z/OS PKI Services
Quick Set-up for Multiple CAs

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z/OS PKI Services: Quick Set-up for Multiple CAs

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Note: Before using this information and the product it supports, read the information in “Notices” on page v.

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Chapter 1. Welcome to PKI Services on z/OS
1.1 Introduction .................................................. 2
  1.1.1 Pre-requisite reading ..................................... 2
  1.1.2 Basic scenario components ............................... 3
1.2 Scenario build .................................................. 3
  1.2.1 Building the scenario ..................................... 4

Chapter 2. Setting up the Root CA environment .................... 5
  2.1 Setting up PKI services rootca environment ................. 6
    2.1.1 Defining VSAM data sets ................................ 6
    2.1.2 Installing the HTTP Server - Powered by Apache .... 13
    2.1.3 Using the set up script to create certificates and key rings .... 14
    2.1.4 Configuring the PKI Services UNIX files ........... 20
    2.1.5 Customizing PKISERVD started task .................... 25
    2.1.6 Configuring the HTTP server for PKI services ....... 26
    2.1.7 Setting up the LDAP server ............................ 31
    2.1.8 Preparing ROOTCA for use ............................. 34
    2.1.9 Enabling ROOTCA for use from the browser .......... 35

Chapter 3. Setting up SUBCA1 and SUBCA2 under ROOTCA ....... 37
  3.1 SUBCA1 set up ................................................ 38
    3.1.1 Creating SUBCA1 certificate request .................. 38
    3.1.2 Requesting the SUBCA1 certificate to be signed by ROOTCA ... 39
    3.1.3 Retrieving SUBCA1 certificate .......................... 43
    3.1.4 Adding the SUBCA1 certificate to RACF ............... 45
    3.1.5 Creating and customizing the UNIX files for SUBCA1 ... 47
    3.1.6 Creating the VSAM data sets for SUBCA1 ............. 49
    3.1.7 Creating certificate, key ring, and authorization for SUBCA1 .. 49
    3.1.8 Starting SUBCA1 ........................................ 50
  3.2 SUBCA2 setup .................................................. 53

Related publications ............................................. 55
IBM Redbooks ..................................................... 55
Other publications ............................................... 55
Help from IBM ..................................................... 55
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Preface

If you are new to Public Key Infrastructure (PKI), this IBM® Redbooks® publication helps you install, tailor, and configure PKI Services on IBM z/OS®. The intention is to show you a simplified set-up in which the ITSO labs were created. You can choose a similar set-up for your site in a controlled test environment where you can gain skills and experience in PKI Services on z/OS, and then move on to plan and implement it across your site.

This IBM Redbooks publication is written at the z/OS Version 2 Release 2 level.

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Thanks to Bob Haimowitz (DSG, Poughkeepsie Center) for setting up and maintaining the systems, and providing valuable advice, guidance, and assistance throughout the creation of this IBM Redbooks publication.

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Welcome to PKI Services on z/OS

In this chapter, you are introduced to this IBM Redbooks publication and provided with suggestions for prerequisite reading. An overview of the scenario that was used to create a controlled environment also is shown.

The IBM HTTP Server - Powered by Apache is referred to as HTTP server throughout this document.

This chapter includes the following topics:

- 1.1, “Introduction” on page 2
- 1.2, “Scenario build” on page 3
1.1 Introduction

This IBM Redbooks publication describes how to quickly set up z/OS PKI Services and have the servers running so that you can try the certificate creation, management, and administration functions. We recommend that you use the set up in your test system first. You must configure more options in the production system.

The steps that were used to set up a scenario in our controlled environment are described. Examples of the use of the PKI Services on z/OS also are provided.

1.1.1 Pre-requisite reading

If you are new to digital certificates, it is suggested that you read the IBM Redbooks publication that is shown in Figure 1-1, which is available at this website:

http://www.redbooks.ibm.com/abstracts/sg248336.html

Topics covered:
• Digital Certificates Overview
  • What is a digital certificate?
  • Why would you use a digital certificate?
• Introducing Certificate Authorities (CA)
  • Intermediate CAs
• The digital certificate lifecycle
• Digital certificate management and administration
• Introducing PKI Services on z/OS
  • Requesting and approving certificates
  • Generating certificates for use across the enterprise
  • Email notifications

Figure 1-1  Prerequisite reading

For more information about PKI Services on z/OS, see the following publications:

► Cryptographic Series PKI Services Guide and Reference, SA23-2286
► IBM HTTP Server - powered by Apache, SC27-8417
► IBM Tivoli® Directory Server Administration and Use for z/OS, SC23-6788
1.1.2 Basic scenario components

The implementation that we set up is shown in Figure 1-2.

