Appendix H

DDU Functionality Matrices

This appendix provides a description of the driver display unit (DDU) screens and menus as the on-board systems are upgraded and replaced. The DDU will go through three phases to complete integration of the on-board systems.

- The first will be as it arrives to the OBS/CCS project from the RFCS project in Limited Integration Mode (LIM), working as a driver interface with smart-card and legacy-radio system functionality.
- The second phase of integration, called RFCS FIM (full integration mode), will support LIM functions and incorporate the VLU master system to manage Level 1 vehicle area networking of on-board data.
- The third phase will integrate modified OBS functionality that accompanies implementation of the CCS and Transit Radio System, including the ability to process remote CCS functionality onboard.

The following table, Appendix **H.1. Home Page (Top level screen after log-on)** summarizes key assignments for the home page on the DDU after implementation of the new Transit Radio System. The “home page” is defined as the main screen that Operators will see when they have successfully logged in and are in operation. The table assumes that button assignments will NOT change but rather that new functionality will be added over time.

Table Appendix H.1, Home Page (Top level screen after log-on)

Assumptions: The following assumptions were made in preparing this table.

- **KEY**: The key number is NOT an indicator of preferred placement on the screen. That is to be decided in design.
- **LIM**: The RFCS will deliver LIM functionality prior to OBS/CCS Level 1 design.
- **ICON**: The actual icon that will be used to visually represent each function has not yet been determined.

KEY	FUNCTION	IMPLEMENTATION PROJECT			ICON
		RFCS "Smart Card", Limited Integration Mode (LIM)	***OBS/CCS Level 1: On-Board Systems & RFCS Full Integration Mode (FIM)***	***700 MHz Transit Radio System (TRS) & OBS/CCS Level 2***	
1.	PRTT	PRTT	PRTT	PRTT	**PRTT**
2.	RTT	RTT	RTT	RTT	**RTT**
3.	TEXT			TEXT	
4.	PA	PA	PA	PA	**PA**
5.	PSA		PSA	PSA	
6.	FARES	FARES	FARES	FARES	**$**
7.	FARE SET	FARE SET	FARE SET	FARE SET	**SET$**
8.	Tunnel Mode			Tunnel Mode	
9.	Unassigned	Unassigned	Unassigned	Unassigned	
10.	MENU	MENU	MENU	MENU	
NAV 1	PAGE OR SCROLL UP				
NAV 2	BACK/CANCEL				
NAV 3	FORWARD/ENTER				
NAV 4	PAGE OR SCROLL DOWN				

Introduction:

The following is a brief explanation of the column headings and organization of the DDU matrices:

- **Function**: The DDU Functions are identified in the left column.
- **Programmable Keys**: These columns indicate what functions should reside on the home page (main menu) and which items should be accessed by a second-level or third-level menu. A maximum of three levels is assumed, meaning that any function can be reached by no more than three clicks.
- **Display**: The Display column describes the type of information that should be displayed. (Actual "display content" shall be determined by Human Factors design and tested by KCM Operators.
- **Description**: The information in this column provides a brief explanation of the operational requirements for the data or function that the display relates to.

Table Appendix H.2, DDU Functionality in RFCS LIM (limited integration mode)

This matrix summarizes the current thinking for the DDU functionality and displays during LIM implementation.

RFCS LIM: Driver Display Unit (DDU) Functionality						
	Programmable Keys				**Display**	**Description**
Function	Key on Home Page	Home Page	2nd Level Menu	3rd Level	The information to be communicated by the display.	Business rules, operational explanation of functionality.
System Startup						Prompt the Operator to log in by sounding a tone 60 seconds after vehicle is powered on if login has not been provided.

