SEAMLESS MOBILE DATA PROJECT EVALUATION

Grant 1997-IJ-CX-K010

PLANNING AND RESEARCH UNIT

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I. BACKGROUND

There was no statewide wireless data capability for law enforcement agencies to utilize in 1996 when this grant was sought. The project was designed to connect the patrol vehicle, via the cellular telephone infrastructure, to the Virginia Criminal Information Network (VCIN) and National Crime Information Center (NCIC). The National Institute of Justice awarded the Virginia State Police a $348,392 grant for the project on May 16, 1997.

Presently, troopers request checks on vehicles or persons through a dispatcher. The dispatcher acquires the information through hard-line computer networks maintained by the state police, and then relays the information back to the trooper. This method has several shortcomings. First, troopers may be relayed information that has been erroneously entered. Second, the response to the trooper may be delayed due to heavy radio traffic or other heavy workload placed upon the dispatcher. Third, radio transmission of "wanted" information might alert the suspect who hears the transmission. In many cases, the suspect then becomes agitated and sometimes violent. Finally, the relay of such data requests has overloaded the available radio frequencies and delayed the ability to use the radio for more urgent communications.

To make this alternative data system viable for state law enforcement, existing public safety software would have to be modified to allow a mobile computer terminal to seamlessly roam between different wireless infrastructures. An architecture would also have to be designed for the mobile data equipment that would not be bound by one wireless service provider. Other wireless infrastructures would be added at a later date to expand the coverage area and minimize the cost of data transmission.

II. PROJECT DESCRIPTION

The grant was used to develop and test a seamless mobile data network within the state for use by law enforcement personnel. The project involved the installation of twenty-four laptop computers into patrol cars augmented by seven pen-based units purchased using state funds (Attachment 1). The pen units were added for comparison test purposes. These computers were connected via modems to a commercial wireless communications provider who provided communications in two forms: Circuit-Switched Cellular Digital Packet Data (CS-CDPD) and Cellular Digital Packet Data (CDPD). The data was then interfaced with state criminal and motor vehicle databases. Several local law enforcement agencies were offered access to the network if they provided their own mobile equipment and paid the cost of airtime.

Hardware:

An IBM compatible laptop computer, CYCOMM PC Mobile model PCP-1T6EA1, was chosen as the laptop. It is a ruggedized unit with a Windows operating system, Pentium processor, and Windows Office software. The selected pen-based computer was a Walkabout Computers Inc. model Hammerhead II, with writing stylus. A Dock Platform integrates the computer into mobile system connecting power source, RF modem, or keyboard in the case of pen-based computer.

An external RF Modem is connected to each computer for the transmission of Virginia Criminal Information Network (VCIN) and Virginia Department of Motor Vehicles (DMV) queries over the cellular network. The selected modem is the Sierra Wireless model MP215, which automatically changes between the CDPD and CS-CDPD standards. A 3 dB gain glass mount cellular antenna is mounted on the rear glass of vehicle to complete the communications package in the patrol vehicle.

Installation of the mobile hardware was performed by state police personnel.

Software:

A contract was awarded to PRC Inc. to integrate all the hardware and software into the MCT system. PRC subcontracted the development of the mobile data browser software to HTE – UCS Inc.

State police personnel performed required changes to the state police mainframe software and local and wide area networks.

Wireless Service:

A contract was awarded to a single carrier for wireless services in the project. The award was to GTE Wireless. This company was later merged into a new company – Verizon. The carrier offered both Cellular Digital Packet Data (CDPD) and Circuit Switched Cellular Digital Packet Data (CS-CDPD).

CDPD is a "packet switched" communication system providing services between Fixed end systems and Mobile end systems. Information is transmitted in packets or blocks of data. CS – CDPD is a hybrid communication system promoted by Verizon. Information is transmitted using a circuit switched connection over the existing cellular infrastructure when CDPD service is unavailable. The difference being that "circuit switched" uses a dedicated connection circuit in contrast to "packet switched". Operating costs for circuit-switched systems are usually higher since the carrier charges the user for the duration of the call.

III. EVALUATION METHODOLOGY

Maintenance Log:

Once it became apparent that hardware and other operational concerns might affect the outcome of trooper surveys and the project itself, a maintenance log (Attachment 2) was kept by the Communications Division. The log tracked what problems were reported to their technicians and what action was taken to resolve the problem.

