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ACE Direct Operations Manual

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1. About the CMS Alliance to Modernize Healthcare

The Centers for Medicare & Medicaid Services (CMS) sponsors the CMS Alliance to Modernize Healthcare (CAMH), the first Federally Funded Research and Development Center (FFRDC) dedicated to strengthening our nation’s healthcare system.

The CAMH FFRDC enables CMS, the Department of Health and Human Services (HHS), and other government entities to access unbiased research, advice, guidance, and analysis to solve complex business, policy, technology, and operational challenges in health mission areas. The FFRDC objectively analyzes long-term health system problems, addresses complex technical questions, and generates creative and cost-effective solutions in strategic areas such as quality of care, new payment models, and business transformation.

Formally established under Federal Acquisition Regulation (FAR) Part 35.017, FFRDCs meet special, long-term research and development needs integral to the mission of the sponsoring agency—work that existing in-house or commercial contractor resources cannot fulfill as effectively. FFRDCs operate in the public interest, free from conflicts of interest, and are managed and/or administered by not-for-profit organizations, universities, or industrial firms as separate operating units.

The CAMH FFRDC applies a combination of large-scale enterprise systems engineering and specialized health subject matter expertise to achieve the strategic objectives of CMS, HHS, and other government organizations charged with health-related missions. As a trusted, not-for-profit adviser, the CAMH FFRDC has access, beyond what is allowed in normal contractual relationships, to government and supplier data, including sensitive and proprietary data, and to employees and government facilities and equipment that support health missions.

CMS conducted a competitive acquisition in 2012 and awarded the CAMH FFRDC contract to The MITRE Corporation (MITRE). MITRE operates the CAMH FFRDC in partnership with CMS and HHS, and maintains a collaborative alliance of partners from nonprofits, academia, and industry. This alliance provides specialized expertise, health capabilities, and innovative solutions to transform delivery of the nation’s healthcare services. Government organizations and other entities have ready access to this network of partners, including RAND Health, the Brookings Institution, and other leading healthcare organizations. This includes select qualified small and disadvantaged business.

The FFRDC is open to all CMS and HHS Operating Divisions and Staff Divisions. In addition, government entities outside of CMS and HHS can use the FFRDC with permission of CMS, CAMH’s primary sponsor.

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# Introduction

## Background

The Federal Communication Commission (FCC) Telecommunications Relay Service (TRS) Center of Expertise (COE) Project promotes the Commission’s goal to foster innovations that advance functionally equivalent telecommunications. Toward that end, the project ensures that the Telecommunications Relay Service employs improved technology for persons who are deaf, hard of hearing, deaf-blind, and/or have speech disabilities. The FCC has embraced a research-based approach to achieve this goal by engaging the Centers for Medicare & Medicaid Services (CMS) Alliance to Modernize Healthcare (CAMH) Federally Funded Research and Development Center (FFRDC), operated by The MITRE Corporation (MITRE), to conduct independent engineering assessments that promote and demonstrate TRS’s functional equivalence.

CAMH is independently assessing voice telephone services, video access services, and Internet Protocol (IP)-based captioning technology; improvements to TRS efficiency; solutions for direct communication between people with communication disabilities and other telephone users; and the effectiveness, efficiency, and consumer response to current and future approaches for delivering TRS.

At the FCC’s request, CAMH developed a Direct Video Calling (DVC) Auto-Routing Proof of Concept (POC) in support of the FCC’s Accessible Communications for Everyone (ACE)[[1]](#footnote-1) program. This DVC auto-routing platform enables direct calling from deaf and hard-of-hearing individuals to an American Sign Language (ASL)-trained agent within the organization’s call center. The agent handles the call using a video-capable phone with real-time video connection. To demonstrate the capabilities of DVC, the FCC and CAMH have further advanced the original auto-routing POC into a call center platform for two to ten customer service representatives. This new DVC platform is called ACE Direct.

## Purpose

This Accessible Communications Environment (ACE) Direct Operations Manual provides guidelines of routine technical and operational processes that might be performed on a daily, weekly, monthly, or annual basis to ensure a high level of performance for ACE Direct.

This manual is an application- and system-dependent document containing basic operations and verification procedures for the ACE Direct suite of servers and applications as built and installed by CAMH for the FCC.

The manual provides a qualified system administrator the minimum necessary set of instructions required to operate and support a production installation of ACE Direct DVC software. The procedures defined within this manual should serve as a fundamental component of a larger and more comprehensive operations and management strategy for any entity that installed and uses ACE Direct.