RFCS LIM: Driver Display Unit (DDU) Functionality

	Programmable Keys				Display	Description
Function	Key on Home Page	Home Page	2nd Level Menu	3rd Level	The information to be communicated by the display.	Business rules, operational explanation of functionality.
Automatic Login	1	Log in	Re-send Login		"Please Log in" then, while the system boots up "Please Wait" In LIM, where the MDU is still controlling the radio, the only status the MDU can give to the DDU to display to the operator is "Sending Login to CCS", and "Login Acknowledged by CCS." If the Login Acknowledged message does not come up, the Operator can select "Re-send Login." Login Data will include: • OID—Valid Operator ID • BID—Block ID (currently, this is two separate fields; block route, and block run) • Fallback radio channel (the Operator must enter a fallback voice channel at login; this is the channel the radio defaults to in case the data system goes down). • When valid the DDU will: - Request missing login data and, when complete, invite Operator acceptance of login. - Display when"Login Acknowledged by CCS." • When invalid the DDU will display invalid login message and do one of the following: - Invite the operator to manually enter login. - Request they re-try card or call a supervisor.	<u>COLD or WARM START</u> • When vehicle power is switched on, the FTP will boot up within .3 seconds (300 milliseconds). The vehicle is disabled until valid login is received. • FTP is tagged with EmployeeID "smart card" that has been loaded with OID and, optionally, BID, fallback radio channel, and vehicle assignment. • FTP signals valid or invalid to the DDU. • When valid: - DDU will signal the vehicle security switch to enable the vehicle for operation. - When Operator accepts the login data, the DDU shall signal the MDU and display "Sending login to CCS." - DDU will signal the Operator when the system is in Data Mode or in Voice Mode. • When invalid, the DDU will have ability to respond in one of the following ways (configurable): - Manual corrections to the login are allowed. - Prompt for re-try (OID must come from valid smart card or the vehicle security switch must be manually overridden). *Manual override of the vehicle security switch accessed in locked compartment by authorized staff only.

RFCS LIM: Driver Display Unit (DDU) Functionality						
	Programmable Keys				**Display**	**Description**
Function	Key on Home Page	Home Page	2nd Level Menu	3rd Level	The information to be communicated by the display.	Business rules, operational explanation of functionality.
Change Login			Change Login		• Display current login data and allow Operator to accept or change the contents of any field. • Operator will accept old entry or enter new data and press enter. If changes are not provided, the previous login shall be retained. Currently, if an Operator doesn't enter data in a field, the MDT fills in the field with whatever it contained in the last login; however, the Operator must enter OID. If a smart card is used for login, manual entry of the OID may or may not be allowed. • Display "Transmitting Your Login to the CCS.". • Display "Login Acknowledged by CCS." • Display BID information.	CHANGE OPERATOR AND/OR WORK ASSIGNMENT only after startup login has enabled the vehicle. Operators can change OID, BlockID, and, if needed, fallback radio channel. The system should prompt for each item, allowing for the Operator to clear and re-enter.
System Settings			Display and Audio Settings	List of Settings	"Contrast," "Backlight," "PA Volume," "Handset Volume," "Call Mode Volume," etc. (ambient light sensor?) There will be two tiers of Systems Settings: settings controlled by Operators, and system settings controlled by Radio Maintenance. The maintenance tier access must be protected.	This should be the path for Operators and maintenance to make adjustments to the DDU display and other Operator features. Operators shall only have ability to adjust settings between max and min ranges that are set by maintenance.
450 MHz Radio						The radio is the single most important component for operations and has priority over all other systems.
Emergency Alarm (EA)					EA: When an Emergency Alarm is initiated, display a flashing bell symbol next to PRTT button. When the EA is acknowledged by the Control Center, the symbol should stop flashing. When follow-up PRTT is pressed, the bell should disappear.	An EA is activated when an Operator presses a foot-activated switch near the brake pedal. An EA is acknowledged by a Coordinator in the Communications Center. NOTE: Only a Coordinator can clear an EA.