Trooper Survey:

Identical written survey instruments (Attachment 3) were disseminated to the troopers at two intervals to determine their views on the hardware, software, and the usefulness of the devices and network in their duties. Twelve evaluation items had multiple-choice responses on a four-point scale: EXCELLENT (1) -GOOD (2) - FAIR (3) - POOR (4). Seven open-ended questions were also provided. Paraphrased, they are:

1. How often did the MCT fail to operate? What was the problem and what fixed it?

2. Any VCIN commands that need a softkey assigned?

3. What did you like most?

4. What did you like least?

5. What changes would you like made to the MCT (hardware, software, mounting, etc.)?

6. Overall, what is your opinion of the use of MCTs in patrol vehicles?

7. Additional comments?

The survey instrument was designed to measure success at achieving the stated goal of the project. The goal was to allow troopers increased access to law enforcement databases that would allow greater productivity and efficiency in the performance of their duties. The survey instrument was given to troopers with a pen-based computer or a notebook computer for comparisons. They were provided training on the hardware and in the operation of the network software.

IV. FINDINGS

Technical Results:

The procurement process, from start of the grant to award, was almost 24 months for the system integrator PRC, Inc. This was followed by a period of missed obligations by PRC that necessitated an extension of the grant. The network became operational in February 2000. There were almost immediate hardware and software failures and some radio interference issues. Software patches were made and some hardware was replaced under warranty. All user troopers were provided training on the hardware and software during that month, but it was deemed insufficient and the contractor provided additional training.

A grant extension request was approved for 18 months to allow contractors time to resolve technical difficulties. Hardware and software problems continued through December 2000. In April 2001, the parties suspected that the Windows operating system might have been a contributor in many of the earlier problems. The system had been upgraded from Windows 95 to Windows 98, but some 95 files were still present and conflicting with 98 operations. Technicians reformatted the hard drives and installed the full Windows 98 Second Edition operating system. There were minimal operating system issues since that time.

The majority of the technical challenges can be classed as software and hardware failures or incompatibilities. The hardest of these challenges to resolve has been the failure of the "seamless transfer" between CS-CDPD and CDPD. Computers dropping a signal and/or rebooting were a problem. This problem of seamless transfer came to its ultimate end in September 2001, when Verizon Wireless notified

the Virginia Department of State Police that they would no longer support circuit-switched CDPD after November 1, 2001. This effectively eliminated network service in four of seven state police divisions. The three divisions in the urbanized eastern portion of Virginia still have CDPD service and will continue operating on the network.

During the grant period there were significant changes in technology and wireless services. Wireless services began migration into different architectures from CDPD and CS-CDPD. New modems and software were developed that allow greater choice of architectures and which will automatically select that architecture with the best signal at the best cost. Satellite data transmission has become more affordable and reliable and more system integrators have entered the public safety field.

User Survey Results:

The first user survey was conducted in October 2000. There were 27 questionnaire responses, 21 were for the laptop unit and 6 were for the pen-based unit. In the 27 responses, the amount of time the units were being evaluated was small. There were 21 evaluations that showed one month or less, the remaining six being 12, 10, 8.5, 8.0, 7, and 2 months. Considering the down time of units reported in the technical results, the actual time of use could be even less. From the questionnaires, it appears that many of the evaluators spent their time evaluating the units while also going through a learning curve in their operation. They had very little time when the system was functioning and they felt proficient with the MCT. This limited the value of the first survey.

Analysis of responses was hindered by the fact that some questions were not answered in the response provided, but were actually answered in the response to a different question. However, some continuing themes were detected in the responses. These were:

1. The MCT was mounted too low, had a driver's side brace that interfered with the trooper's weapon, and should be angled more toward the driver.

2. The MCT broke or lost connection with the mainframe consistently. Some suggest that a satellite connection would be an improvement over cell telephone lines.

3. System lock-ups were a consistent problem, with disconnecting power and reconnecting power the corrective action to re-establish connection.

4. A floppy disk drive and MS Word would be desirable along with a connection to the computer aided dispatch system.

5. The troopers did not like the free form entry of the VCIN commands to get driver transcripts. They felt there was too much typing of arcane commands when a softkey would be better. Also, there were double entries for in-state and out-of-state records.

