndFeel() );
}
catch( Exception e ){}
}
```

Colors

Foreground/Text

Foreground colors should contrast extremely with the background. Since most of our background colors are very light, labels, and text areas will have black foreground colors. Buttons on the other hand have very dark backgrounds, so their text will normally be white.

Background

Backgrounds for panels should be light and change in color and or image with different concept area. For example if there are two panels on one screen that represent different ideas, utility record and meter status, they should be of different colors to make them easily distinguishable.

Since colors cannot be completely relied upon due to color blindness, images with different subtle textures should be used as well. Images can be added by using **com.innovatec.ui.BasicPanel** instead of JPanel, and setting the image through **BasicPanel.setBackgroundImage**.

Navigation Keyboard

In general, navigating between components follows these rules.

- Tab or Ctrl-Tab. Moves keyboard focus to the next component or to the first member of the next group of components. Use Ctrl-Tab when the component itself accepts tabs, as in text fields, tables, and tabbed panes.
- Shift-Tab. Moves keyboard focus to the previous component or to the first component in the previous group of components.
- Arrow keys. Moves keyboard focus within the individual components of a group of components, for example, within menu items in a menu or within radio buttons in a group of radio buttons.
  Most of the keyboard navigation is taken care of by Java, some changes in tab order may need to be implemented by specifying the next focusable component to a component. This can be accomplished by **JComponent.setNextFocusableComponent**.

Mnemonics

Mnemonics are another keyboard alternative to the mouse. Mnemonics can be used to navigate menus.

Rules of thumb for creating mnemonics:

1. If the mnemonic does not appear in the table of common mnemonics, choose the first letter of the menu item. For instance, choose J for Justify.
2. If the first letter of the menu item conflicts with those of other menus, choose a prominent consonant. For instance, the letter S has already been designated as the mnemonic for the Style command. Therefore, choose the letter Z as the mnemonic for the Size command.
3. If the first letter of the menu item and the prominent consonant conflict with those of other menu items, choose a prominent vowel.

Mnemonics can be set by **AbstractButton.setMnemonic**.

Mnemonics can also be added to any item with a label. This can make it very easy to go directly to a component and add information. A mnemonic can be added to a component via the label by **JLabel.setLabelFor** and **JLabel.setDisplayMnemonic**.

Shortcuts

All common commands should have a short cut key strokes, these should be clearly labeled on the menu and or button for that command. The same shortcut key cannot refer to different actions in the application. Here is partial list of shortcut keys and their purpose:

Common Shortcut combinations include:

Ctrl-N	New (File Menu)
Ctrl-O	Open (File Menu)
Ctrl-S	Save (File Menu)
Ctrl-P	Print (File Menu)
Ctrl-Z	Undo (Edit Menu)
Ctrl-X	Cut (Edit Menu)
Ctrl-C	Copy (Edit Menu)
Ctrl-V	Paste (Edit Menu)
Ctrl-F	Find (Edit Menu)
Ctrl-A	Select All (Edit Menu)
F1	Help
Ctrl-Q	Exit Application

Mouse

A user can navigate through applications with the mouse. Specifically clicking once on an enabled button should cause that buttons action to occur. Clicking once on an editable text component should cause the text caret to be placed and put the text component in insert mode.

Components

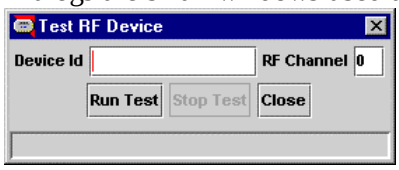
Primary Windows

A primary window is a window used as primary communication with the user by the application. This is where the user will return to in order initiate different functionality. A Primary Window shall consist of a Titlebar giving the name of the application, frame, and what is being done.

Secondary Windows

Dialogs

Dialogs are small windows used to concisely communicate with the user.



Login Dialog

Prompt the user for login name and password.

Use com.innovatec.ui.LoginDialog.

Plain Windows

Splash Screens

A splash screen is a window with no standard window decorations (titlebar, close, minimize, maximize icons) that informs the user that the software is loading and what exactly the program is.
A splash screen in ENICS shall consist of the Innovatec logo, an image for the application, the application logo, version, and copyright information.

A splash screen should be implemented using com.innovatec.ui.Jsplash. **The application name, version and copyright information should appear on all splash screens.Applets**

Applets can be broken down into two types, simple and complex. How an applet is displayed depends on what type of applet it is. A simple applet would consist of one screen, no menus, no toolbars, no status bar. This type of applet should be displayed within the browser window and should not add the confusion of creating another frame.