RFCS LIM: Driver Display Unit (DDU) Functionality						
	Programmable Keys				**Display**	**Description**
Function	Key on Home Page	Home Page	2nd Level Menu	3rd Level	The information to be communicated by the display.	Business rules, operational explanation of functionality.
Priority Request to Talk	1	PRTT*			"Transmitting Your Priority Request to Talk to the CCS."	Operator needs to talk to a Communications Coordinator ASAP.
Request to Talk	2	RTT			"Transmitting Your Request to Talk to the CCS."	Routine, non-urgent, non-emergency request to talk to a Communications Coordinator in the Control Center.
Public Address System					It would be useful if the display would indicate who is controlling the PA at any given time. (Operator, CCS)	Listed below with their respective priorities are the users that shall share the PA system. A higher-priority user may override one with a lower priority.
1 – Coordinator Announcement					"Public Announcement by Coordinator." This is done remotely and does not require any input by the Operator. (Currently this is called a "PA Voice Call" on the MDT screen.)	Staff in the Communications Center have the capability to send an announcement out to all or selected buses. Overrides "2: Operator announcement."
2 – Operator Announcement	4	PA*			Display status "PA On" or "PA Off."	Toggle between "PA On" and "PA Off."
Fare Collection	6				The fare-collection screen should be displayed when a smart card is presented to the FTP or when the operator presses the "FARES" key.	The screen should default back to the home page after 60 seconds with no smart-card activity.
Transaction Activity					Show the transaction amount and type of fare paid each time a smart card is presented.	The Operator should be able to see the same thing that the smart-card customer sees on the FTP.
Reverse Transaction			Reverse Charge		Reverse $$—activated each time an electronic-purse media is presented.	"Undo" backs out the previous transaction. Payment is credited back to the customer card.
Set Default Fare	7	Fare			Display current default fare: Free; Peak 1-Zone; Peak 2-Zone; Off-Peak 1-Zone; Off-Peak 2-Zone	The default fare is set by the Operator to the predominant fare for the trip. It will be the fare that is automatically charged of checked for on passes.
Fare Zone Toggle		Change Zone				Used when patron traveling different zone from default fare set. Toggle between zone 1 and zone 2 fare.

RFCS LIM: Driver Display Unit (DDU) Functionality						
	Programmable Keys				**Display**	**Description**
Function	Key on Home Page	Home Page	2nd Level Menu	3rd Level	The information to be communicated by the display.	Business rules, operational explanation of functionality.
Transaction Override			Extra Charges		Extra passengers ON	To allow patron to present card to pay for more than one customer.
Fare Type			Fare Type	Show Fare Types	"Adult," "Youth," "Elderly/Disabled," "Family Pass," etc.	Adult, Youth, etc.—used when patron advises that fare is different from card type.
New Trip			Set Trip	Enter Trip	Set Trip Number	The Operator should select to tag beginning of each trip.
Menu	10	Menu			New functions should be displayed next to the programmable keys such as: 5—System Settings.	Brings up a page with items described in "Second Level Menu."
Operator Information					Items described here would be included in the top display but not associated with any buttons.	This information shall be displayed to aid the Operators in effectively doing their work.
Clock		√			The top-level display should include a LARGE display of the current time based on time source to be approved in design.	Time is the single most important piece of information used by Operators throughout their workday.
Message/Status Alerts		√			Display incoming messages and status alarms: - Call-mode - Single call, pick up handset - All-call. (All-Calls start out as call-mode calls and, after a brief introduction, a Coordinator usually invites Operators to pick up their handsets to listen to the rest of the call.)	A tone should sound and a message display should appear. Call mode is when a Coordinator makes an announcement over the hailing speaker in the driver cockpit.
Route/Run		√			Show the block (route/run) logged in to.	It's unclear as to whether this info needs to be displayed on the main page. (Route and run are currently displayed on the MDT and it is an important indication to the Operator as to how her bus is identified by the CCS.)

- Asterisked Functions - The PA and RTT/PRTT buttons should remain on screen at all times regardless of what else the DDU is being used for. The Operator shall be able to activate any of these three functions at any time.

Table Appendix H.3, DDU Functionality in RFCS FIM (full integration mode)

This matrix summarizes the current thinking for the DDU functionality and displays during FIM and Level 1: OBS implementation.

A maximum of three levels is assumed, implying that any screen can be reached by no more than three clicks.

(Actual "display content" shall be determined by Human Factors design and tested by KCM Operators.)