6. Troopers were virtually unanimous in their praise for the concept of the MCT, but the lack of reliability and dependability of the current system was discouraging.

7. The evaluators were vocal in their praise for the reduction in radio traffic, and reliance on a dispatcher. While some experienced slow returns on requests, many did like the speed of response when the MCT was working as advertised.

The second user survey was conducted in August 2001. There were 29 questionnaire responses, 22 were for the laptop unit and 7 were for the pen-based unit. In this survey, the amount of time the units had been evaluated by the troopers had increased as expected. There were only 4 evaluations that showed six months or less, 17 had between seven and twelve months of evaluation time, and 4 had more than twelve. The remaining four questionnaires did not indicate the time of evaluation. With the increased time, it became obvious the evaluators spent more time evaluating the units and less on the learning curve and maintenance issues. Most problems seemed to mitigate when the latest software upgrade was installed in April 2001. Ratings on closed questions generally improved and troopers began to focus their open-ended answers on enhancements rather than problems. Call drop-offs when switching from CS-CDPD to CDPD or when switching cell sites is still a problem.

Analyses of responses indicate some continuing themes from the first survey were detected in the responses. These were:

1. The MCT was mounted too low and should be flexible to allow the driver to push it away or pull closer as needed.

2. The MCT broke or lost connection with the mainframe less often as time progressed and improvements in software were made.

3. System lock-ups were a consistent problem, with disconnecting power and reconnecting power the corrective action to re-establish connection.

4. A floppy disk drive, CD drive and form templates with word processing would be desirable, along with a connection to the computer aided dispatch system.

5. The troopers liked the additional softkeys, but suggested a few more. The ability of the software to run multiple checks automatically from one entry became an issue as use increased.

6. Troopers continue virtually unanimous in their praise for the concept of the MCT, and have lessened comments on the lack of reliability and dependability of the current system.

7. The evaluators were vocal in their praise for the reduction in radio traffic, and reliance on a dispatcher. They also added increased productivity to their comments.

8. Users reported no substantial differences between pen-based units and laptops for use in accessing databases. A more permanent mounted keyboard is necessary for safety and maintenance. The efficacy of pen-based units might be questioned if full reporting and CAD interface are added to the requirements definition.

V. RECOMMENDATIONS

1. The dependability of the wireless services appears to be increasing as carriers build out systems, adopt cooperative agreements with other carriers and migrate toward a more uniform architecture. It appears that leasing wireless services is prudent if leases include upgrades as they are developed. The pace of the installation/operation of this grant-funded system could not keep up with the technology changes in the industry and so the carrier discontinued CS-CDPD before the end of the grant period.

2. Modems should be leased when possible to take advantage of newer technology and resolve problems in a more timely fashion.

3. Agencies should carefully screen system integrators and their subcontractors and include performance penalties in contracts.

4. Units should have CD/RW drives for information storage and easier downloading of software.

5. Seat management should be considered if large numbers of units are purchased and located throughout a geographic region to reduce downtime due to maintenance and assure up-to-date hardware and software.