## Scope

This manual provides a reference guide for the relevant operations and maintenance of the ACE Direct components, Asterisk, Node.js, and the other interfaces to ACE Direct implementation at the FCC. This guidance is intended for qualified support personnel on the resolution of some basic system issues related to ACE Direct components. The guide also includes direction on the periodic, required systems administration activities to ensure a high level of performance of ACE Direct. In addition, the guide offers considerations for creation of a more comprehensive operations and management policy.

Figure 1 shows the key focus areas for operations of the ACE Direct platform on a daily, weekly, monthly, and annual basis. These focus areas (and applicable procedures) should be considered when creating and implementing a comprehensive operations and management strategy and solution.

Figure 1 depicts the key focus areas for direct operations of the ACE Direct platform on a daily, weekly, monthly, and annual basis.

Figure . Focus Areas for ACE Direct Operations Manual

This manual provides a reference for key procedures within these focus areas and should not be considered an all-inclusive comprehensive solution for all the operations of the party utilizing ACE Direct.

## Assumptions

The development of this manual relies on the following assumptions:

* User has root (aka “sudo”) access to all servers.
* Server OS is up and running normally.
* Initial setup of all software and applications is complete and has been tested to be in a working state.
* The actor performing ACE Direct processes has appropriate knowledge of Linux file system management and system administration.
* The use of the term “System Administrator” within this manual refers to any individual of any role that may be tasked with the operations contained within. The term does not suggest that all processes and procedures described here are to be performed exclusively by a “System Administrator.”
* The ACE Direct procedures and practices are to be adjusted, added to, modified, or otherwise tailored, as necessary, to suit the installing parties’ implementation of ACE Direct.
* The user possesses sufficient knowledge of ACE Direct to perform tests on the system via the use cases specified in Appendix A.

# ACE Direct Software Requirements

The minimum versions of software and operating systems required for ACE Direct are:

Operating Systems (OS)

* CentOS 7.3.1611
* VyOS version 1.1.0

Applications

* Asterisk version 14.2.1, PJSIP version 2.5.5
* Node.js version 7.2.1, NPM version 0.32.1
* MySQL version 5.6.35
* Turnserver version 3.2.3.8
* Enterprise Service Bus:
  + Apache ServiceMix version 6.1.2
  + Java SE version 1.8
  + Apache Maven version 3.0.4

# Routine Operations of ACE Direct

The ACE Direct platform requires a qualified system administrator to perform routine OS patches, system updates, and certain operations such as stop and start the managed servers and services as needed. The systems administrator monitors various ACE Direct system components, including system utilization, active system monitoring, and overall system health. The procedures in this manual describe many of the routine procedures for maintaining the health and performance of the ACE Direct platform.

## Daily Operations

The daily operations of ACE Direct can include many routine tasks that system administrators perform that will most likely need to be tailored to suit the environment and comply with company policy. These tasks may require an administrator to perform procedures such as system shut down and start up while validating and verifying the state of ACE Direct servers to ensure the application is operating correctly.

### Administrative Procedures

ACE Direct may require a system administrator to perform certain key tasks during its daily operation. The administrative procedures detailed here provide specific instructions for performing these routine tasks.

#### ACE Direct System Start-up

System start-up consists of the following procedures:

* Asterisk Server
* Log Files Location
* Troubleshooting the Asterisk Server
* Node.js Server
* Node.js Server Troubleshooting
* MySQL Database Server
* MySQL Database Server Troubleshooting

##### Asterisk Server

To start the Asterisk service, run the following from the OS command line:

service asterisk start

Once the service has been started, verify that Asterisk is running using the following commands:

service asterisk status

asterisk -rvvvvcg

The second command will open the Asterisk console. If it is successful, then Asterisk has properly started.

##### Log Files Locations

The use of log files can be a powerful tool to diagnose or troubleshoot ACE Direct. The common log files are located in the following locations:

* Asterisk - /var/log/asterisk/
* Node - ~/.pm2/logs

##### Troubleshooting the Asterisk Server

If Asterisk fails to start, perform the following:

* Check the following log files for any warnings or errors:  
  /var/log/asterisk/messages  
  /var/log/asterisk/full
* Ensure that there are no syntax/formatting errors in any recently changed config files
* Restart the server

Use a softphone client such as Linphone to try to registering to Asterisk. Place a few calls to other endpoints to confirm that Asterisk is properly managing calls between endpoints.