RFCS FIM and Level 1: Driver Display Unit (DDU) Functionality

	Programmable Keys				Display	Description
Function	Key on Home Page	Home Page	2nd Level Menu	3rd Level	The content of the displayed information.	Business rules, operational explanation of functionality.
System Startup					A separate display for system initiation.	Needed to ensure Operator logs in shortly after starting the vehicle. A tone should sound after 60 seconds if login has not been completed.
Automatic Login Change Login	1	Log in	Re-send Login	Change Login	Same as LIM	Same as LIM
System Settings			System Settings	List of Settings	Same as LIM	Same as LIM
450 MHz Radio						The radio is the single most important component for operations and has priority over all other systems.
Emergency Alarm (EA)					Same as LIM plus - Camera icon should be displayed if security camera system is installed and saving event.	Same as LIM
Priority Request to Talk	1	PRTT*			Same as LIM	Same as LIM
Public Address System*					It would be useful if the display would indicate who is controlling the PA at any given time.	Listed below with their respective priorities are the users that shall share the PA system. A higher-priority user may override one with a lower priority.

RFCS FIM and Level 1: Driver Display Unit (DDU) Functionality

	Programmable Keys				Display	Description
Function	Key on Home Page	Home Page	2nd Level Menu	3rd Level	The content of the displayed information.	Business rules, operational explanation of functionality.
1 – Coordinator Announcement					Same as LIM	Staff in the Communications Center have the capability to send an announcement out to all or selected buses. Overrides 2, 3 and 4.
2 – Operator Announcement	4	PA*			Same as LIM	Operators shall be able to take over the PA from lower priority uses at their discretion. Overrides 3.
3 – Automated Announcement			Replay Last		"Replay last announcement"	The Operator shall have the ability to replay the current/last announcement with the press of a button.
4 – Public Service Announcement	5	PSA's	List of PSA's		Same as FIM	Same as FIM
Fare Collection	6				If implemented, add displays for automatically changing the fare set for each trip and zone boundary.	Fare Collection functions are the same as in LIM except that OBS can set the default fare; change fare at zone boundary and signal the end/start of each trip.
Transaction Activity					Same as LIM	Same as LIM
Reverse Transaction			Reverse Charge		Same as LIM	Same as LIM
Set Default Fare	7	Fare			Add screens dealing with automatically setting the fare, if implemented.	The default fare can be set automatically by OBS or entered manually by the Operator.
Zone Toggle		Change Zone			To toggle between 1-Zone and 2-Zone (whichever one is not the default).	If OBS automatically changes fare at zone boundary, the zone toggle may no longer be necessary.
Transaction Override			Extra Charges		Same as LIM	Same as LIM

RFCS FIM and Level 1: Driver Display Unit (DDU) Functionality

	Programmable Keys				Display	Description
Function	Key on Home Page	Home Page	2nd Level Menu	3rd Level	The content of the displayed information.	Business rules, operational explanation of functionality.
Fare Type			Fare Type	Show Fare Types	Same as LIM	Same as LIM
New Trip			Set Trip	Enter Trip	Add screens for automatically entering a new trip, if implemented.	OBS may automatically signal end and start of each trip if the decision is to implement it.
Destination Signs			Change Sign	Sign Code List	Display the text of current outside signage. When the key is pressed it should allow the Operator to select or manually enter a new sign code.	Destination signs will be automatically controlled by the OBS but the Operator shall have the capability to override the automation.
Menu	10	Menu			Add new key assignments for CCS and TRSR functions.	Add new key assignments for items described in "2nd Level Menu."
Operator Information					Items described here would be included in the top display but not associated with any buttons.	This information shall be displayed to aid the Operators in effectively doing their work.
Clock		√			Same as FIM	Same as FIM
Operator Run Card		√			The next timepoint on a route and the scheduled arrival time should be displayed, such as: "3rd & Union – 4:35pm."	The VLU will signal the DDU to update the display with the next timepoint as soon as the Operator logs on and every time a timepoint is reached.
Message/Status Alerts		√			Same as LIM plus added displays for alarms regarding OBS functionality: Health status messages for subsystems interfaced to the OBS including: - Security Camera - AVM alarms	A tone should sound and a message should appear. Alarm message displays to be initiated by signal from VLU.
Schedule Adherence		√			Show late as "-" and early as "+" time.	The VLU will calculate current schedule adherence status at each timepoint and update the DDU.
Route		√			Display should indicate either "On Route" or	The VLU will monitor route adherence status