ATTACHMENT 1

EQUIPMENT ASSIGNMENT

MDC USER	Badge	Port#	Computer	MCT S/N	MCT P/N	CDPD Svcs	MODEM ESN	MODEM MID	MODEM IP Address	MODEM CM#	CM#	Vehicle #
Headquarters												
SPARE	N/A	4130	Laptop	91210030	47595	PS NoCap	206-00040392	8043635910	166.150.126.002	CM29	CM29	N/A
Division I												
Roger T. Marvin	1164	4100	Pen-based	015742	47567	PS NoCap	206-00090435	8043636945	166.150.126.010	CM1	CM1	99-143
E.T. Miller	1596	4101	Laptop	90910009	47568	PS NoCap	206-00090991	8043636941	166.150.126.006	CM2	CM2	98-337
Gary A. Crawley	1656	4102	Laptop	91210020	47569	PS NoCap	206-00090439	8043636942	166.150.126.007	CM3	CM3	98-074
James E. Elmore	0518	4103	Pen-based	015744	47570	PS NoCap	206-00090890	8043635912	166.150.126.004	CM4	CM4	98-350
John P. Houlberg	1657	4104	Pen-based	015741	47571	PS NoCap	206-00090452	8043636946	166.150.126.011	CM5	CM5	98-002
Donald W. Jones	0992	4105	Laptop	81210233	47572	PS NoCap	206-00090450	8043636947	166.150.126.012	CM6	CM6	99-094
David B. Barker	1395	4106	Laptop	00210028	47573	PS NoCap	206-00090426	8043636948	166.150.126.013	CM7	CM7	98-144
Division II												
Jason S. Haga	1150	4107	Laptop	00210039	47590	COM 3000	206-00090416	8043636949	166.150.126.014	CM24	CM24	97-206
Robert H. Houston	1241	4108	Laptop	00210033	47593	COM 125	206-00090475	8043636950	166.150.126.015	CM27	CM27	98-006
Quinten M. Garber	1669	4109	Laptop	00210035	47906	COM 125	206-00091055	8043636951	166.150.126.016	CM31	CM31	98-001
Division III												
Thomas D. Daniel	1446	4110	Laptop	91210011	47579	COM 125	206-00090962	8043636952	166.150.126.017	CM13	CM13	98-168
James D. Wells	1678	4111	Laptop	00210043	47583	COM 125	206-00090400	8043636953	166.150.126.018	CM17	CM17	97-131
Glenn K. Phillips	1375	4112	Laptop	00210046	47582	COM 125	206-00090880	8043636954	166.150.126.019	CM16	CM16	97-365
Division IV												
Charles M. Delp	0589	4113	Laptop	00210042	47591	COM 125	206-00090493	8043636955	166.150.126.020	CM25	CM25	97-391
Ritchie A. Maddox	1353	4114	Laptop	00210037	47592	COM 125	206-00091155	8043636956	166.150.126.021	CM26	CM26	98-152
Sterling K. Tucker	1332	4115	Laptop	00210032	47578	COM 125	206-00091145	8043636957	166.150.126.022	CM12	CM12	97-373

MDC USER	Badge	Port#	Computer	MCT S/N	MCT P/N	CDPD Svcs	MODEM ESN	MODEM MID	MODEM IP Address	MODEM CM#	CM#	Vehicle #
Division V												
Stephen J. Harris	0991	4116	Laptop	00210041	47577	PS NoCap	206-00090455	8043636958	166.150.126.023	CM11	CM11	97-089
Michell Anaya Cotton	0507	4117	Laptop	00210045	47589	PS NoCap	206-00090466	8043636959	166.150.126.024	CM23	CM23	97-363
James A. Pew	1798	4118	Laptop	00210036	47588	PS NoCap	206-00090410	8043636231	166.150.126.005	CM22	CM22	97-395
Jerome M. Craig	1524	4119	Laptop	91210027	47585	PS NoCap	206-00090955	8043635911	166.150.126.003	CM19	CM19	97-216
Jeffrey Durr	0771	4120	Pen-based	015738	47580	PS NoCap	206-00091074	8043636960	166.150.126.025	CM14	CM14	98-194
Hugh A. Nealy	1393	4121	Pen-based	015739	47596	PS NoCap	206-00091010	8043636961	166.150.126.026	CM30	CM30	97-351
Brian D. Olha	1339	4122	Pen-based	015740	47576	PS NoCap	206-00090885	8043636962	166.150.126.027	CM10	CM10	98-167
Division VI												
Michael S. Browning	1191	4123	Laptop	00210034	47586	COM 125	506-00091057	8043636963	166.150.126.028	CM20	CM20	98-005
William L. Warren	0853	4124	Laptop	00210044	47587	COM 125	206-00090482	8043636964	166.150.126.029	CM21	CM21	98-139
G. Kevin Harth	1675	4125	Laptop	91210016	47594	COM 125	206-00091100	8043636965	166.150.126.030	CM28	CM28	00-278
Division VII												
William E. Ivie	0915	4126	Laptop	90910015	47574	COM 3000	206-00090853	8043636944	166.150.126.009	CM8	CM8	00-242
Anthony L. Conte	1683	4127	Laptop	00210038	47584	COM 3000	206-00090418	8043636966	166.150.126.031	CM18	CM18	99-135
Edmund J. Kelly	1639	4128	Laptop	91210009	47581	COM 3000	206-00091046	8043636943	166.150.126.008	CM15	CM15	00-304
Chadwick D. Rogers	1506	4129	Pen-based	015743	47575	COM 3000	206-00090482	8043636967	166.150.126.032	CM9	CM9	98-155