![Diagram of three instances of PKI Services](image)

Figure 1-2 Three instances of PKI Services

ROOTCA is an instance with a self-signed certificate. It issues the server certificate for the HTTP server. After the ROOTCA instance is set up with the HTTP server, it is used to issue CA certificates for SUBCA1 and SUBCA2.

ROOTCA can be put offline after it issues the intermediate CAs. All of the certificates are then issued by SUBCA1 or SUBCA2, according to your needs. For example, you can assign SUBCA1 to issue certificates for internal use and SUBCA2 to issue certificates for your business partners.

1.2 Scenario build

The environment is built by producing the following entities:

- PKI CA certificates that are owned by CERTAUTH: ‘ROOTCA PKI CA’, ‘SUBCA1 PKI CA’, ‘SUBCA2 PKI CA’
- IDs for the servers:
  - PKI daemon ID: PKISRVD
  - HTTP server ID: WEBSRV
  - LDAP server ID: GLDSRV
- PKI key rings:
  - PKISRVD/CAring.ROOTCA, contains ROOTCA PKI CA
  - PKISRVD/CAring.SUBCA1, contains ROOTCA PKI CA, SUBCA1 PKI CA, and SUBCA1 RA
  - PKISRVD/CAring.SUBCA2, contains ROOTCA PKI CA, SUBCA2 PKI CA, and SUBCA2 PKI RA
- One HTTP server for all domains:
  - HTTP server certificate that is owned by WEBSRV with label ‘SSL Cert’.
  - HTTP key ring: WEBSRV/SSLring contains ROOTCA PKI CA, SSL Cert, SUBCA1 PKI CA, and SUBCA2 PKI CA.
- Start procedures in SYS1.PROCLIB:
  - HTTP server - SYS1.PROCLIB(IHSSRVER): s ihssrver
  - LDAP server - SYS1.PROCLIB(GLDSRV): s gldsrv
PKI server - SYS1.PROCLIB(PKISERVD):

- S pkiservd,jobname=rootca,dir='/etc/pkiserv/rootca'
- S pkiservd,jobname=subca1,dir='/etc/pkiserv/subca1'
- S pkiservd,jobname=subca2,dir='/etc/pkiserv/subca2'

1.2.1 Building the scenario

The environment was built at the z/OS Version 2 Release 2 level.

The following directories are needed for the configuration files:

- /etc/pkiserv/rootca
- /etc/pkiserv/subca1
- /etc/pkiserv/subca2

The following directories are needed to store the CRL files if CRL Distribution point is to be created by using the HTTP protocol:

- /var/pkiserv/rootca
- /var/pkiserv/subca1
- /var/pkiserv/subca2

The following products are needed to build the scenario:

- An HTTP server to manage requests through a web server.

Note: The z/OS level is V2.2 and HTTP Server - powered by Apache is used.

- Sendmail (optional) for sending email notifications to certificate requesters and administrators.
- VSAM data sets to store the object store and issue certificate lists.

Although the ROOTCA, SUBCA1, and SUBCA2 share the HTTP server and LDAP server, the configuration files and VSAM data set store is unique to each CA.

For more information about building and configuring the ROOTCA PKI instance, HTTP server, the LDAP server, and some configuration work for SUBCA1 and SUBCA2, see Chapter 2, “Setting up the Root CA environment” on page 5.

For more information about building and configuring the SUBCA1 and SUBCA2 intermediate CAs, see Chapter 3, “Setting up SUBCA1 and SUBCA2 under ROOTCA” on page 37. (The configuration work is for each unique instance only.)
Chapter 2. Setting up the Root CA environment

In this chapter, the process that is used to build the PKI Services environment for the ROOTCA is described.
2.1 Setting up PKI services rootca environment

Samples for setting up an environment are provided in this book as part of the installation process. Each sample is identified throughout the course of the book as and when it is needed.

We suggest that you set up a partitioned data set into which the samples can be copied and then, modify them as suggested or to meet your installation standards. For this book, the data set PKI.QUICK.SETUP is allocated. This data set is referred to as the SETUP data set throughout this paper.

The samples are copied under the same member name and modified where necessary to suit the controlled environment.

Note: Ensure that you read all the comments in the SAMPLIB members and complete the appropriate tasks.

2.1.1 Defining VSAM data sets

The VSAM data sets include the PKISRVD prefix. The data sets that include the object store (OST) qualifier are related to object store, which is used to store certificate requests. The data sets that include the issued certificate list (ICL) qualifier are related to the issued certificates list, which is used to store issued certificates.

VSAM data set configuration for ROOTCA

The root CA VSAM data sets are shown in Figure 2-1.