If Asterisk has started, but connections to the Asterisk server fail, check the Asterisk log file in /var/log/asterisk/messages for any error messages and inspect the endpoints network configuration settings to ensure the following traffic types can flow to and from the server:

Table . Asterisk Required Ports/Protocol

| Traffic Type | Protocol | Port(s) |
| --- | --- | --- |
| Asterisk default port | TCP | 5060 |
| HTTPS traffic (websocket) | TCP | 443 |
| RTP traffic | TCP/UDP | 10000-20000 |
| STUN Traffic | TCP/UDP | 3478 |

##### Node.js Server

In each Node process directory, execute the “\*.sh” script to start each process. Run the following command a few times over the course of several seconds, and ensure the process is not incrementally restarting:

pm2 list

Verify that the processes are properly running by accessing the respective web pages from a compatible web browser such as Mozilla Firefox. Exercise the use case scenarios in Appendix A to validate all ACE Direct system functionality.

##### Node.js Server Troubleshooting

If one of the processes fails to start, or are continuously restarting, perform the followings:

* Ensure that the ports used for each service are not already in use by running the below command:  
  sudo netstat -tanp
* Inspect the log file in ~./pm2/logs for any errors. If an error stating that a Node ‘package’ cannot be found, run the following in the process directory:  
  npm install  
  bower install (if applicable)
* Restart the server

##### MySQL Database Server

To start the MySQL server/daemon, execute the following command:

service mysqld start

To verify that the server is properly running, first use the following command to log in to MySQL:

mysql -u username -p password

Then execute the following command from the Asterisk server:

echo "select 1" | isql -v asterisk-connector

##### MySQL Database Server Troubleshooting

If MySQL fails to start, perform the following:

* Ensure that another MySQL process is not already running
* Ensure that no syntax/format issues are present in /etc/mysql.cnf
* Restart the server

#### ACE Direct System Shutdown

System shutdown involves the Asterisk Server, Node.js Server, and MySQL Server.

##### Asterisk Server

Execute one of the following commands through the Asterisk Command Line Interface (CLI) to shut down the Asterisk server:

* Core stop now
* Core stop when convenient
* Core stop gracefully

The “stop” commands shut down the Asterisk server process. Execute the Asterisk program in server mode to get it running again (see subsection 1.1.1.1).

The “now,” “gracefully,” and “when convenient” arguments tell Asterisk how quickly to shut down or restart. Use the “now” command” interrupt the current calls and tasks in progress on the server. The “when convenient” command is appropriate if it is preferable that Asterisk waits until all the calls and tasks are finished and there is no call activity at all. If it is likely that you plan to have any callers besides yourself on the system, the “when convenient” is the proper choice

Although the Asterisk console may appear uncomplicated, it is a highly useful tool for diagnosing problems and checking on system status. Type “core show help” in the Asterisk CLI to get a list of commands.

There are some parts of Asterisk that require a restart to reflect changes. To restart Asterisk, first decide when the restart should occur. There are three choices:

1. now: This option stops all calls in progress, immediately stops Asterisk, and restarts it.
2. gracefully: This option does not stop calls in progress, but does not allow any new calls to be started. When all calls that are in progress are completed, the server will restart. Be careful, as a hung channel will basically disable your server.

when convenient: This option does not end any calls in progress, and allows new calls to start as usual. When there are no calls in progress, the server will restart. This means that incoming and outgoing calls are not interrupted except for the short period of time in which Asterisk is actually restarting. This would not work on high-load servers, because there may never be a time when there are no calls in progress, and it will also not work if a channel is “stuck,” meaning the server thinks it has a call in progress when, in fact, it does not.

To verify the Asterisk service has stopped, run the following command from the OS CLI:

ps aux|grep asterisk

You should expect to see no Asterisk process(es) in the results. In the event Asterisk fails to stop through the use of the Asterisk CLI, execute the following command from the OS CLI:

service asterisk stop

##### Node.js Server

To stop a Node process, simply run one of the following commands:

pm2 stop <id|app|all>

pm2 delete <id|app|all>

The ‘stop’ command will stop the process, but leave it in memory should you want to start it up again. The ‘delete’ command will not only stop the process, but delete it from memory altogether. You can either specify a PM2 process ID or name to stop a particular process, or simply use ‘all’ to stop/delete all currently running processes. You can verify that the process(es) is stopped by running ‘pm2 list’ as above.

##### MySQL Server

To stop the MySQL daemon, run the following command:

service mysqld stop

Ensure that no active connections to MySQL are running before stopping the daemon because this may cause issues with other applications. Verify that the daemon is stopped by running:

service mysqld status

You can verify the daemon is stopped by trying to connect to the server from Asterisk using the command specified in subsection 1.1.1.3, only this time it should fail.