ATTACHMENT 2

MAINTENANCE LOG

Implementation and Operation Maintenance Report

February 2000

Mobile terminal users experiencing problem of not being able to reconnect to server after losing communication with, or having to shut down computer due to a "lock up" condition without logging off.
Terminal users with (PC Mobile) laptops in their vehicle are complaining of severe interference to the "TAC" channel on the radio system. Unable to receive other units calling them unless they are extremely close to each other. Have experienced a 40% failure of laptop keypads out of first (5) laptop systems installed. CYCOMM has replaced defective units under warranty.

March 2000

The laptop computer (PC Mobile) has been found to cause interference with the State Police radio system when being used inside the vehicle. Our initial testing showed that the received noise level on the radio "TAC" channel was 30db above the normal noise level. This constitutes an unusable channel on the vehicles' radio system for conducting normal State Police communications. The laptop vendor (CYCOMM) has assured our agency that their product is RF interference compliant, and is working on a fix for the problem. CYCOMM sent a software patch to change the clock frequency, which shifted the radiated noise from 154.7MHz to 145.2MHz. Our testing shows that interference to the "TAC" channel at 154.665MHz, is no longer present after software patch is installed.

April 2000

During transition from CDPD to CS-CDPD wireless data standards, our units are reporting extended waits for re-connection to the VSP server. PRC, our MCT vendor has identified a software parameter needing to be changed to speed up reconnect time. Currently the wireless modems are set to "B preferred" a setting which allows the modem to search both "A" and "B" channels when attempting to connect to the cellular network. To minimize search time the appropriate setting should be "B" only.

Problems with the MCT terminals "locking up" are being experienced while attempting to load software in the field. Pen based MCT units are experiencing problem with not being able to enter data into all fields of the query form.

May 2000

The earlier problem with computer "locking up" during the loading of Mobile Data Browser software has been resolved. The program was taking up excessive memory space. The wireless modem is experiencing the loss of transmitted "data packets" when transitioning between CDPD and CS-CDPD. Modem is also "locking up" when receiving an inbound call while in the CS-CDPD mode. UCS, the vendor who developed the browser software, has suggested running a log on one of the affected terminals to see who is reconnecting the socket when the data packets are being lost. Wireless modem settings have been edited to provide a faster transition from CDPD to CS-CDPD, and to hold CDPD service longer in a marginal coverage area before changing over to CS-CDPD. It has also been found that when DC power is removed from the modem, the programmable parameters are resetting to the default values.

August 2000

PRC has reported working on updating VSP specific forms to be integrated with UCS, Inc. software updates for installation on the pen-based (Hammerhead) terminals. The updates are to target the problem with entering data in to all fields on the query form. VSP is currently testing a fix to allow the terminal user to reconnect after losing communication with the server, or shutting down without logging off.

October 2000

The majority of the mobile terminal users have reported seeing the message "No Response From Modem" after being logged onto the server and running some queries. While this problem was not seen during initial testing at Administration Headquarters, it has occurred often out in the field.

Running driver license queries from the mobile terminals has been causing an application crash on the server. It has been determined that some QD (Query Driver) responses are triggering the crash.

Virginia State Police has contacted DMV data processing group to ascertain why transcripts are not being sent. It is suspected that the ORI being used with the mobile terminals may not have the terminals associated correctly.

Two mobile terminal users in the Appomattox Division are experiencing difficulty connecting to the server. These terminals are operating in the CS-CDPD mode.

PRC is currently working with UCS to pinpoint origin of "Illegal Function" message being displayed on pen-based terminals. UCS believes error message is a result of a software update being performed by Walkabout Computer, Inc., when the pen-based (Hammerhead) units are returned for warranty repair. It has been determined that they re-image the machine as part of the SOP for diagnosing software related complaints. As a result, we are now installing a newer version of the browser to compensate for changes made by the re-image process.

November 2000

PRC has contacted Sierra Wireless the modem vendor to assist in solving the "No Response From Modem" message problem. They are investigating the possibility of a surge causing the modem to "freeze up". A new version of the modem control software Watcher is being tested as a fix for the problem.

UCS has sent an updated version of the server communication file to be loaded and tested on the pen-based units.