RFCS FIM and Level 1: Driver Display Unit (DDU) Functionality

	Programmable Keys				Display	Description
Function	Key on Home Page	Home Page	2nd Level Menu	3rd Level	The content of the displayed information.	Business rules, operational explanation of functionality.
Adherence					"Off Route."	and update the DDU.
Route/Run		√			Same as LIM	Same as LIM

* Asterisked Functions - The PA and PRTT buttons should remain on screen at all times regardless of what else the DDU is being used for. The Operator shall be able to activate any of these functions at any time.

Table Appendix H.3, DDU Functionality for Level 2 & TRS

This matrix summarizes the current thinking for the DDU functionality and displays for OBS/CCS Level 2 and TRS (transit radio system) implementation.

Level 2: Driver Display Unit (DDU) Functionality

	Programmable Keys				Display	Description
Function	Key on Home Page	Home Page	2nd Level Menu	3rd Level	The content of the displayed information.	Business rules, operational explanation of functionality.
System Startup						
Automatic Login	1	Login	Re-send Login		• Add message "radio on" when a comm. link is established. • Add message "invalid BID" when signaled by the CCS.	• With the new radio system, the VLU will automatically establish radio comm. if a login is not immediately provided. On-board controls will still not be unavailable until a valid login is received or overridden by the transit security switch. • The CCS will further verify the login to ensure that the work assignment (BID) is valid.
Change Login				Change Login	Add messages for remote Coordinator functions.	The new CCS will enable a Coordinator to login or change BID and/or OID.
Logout			Logout	Operator or System	A screen to enable an Operator to log off. Logoff would be used when an Operator is exiting the vehicle after completing work assignment.	Logoff should be used for road relief and coach changes. It shall not terminate radio communications nor change the OBS system status. A new login is required to re-enable operator controls.
System Settings			System Settings	List of Settings	PA Volume controls may be removed from Operator screens.	Same as LIM except PA Volume may be controlled by the VLU and therefore, the Operator adjustment may be disabled.
700 MHz Radio						The radio is the single most important component for operations and has priority over all other systems.
Emergency Alarm (EA)					Same as FIM	Same as FIM

Level 2: Driver Display Unit (DDU) Functionality

	Programmable Keys				Display	Description
Function	Key on Home Page	Home Page	2nd Level Menu	3rd Level	The content of the displayed information.	Business rules, operational explanation of functionality.
Priority Request to Talk	1	PRTT*	Cancel PRTT		Add a "Cancel PRTT" button which will stay active until the call is answered or if pressed, a message "PRTT Cancelled" should display briefly and then clear.	When "Cancel PRTT" is pressed, the system will cancel the call at the CCS.
Request to Talk	2	RTT	Cancel RTT		Add "Cancel RTT" button to be activated until the call is answered or if pressed, a message "RTT Cancelled" should display briefly and then clear.	When "Cancel RTT" is pressed, the system will cancel the call at the CCS.
Text Messaging	3		Text Msg's	List of messages	Pressing the "Text Messages" button will bring up a list of preprogrammed "Text Messages" for the Operator to select and send a message or return to Home Page.	With a new radio system, preprogrammed text messages shall be available to automate routine communications.
Radio Mode	8	CCS Tunnel			Display current mode, "CCS" or "Tunnel"	For joint bus/rail operation in the tunnel the radio must switch to a Tunnel Channel when entering tunnel access and back to CCS radio comm. when exiting tunnel area.
Public Address System*					It would be useful if the display would indicate who is controlling the PA at any given time.	Listed below with their respective priorities are the users that shall share the PA system. A higher-priority user may override one with a lower priority.
1 – Coordinator Announcement					"Public Announcement by Control Center" This is done remotely and does not require any input by the Operator.	Staff in the communications center have the capability to send an announcement out to all or selected buses. Overrides 2 and 3.
2 – Operator Announcement	4	PA*			Toggle between "PA On" and "PA Off"	Operators shall be able to take over the PA at their discretion. Overrides 3.
3 – Automated Announcement			Replay Audio		"Replay announcement" or "Replay Audio"	The Operator shall have the ability to replay the current/last announcement with the press of a button.