A complex applet is one that needs to be interacted with from another frame. A separate frame allows clear delineation between the applet's menus, toolbars, statusbar, and the browser's equivalent. A code snippet for a complex applet's frame could look like this:

```
public void init(){
        ...
        frame = new JFrame();
        frame.getContentPane().add( panel );
        ...
}
public void start(){
        ...
        frame.setVisible( true );
        ...
}
public void stop(){
        ...
        frame.setVisible( false );
        ...
}
```

This will make the applet a non-visual component, and the visual components are added the frame itself.

Buttons

Buttons should be different colors from each other and the background, colors can be repeated, but as far from a button of the same color as possible.

Toolbars

Icons on toolbars will match icons for buttons and or menus.

Menus

All commands available should also be made available by menu.

As much as possible all menus should have shortcut keys and or mnemonic associated with them. If a menu shares functionality with a button is should share the same label.

Status Bar

Small bar at the bottom used to convey information to the user. The status bar should be used before a dialog box if at all possible. Error messages should be in Red. Successful completion should be indicated with black. For implementation use **com.innovatec.ui.StatusBar**.

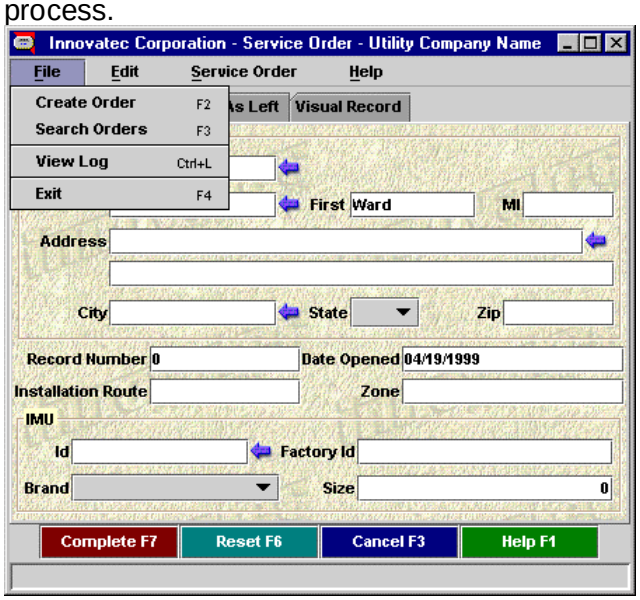
Organizing

Group Boxes

Used to group like concepts. Group boxes should used sparingly and group boxes within group boxes should be avoided, they can become confusing very fast and add very little to the organization of the screen. Instead of Group boxes consider having titles for areas, labels that extend slightly more left than the rest.

Tabbed Panes

Tabbed panes are the preferred method of breaking large hunks of data that are only tied together by a process.



Change Log

Date	Applications/Subsystems Affected	Description of changes
5/17/99, Revision 0.2		Changed revision number to 0.2 from 0.1.92
5/17/99, Revision 0.2		Remove action item for authentication of remote redistribution servers. It was decided in requirements review that host identification and the risks it presents were tolerable and the way to go.
5/17/99, Revision 0.2		Added meter model to physical assets database.
5/17/99, Revision 0.2		Moved PIN number and calibration factor data out of the specs for the physical assets database and into the network configuration database.
5/18/99, Revision 0.2		Added logging for remote distribution server applications.
5/18/99, Revision 0.2		Added alarm by alarm and meter by meter configuration for remote data distribution.
5/18/99, Revision 0.2		Added use of factory commissioning signature in IMU for factory commissioning tool if the meter supports it.
5/18/99, Revision 0.2		Remove requirements for physical display of Innovatec communications network.
5/18/99, Revision 0.2		Updated shortcut keys: Changed Exit Application from F4 to Ctrl-Q. Assigned find to Ctrl-F and Paste to Ctrl-V which is Windows standard.
5/18/99, Revision 0.2		Changed typo in Statusbar area that said successful messages should be in red, should be in black.
6/4/99, Revision 0.2		Add requirements for ENICS Health monitor, add requirement for alarm monitor to allow for server generated alarms (in addition to alarm messages).
6/4/99, Revision 0.2		Added requirements for COM interface.
6/4/99, Revision 0.2		Add field service application database to internal database requirements.
6/15/99 Revision 0.2		Signoff complete