December 2000

The mobile terminal users in the Chesapeake Division are reporting instances of terminals "locking up" and having to be shut down and rebooted.

State Police has returned one laptop to CYCOMM to have the hard disk formatted and Windows 98 reloaded.

April 2001

When the PC Mobile laptops were first delivered they were running on the Windows 95 operating system. The operating system was then upgraded to Windows 98 via an upgrade software package. It has since been determined that certain files within the previous operating system are still present and conflicting with Windows 98 operations. This may have been a contributor in past software related problems experienced and has prompted the project administrators to now install Windows 98 in its entirety. All mobile terminals in operation have been scheduled for re-installation of software. CYCOMM sent down a field technician to reformat the hard disk of each laptop and then reload Windows 98SE along with necessary configurations.

August 2001

Since the software reload in April our agency has experienced minimal problems related to operating system issues. Thirty percent of the PC Mobile fleet has had the rechargeable battery replaced since March 2001. Walkabout computer has provided our agency with new rechargeable battery packs to replace the (7) units in service now as a preventative maintenance measure. To date our agency service records show that we have experienced six modem failures requiring equipment to be returned for factory service.

ATTACHMENT 3

SURVEY INSTRUMENT

An analysis of each evaluation item by the type of unit installed is provided below.

1. Physical Mounting of the MCT in the Vehicle

	Excellent		Good		Fair		Poor		Not Rated		Total	
	#	%	#	%	#	%	#	%	#	%	#	%
Mobile Laptop PC	4	19%	13	62%	4	19%	0	0%	0	0%	21	100%
2nd Survey	4	18%	14	64%	2	9%	2	9%	0	0%	22	100%
Pen-Based Unit	0	0%	1	17%	2	33%	3	50%	0	0%	6	100%
2nd Survey	0	0%	2	29%	1	14%	4	57%	0	0%	7	100%
1st Survey Total	4	15%	14	52%	6	22%	3	11%	0	0%	27	100%
2nd Survey Total	4	14%	16	55%	3	10%	6	21%	0	0%	29	100%

2. Performance Against the Rigors of Everyday Use

	Excellent		Good		Fair		Poor		Not Rated		Total	
	#	%	#	%	#	%	#	%	#	%	#	%
Mobile Laptop PC	7	33%	9	43%	3	14%	1	5%	1	5%	21	100%
2nd Survey	7	32%	12	54%	3	14%	0	0%	0	0%	22	100%
Pen-Based Unit	1	17%	2	33%	1	17%	0	0%	2	33%	6	100%
2nd Survey	2	29%	3	42%	2	29%	0	0%	0	0%	7	100%
1st Survey Total	8	29%	11	41%	4	15%	1	4%	3	11%	27	100%
2nd Survey Total	9	31%	15	52%	5	17%	0	0%	0	0%	29	100%

3. Software Package Ease of Use

	Excellent		Good		Fair		Poor		Not Rated		Total	
	#	%	#	%	#	%	#	%	#	%	#	%
Mobile Laptop PC	4	19%	13	62%	4	19%	0	0%	0	0%	21	100%
2nd Survey	4	18%	16	73%	2	9%	0	0%	0	0%	22	100%
Pen-Based Unit	2	33%	2	33%	1	17%	0	0%	1	17%	6	100%
2nd Survey	2	29%	2	29%	3	42%	0	0%	0	0%	7	100%
1st Survey Total	6	22%	15	55%	5	19%	0	0%	1	4%	27	100%
2nd Survey Total	6	21%	18	62%	5	17%	0	0%	0	0%	29	100%

4. General Operation of the Software Package

	Excellent		Good		Fair		Poor		Not Rated		Total	
	#	%	#	%	#	%	#	%	#	%	#	%
Mobile Laptop PC	3	14%	12	57%	4	19%	1	5%	1	5%	21	100%
2nd Survey	2	9%	11	50%	9	41%	0	0%	0	0%	22	100%
Pen-Based Unit	1	17%	2	33%	1	17%	1	17%	1	17%	6	100%
2nd Survey	1	14%	4	57%	2	29%	0	0%	0	0%	7	100%
1st Survey Total	4	15%	14	52%	5	19%	2	7%	2	7%	27	100%
2nd Survey Total	3	10%	15	52%	11	38%	0	0%	0	0%	29	100%