## Weekly Operations

The weekly operations of ACE Direct should include, but are not limited to, routine maintenance such as patches and security updates of the operating systems, low-impact changes, and compiling server status reports.

ACE Direct requires regular updates of ACE Direct servers to maintain compliance with corporate policy. These updates can be all inclusive or selective to only apply security updates.

### Updates

To update the ACE Direct Servers, perform SSH into the server to be updated and issue the following command:

yum update -y

To update security only patches, enter the following command:

yum update –security -y

### Log Management

ACE Direct requires periodic review of log files for size and disk space consumption. These log files should be rotated weekly and backed up. This process should be scripted to comply with company policy although may occasionally need to be manually compressed.

To compress log files, perform SSH to the server and issue:

gzip -7 /path/to/log/files

#### ACE Direct Server Reports

Regularly check the overall health of the ACE Direct system. This procedure will depend on company policy and the environment in which ACE Direct is deployed, although a regular weekly report of server usage and other environment statistics can be a useful tool in preventive maintenance. Monitor statistics such as increased CPU utilization, runaway processes, disk usage, and other common statistics to identify potential problems in the environment before there are any adverse effects to ACE Direct functionality.

### Failover Testing

ACE Direct is generally robust and stable although incidents may occur. Consequently, it is recommended that you schedule regular failover testing for ACE Direct. This practice should comply with the company policy and is environment specific.

## Monthly Operations

Monthly operations for ACE Direct are required to consolidate the results of weekly log rotations and perform higher impact changes that may not be suitable for weekly operations.

### Hardware Upgrades/Maintenance

ACE Direct may periodically require hardware upgrades to improve performance or replace an aging infrastructure. Any hardware upgrades to ACE Direct servers is at the discretion of the installing company and the environment in which ACE Direct is installed.

### Operating System Upgrades

ACE Direct is built on the Centos 7.X operating system. This system may release periodic upgrades, which typically represents a significant operating system-level change that can bring new features and functionality to ACE Direct. It is important to carefully review the upgrade notes to assure compatibility with ACE Direct before performing any such upgrade.

### System Maintenance and Cleanup

ACE Direct is a high-availability service platform that requires regular cleaning of cache and temporary files. Performing backups and file system maintenance should be performed at regular intervals to keep ACE Direct operating at optimal performance.

Some considerations when evaluating file system maintenance can include:

* Temporary folders
* Disk usage
* Log file verbosity
* Backup operations

### Monthly Server Reports

ACE Direct benefits from proactive environment maintenance. Consolidating weekly server reports into a larger monthly report can help identify trends in the statistics and identify potential problem areas.

## Annual Operations

Annual operations of ACE Direct will be subject to the policy of the installation companies. Several considerations specific to ACE Direct are:

* System stress test
* System compliance audits
* System health checks
* Call volume tests

# Website Operations

The Management Portal displays real-time monitoring of the call center information. The portal consists of two components, the Management and Call Detail Record (CDR) dashboards. The Management Dashboard displays call metrics for the Asterisk queue and the agents assigned to the queue. The CDR Dashboard displays the view and exports call detail information.

## Management Dashboard

The Management dashboard presents information about the operations of the call center and incoming calls, including real-time monitoring of call center metrics, queue metrics, call agent information, and the resource status table.

### Understanding Dashboard Metrics

The ACE Direct web interface provides a Management Console that can display some vital metrics of the system and report the overall system health. Understanding these metrics and the controls through the web interface is vital to maintain information assurance and integrity.

### Call Center Metrics

ACE Direct provides the following Call Center metrics:

* Calls Waiting – the number of calls currently in queue
* Calls Handled – the total number of calls completed by agents
* Average Hold Time – shown in minutes
* Calls Abandoned – total number of calls failed to be answered by an agent

### Queue Metrics

The dashboard shows more granular information regarding the individual queues. This information is queue specific, encompassing the two queues of ACE Direct (Complaints Queue and General Questions Queue). The queue metrics displayed are:

* Logged In – Agents currently logged in to the ACE Direct queue
* Available Agents – Agents logged in AND ready to receive calls
* Current Calls – Number of calls currently connected with an agent
* Total Calls – Total number of currently active calls in the queues
* Calls Handled – Total number of calls per queue
* Calls Abandoned – Number of calls failed to be answered by an agent
* Talk Time – The number of active call minutes
* Hold Time – Total number of minutes that callers have been on hold per queue
* Longest Hold Time – The greatest number of minutes a caller has spent on hold

### Resource Status Table

The Resource Status Table displays information about the health of the system. The status “Running” indicates all is nominal while “Offline” indicates that service is no longer available. This may indicate a problem and require restarting the service, or further investigation.