Level 2: Driver Display Unit (DDU) Functionality

	Programmable Keys				Display	Description
Function	Key on Home Page	Home Page	2nd Level Menu	3rd Level	The content of the displayed information.	Business rules, operational explanation of functionality.
4 – Public Service Announcement	5	PSA's	List of PSA's		Pressing the "PSA" button will bring up a list of preprogrammed "public service announcements" for the Operator to select for replay or return to Home Page.	A list of prerecorded public service announcements will be available for Operators to activate, such as "No smoking, drinking or eating is allowed on the bus."
Fare Collection	6				The fare-collection screen should be brought to the top of the screen automatically whenever a smart card is presented to the FTP or when the Operator presses the FARES key.	The screen should default back to the main page after 60 seconds with no smart card activity.
Transaction Activity					Same as FIM	Same as FIM
Reverse Transaction			Reverse Charge		Same as FIM	Same as FIM
Set Default Fare	7	Fare			Same as FIM	Same as FIM
Zone Toggle	7		Fare Zone		Same as FIM	Same as FIM
Transaction Override			Extra Fares		Same as FIM	Same as FIM
Category Toggle			Fare Type		Same as FIM	Same as FIM
New Trip			Set Trip		Add screens for automatically entering a new trip, if implemented.	

Level 2: Driver Display Unit (DDU) Functionality

	Programmable Keys				Display	Description
Function	Key on Home Page	Home Page	2nd Level Menu	3rd Level	The content of the displayed information.	Business rules, operational explanation of functionality.
Security Cameras		CCTV			Display a camera symbol when an event is being saved.	When the button is pressed, a preset amount of video before and after is saved.
Destination Signs			Change Sign	Sign Code List	Display the text of current outside signage. When the key is pressed it should bring a Dest. Sign change box.	Destination signs will be automated but the Operators shall have the capability to override the automation.
Menu	10	Menu			New functions should be displayed next to the programmable keys such as: 5—System Settings.	Brings up a page with menu items described in "Levels."
Operator Information					Items described here would be included in the top display but not associated with any buttons.	This information shall be displayed to aid the Operators in effectively doing their work.
Clock		√			The top level display should include a LARGE display of the current time based on GPS input and synchronized with the Communications Center.	Time is the single most important piece of information used by operators throughout their workday.
Operator Run Card		√			The next timepoint on a route and the scheduled arrival time should be displayed, such as: "3rd & Union—4:35pm."	The VLU will update the display to show the next timepoint as soon as the Operator logs on and every time a timepoint is reached.
Message/Status Alerts		√			Display the appropriate alert: - Incoming radio message - Incoming text message - Single call, pick up handset - All call, pick up handset - NO PRTT/RTT = Voice mode only - No Voice Radio = Data mode only	A tone should sound and a message should appear. Displayed when radio is operating in voice mode only. Displayed when operating in data mode only.

Level 2: Driver Display Unit (DDU) Functionality

	Programmable Keys				Display	Description
Function	Key on Home Page	Home Page	2nd Level Menu	3rd Level	The content of the displayed information.	Business rules, operational explanation of functionality.
Schedule Adherence		√			Show late as "-" and early as "+" time.	The VLU will calculate current schedule adherence status at each timepoint and update the DDU.
Route Adherence		√			Show as either "On Route" or "Off Route."	The VLU will monitor route adherence status and update the DDU.
Route/Run		√			Show the route/run logged in to.	It's unclear as to whether this info needs to be displayed on the main page.
Radio Channel			√		Show the current fallback voice radio channel and whether it is in data or voice mode.	Currently, the Operator inputs the fall back voice channel as a part of normal login.

* Asterisked Functions - The PA and RTT/PRTT buttons should remain on screen at all times regardless of what else the DDU is being used for. The Operator shall be able to activate any of these three functions at any time.