5. Viewing of the MCT Screen in Direct Sunlight

	Excellent		Good		Fair		Poor		Not Rated		Total	
	#	%	#	%	#	%	#	%	#	%	#	%
Mobile Laptop PC	1	5%	12	57%	5	24%	3	14%	0	0%	21	100%
2nd Survey	1	5%	10	45%	7	32%	4	18%	0	0%	22	100%
Pen-Based Unit	0	0%	2	33%	2	33%	2	33%	0	0%	6	100%
2nd Survey	0	0%	2	29%	1	14%	4	57%	0	0%	7	100%
1st Survey Total	1	4%	14	52%	7	26%	5	18%	0	0%	27	100%
2nd Survey Total	1	3%	12	41%	8	28%	8	28%	0	0%	29	100%

6. Mounting Angle for Ease of Viewing

	Excellent		Good		Fair		Poor		Not Rated		Total	
	#	%	#	%	#	%	#	%	#	%	#	%
Mobile Laptop PC	2	10%	16	76%	1	5%	2	10%	0	0%	21	100%
2nd Survey	2	9%	16	73%	2	9%	2	9%	0	0%	22	100%
Pen-Based Unit	2	33%	2	33%	1	17%	1	17%	0	0%	6	100%
2nd Survey	1	14%	4	57%	0	0%	2	29%	0	0%	7	100%
1st Survey Total	4	4%	18	67%	2	7%	3	11%	0	0%	27	100%
2nd Survey Total	3	10%	20	69%	2	7%	4	14%	0	0%	29	100%

7. Cellular Coverage in Area While Operating MCT

	Excellent		Good		Fair		Poor		Not Rated		Total	
	#	%	#	%	#	%	#	%	#	%	#	%
Mobile Laptop PC	4	19%	8	38%	4	19%	5	24%	0	0%	21	100%
2nd Survey	5	23%	7	32%	7	32%	3	13%	0	0%	22	100%
Pen-Based Unit	5	83%	1	17%	0	0%	0	0%	0	0%	6	100%
2nd Survey	4	57%	3	43%	0	0%	0	0%	0	0%	7	100%
1st Survey Total	9	33%	9	33%	4	15%	5	19%	0	0%	27	100%
2nd Survey Total	9	31%	10	35%	7	24%	3	10%	0	0%	29	100%

All of the respondents utilizing the pen-based units rated the cellular coverage as excellent or good. For mobile laptop PC users, 57% rated the cellular coverage as excellent or good and 43% rated the coverage as fair or poor.

8. Transition of MCT from CDPD Area to CS-CDPD

	Excellent		Good		Fair		Poor		Not Rated		Total	
	#	%	#	%	#	%	#	%	#	%	#	%
Mobile Laptop PC	1	5%	5	24%	6	28%	5	24%	4	19%	21	100%
2nd Survey	3	14%	9	41%	6	27%	1	4%	3	14%	22	100%
Pen-Based Unit	1	17%	2	33%	0	0%	1	17%	2	33%	6	100%
2nd Survey	2	29%	2	29%	1	14%	1	14%	1	14%	7	100%
1st Survey Total	2	8%	7	26%	6	22%	6	22%	6	22%	27	100%
2nd Survey Total	5	17%	11	38%	7	24%	2	7%	4	14%	29	100%

Just over half (53%) of the mobile laptop PC users, rated the transition from CDPD to CS-CDPD as fair or poor. Several respondents indicated that the unit would frequently lock up when it transitioned from CDPD service to CS-CDPD. This compares to 17% of those with pen-based units rating the transition from CDPD to CS-CDPD as fair or poor. Half of the pen-based unit users rated the transition as excellent or good.

9. Performance of the MCT in CS-CDPD Area

	Excellent		Good		Fair		Poor		Not Rated		Total	
	#	%	#	%	#	%	#	%	#	%	#	%
Mobile Laptop PC	0	0%	9	43%	4	19%	6	29%	2	9%	21	100%
2nd Survey	2	9%	10	45%	8	36%	1	5%	1	5%	22	100%
Pen-Based Unit	0	0%	2	33%	1	17%	0	0%	3	50%	6	100%
2nd Survey	1	14%	3	43%	2	29%	0	0%	1	14%	7	100%
1st Survey Total	0	0%	11	40%	5	19%	6	22%	5	19%	27	100%
2nd Survey Total	3	10%	13	45%	10	35%	1	3%	2	7%	29	100%

Sixty-two percent of those with mobile laptop PC's and half of those with pen-based units rated the performance of the MCT in the CS-CDPD area as good or fair.