### Clearing Counters

The “Clear Counters” button provides a means to reset all counters to 0. This operation does not save the current state of the metrics or record any information at this time. Pressing this button will reset this data and should be used sparingly.

## CDR Dashboard

The Call Detail Record displays a table of recorded call data. This information is recorded in ACE Direct to a MySQL table. This information is displayed in a dynamic table that can be sorted by any column using the arrows at the top. The CDR may be exported as a CSV file using the download icon from the top right.

1. ACE Direct User Stories
   1. User Story 1 (ZVRS to CSR Linphone)

Summary:

The ASL user with a ZVRS registered video phone can call into ACE Direct via a dial-in number. The menu will be displayed to the user, at which point the user will choose the intent of the call by selecting one of the options form the menu. The user selects to file a complaint and is placed into the complaints queue. An AD CSR received the call from the queue and answers the user.

depicts the graphical flow of this user story according to the following steps:

1. ZVRS user dials dial-in number
2. Asterisk displays main menu
3. ZVRS user selects ‘File a Complaint’
4. ZVRS user is placed into a queue

AD CSR answers call form queue

Figure 2 depicts the flow of User Story 1 as described in the steps immediately preceding the figure.

Figure . User Story 1 – ZVRS to CSR

* 1. User Story 2 (WebRTC to CSR Linphone)

Summary:

A consumer files a complaint using the complaint portal (via WebRTC), and is them placed into the complaints queue. The AD CSR uses Linphone to accept the call from the WebRTC user. depicts the graphical flow of this user story according to the following steps:

1. User travels to complaint portal, enters qo-digit VRS number
2. User files complaint, receives ticket number, and calls ACE Direct
3. User is placed into complaints queue

AD CSR picks up call from user

Figure 3 depicts the flow of User Story 2 as described in the steps immediately preceding the figure.

Figure . User Story 2 – WebRTC to CSR Linphone

* 1. User Story 3 (Linphone to CSR Linphone)

Summary:

As an ASL user with a provider-registered softphone, I can call into ACE Direct via a dial-in number. The menu will be displayed to the user, at which point the user will choose the intent of the call by selecting one of the options form the menu. The user opts to file a complaint and is placed in the complaints queue. An AD CSR received the call from the queue and answers the user. depicts the graphical flow of this user story, which follows the same steps as User Story 1.

Figure 4 depicts the flow of User Story 3 as described in the steps immediately preceding the figure.

Figure . User Story 3 – Linphone to CSR Linphone)

* 1. User Story (Video Mail)

Summary:

As a CSR, I can retrieve video mail.

***Note*:** The caller who leaves a video email can be one of the following:

1. Another ASL user from either the ACE Connect Lite or another provider’s network, i.e., ASL-to-ASL direct call.
2. An ACE Connect Lite CA who leaves the video email on behalf of a PSTN/Hearing caller.
3. Leaving a video mail: After the call rings for 10 seconds, the caller will see a video.

A more stable ACE APP release is needed or use ZVRS to leave the video mail and use Linphone to retrieve it.

* 1. User Story (Call On Hold and Call Transfer)

Summary:

As an ACE Direct CSR, I can perform “Call on Hold” and “Call Transfer,” as needed.

1. While in a call, place customer on hold.

Return to call, then transfer call to another CSR.

* 1. User Story (Agent Status)

Summary:

As the ACE Direct CSR, I can log in using the CSR Desktop along with other CSRs and I can change my status between “Ready” and “Away.”

1. Navigate to ACE Direct agent portal and log in as an agent.

Use the “Ready” and “Away” buttons to update the agent’s status (validate status updates in Asterisk queues).

Acronyms

| Term | Definition |
| --- | --- |
| ACE | Accessible Communications for Everyone |
| AD | ACE Direct |
| AMI | Asterisk Manager Interface |
| AMA | Automatic Message Accounting |
| API | Application Programming Interface |
| APP | Access Point Platform |
| ASL | American Sign Language |
| CAMH | CMS Alliance to Modernize Healthcare |
| CLI | Command Line Interface |
| CMS | Centers for Medicare & Medicaid Services |
| CSR | Customer Service Representative |
| CSV | Comma Separated Value |
| DHOH | Deaf/Hard-of-Hearing |
| FFRDC | Federally Funded Research and Development Center |
| HHS | Department of Health and Human Services |
| PSTN | Public Switch Telephony Network |
| WebRTC | Web Real-Time Communication |
|  |  |

1. <https://www.fcc.gov/ace> [↑](#footnote-ref-1)