10. Response Time After Query Sent in CDPD Area

	Excellent		Good		Fair		Poor		Not Rated		Total	
	#	%	#	%	#	%	#	%	#	%	#	%
Mobile Laptop PC	11	52%	3	14%	1	5%	1	5%	5	24%	21	100%
2nd Survey	7	32%	6	27%	5	23%	0	0%	4	18%	22	100%
Pen-Based Unit	4	67%	2	33%	0	0%	0	0%	0	0%	6	100%
2nd Survey	4	57%	3	43%	0	0%	0	0%	0	0%	7	100%
1st Survey Total	15		5	19%	1	4%	1	4%	5	19%	27	100%
2nd Survey Total	11	38%	9	31%	5	17%	0	0%	4	14%	29	100%

It is important to note that 66% of mobile laptop PC users and all pen-based users) rated the CDPD response time as excellent or good.

11. Response Time After Query Sent in CS-CDPD Area

	Excellent		Good		Fair		Poor		Not Rated		Total	
	#	%	#	%	#	%	#	%	#	%	#	%
Mobile Laptop PC	2	10%	6	28%	3	14%	8	38%	2	10%	21	100%
2nd Survey	4	18%	7	32%	9	41%	2	9%	0	0%	22	100%
Pen-Based Unit	0	0%	2	33%	1	17%	0	0%	3	50%	6	100%
2nd Survey	0	0%	4	57%	2	29%	0	0%	1	14%	7	100%
1st Survey Total	2	7%	8	30%	4	15%	8	30%	5	18%	27	100%
2nd Survey Total	4	14%	11	38%	11	38%	2	7%	1	3%	29	100%

When compared to the rating for the CDPD query response time, the CS-CDPD response time was rated lower. Just over half of the mobile laptop PC users rated the CS-CDPD query response time as fair or poor.

12. Display Readability During Night Operation

	Excellent		Good		Fair		Poor		Not Rated		Total	
	#	%	#	%	#	%	#	%	#	%	#	%
Mobile Laptop PC	15	71%	6	29%	0	0%	0	0%	0	0%	21	100%
2nd Survey	13	59%	8	36%	0	0%	1	5%	0	0%	22	100%
Pen-Based Unit	2	33%	2	33%	0	0%	2	33%	0	0%	6	100%
2nd Survey	1	14%	3	43%	0	0%	3	43%	0	0%	7	100%
1st Survey Total	17	63%	8	30%	0	0%	2	7%	0	0%	27	100%
2nd Survey Total	14	48%	11	38%	0	0%	4	14%	0	0%	29	100%

Although the vast majority of both MCT's (100% of those with mobile laptop PC's and 66% of those with pen-based units) rated the display readability during night operation as excellent or good, several respondents indicated that the keyboard lights are distracting and should be diffused. A pen-based user also noted that the green light strip that is mounted at the top of the keyboard tends to cast a glare across the keys making visibility difficult.

An analysis of the responses to the open-ended questions provided the following information.

- The vast majority commented that after installation, the MCT's continuously failed to operate.
- System lock-ups were a persistent problem, necessitating re-booting the system to correct the problem.
- To eliminate typing, a softkey assignment for driver transcripts would be beneficial.
- There was unanimous support for the utilization of MCT's in patrol vehicles. Several respondents commented that the MCT's allow the trooper to perform his/her job more efficiently and provide more licensing/registration/wanted checks and charges.
- The vast majority commented that the MCT's were instrumental in reducing radio traffic and provided the capability to run DMV checks without dispatcher intervention. Also, comments were made that the driver transcript information can be read personally by the trooper, thus avoiding interpretation by a dispatcher.
- A connection to CAD would be beneficial.
- To fully utilize the capabilities of the MCT, the addition of a word processing software, a floppy drive, and printer was suggested.
- A comment was made that the mouse control on the laptop and the emergency F12 key are located next to each other. This key arrangement increases the likelihood that the emergency button will be accidentally activated.