Figure 2-1 Rootca VSAM data sets

| PKISRVD.ROOTCA.VSAM.OST       | PKISRVD.ROOTCA.VSAM.ICL          |
| PKISRVD.ROOTCA.VSAM.OST.AIX   | PKISRVD.ROOTCA.VSAM.ICL.DA       |
| PKISRVD.ROOTCA.VSAM.OST.AIX.DA| PKISRVD.ROOTCA.VSAM.ICL.IX       |
| PKISRVD.ROOTCA.VSAM.OST.AIX.IX| PKISRVD.ROOTCA.VSAM.ICL.REQAIX   |
| PKISRVD.ROOTCA.VSAM.OST.DA    | PKISRVD.ROOTCA.VSAM.ICL.REQAIX.DA|
| PKISRVD.ROOTCA.VSAM.OST.IX    | PKISRVD.ROOTCA.VSAM.ICL.REQAIX.IX|
| PKISRVD.ROOTCA.VSAM.OST.PATH  | PKISRVD.ROOTCA.VSAM.ICL.REQUEST  |
| PKISRVD.ROOTCA.VSAM.OST.REQAIX| PKISRVD.ROOTCA.VSAM.ICL.STATAIX  |
| PKISRVD.ROOTCA.VSAM.OST.REQAIX.DA| PKISRVD.ROOTCA.VSAM.ICL.STATAIX.DA|
| PKISRVD.ROOTCA.VSAM.OST.REQAIX.IX| PKISRVD.ROOTCA.VSAM.ICL.STATAIX.IX|
| PKISRVD.ROOTCA.VSAM.OST.REQUESTR| PKISRVD.ROOTCA.VSAM.ICL.STATUS   |
| PKISRVD.ROOTCA.VSAM.OST.STATAIX|                               |
| PKISRVD.ROOTCA.VSAM.OST.STATAIX.DA|                           |
| PKISRVD.ROOTCA.VSAM.OST.STATAIX.IX|                          |
| PKISRVD.ROOTCA.VSAM.OST.STATUS |                               |
Defining the ROOTCA VSAM data sets

Copy member SYS1.SAMPLIB(IKYCVSAM) into your set up data set. Change the volume and the data set names. In our system, we change ‘vvvv’ to BH6ST5, and qualify the VSAM data set names with ROOTCA, as shown in Figure 2-1 on page 6.

The job features several steps that include the following commands:

- **DELCLUST**: Deletes clusters, paths, and alternative indexes, as shown in Figure 2-2.

```plaintext
DELETE -
    PKISRVD.ROOTCA.VSAM.OST -
    ERASE
IDC3012I ENTRY PKISRVD.ROOTCA.VSAM.OST NOT FOUND
IDC3009I ** VSAM CATALOG RETURN CODE IS 8 - REASON CODE IS IGG0CLA3-42
IDC0551I ** ENTRY PKISRVD.ROOTCA.VSAM.OST NOT DELETED
IDC0001I FUNCTION COMPLETED, HIGHEST CONDITION CODE WAS 8

DELETE -
    PKISRVD.ROOTCA.VSAM.ICL -
    ERASE
IDC3012I ENTRY PKISRVD.ROOTCA.VSAM.ICL NOT FOUND
IDC3009I ** VSAM CATALOG RETURN CODE IS 8 - REASON CODE IS IGG0CLA3-42
IDC0551I ** ENTRY PKISRVD.ROOTCA.VSAM.ICL NOT DELETED
IDC0001I FUNCTION COMPLETED, HIGHEST CONDITION CODE WAS 8

IF MAXCC LT 9 THEN SET MAXCC = 0
```

*Figure 2-2  Step DELCLUST output*
DEFKSDS: Defines two VSAM clusters, as shown in Figure 2-3.

```
IDCAMS  SYSTEM SERVICES

DEFINE CLUSTER
   (NAME(PKISRVD.ROOTCA.VSAM.OST) -
    VOL(BH6ST5) -
    RECSZ(1024 32756) -
    INDEXED -
    NOREUSE -
    KEYS(4 0) -
    SHR(2) -
    CYL(3,1) -
    LOG(NONE) -
    OWNER(PKISRVD) ) -
DATA -
   (NAME(PKISRVD.ROOTCA.VSAM.OST.DA) -
    CISZ(4096) -
    SPANNED) -
INDEX -
   (NAME(PKISRVD.ROOTCA.VSAM.OST.IX))
IDC0508I DATA ALLOCATION STATUS FOR VOLUME BH6ST5 IS 0
IDC0509I INDEX ALLOCATION STATUS FOR VOLUME BH6ST5 IS 0
IDC0001I FUNCTION COMPLETED, HIGHEST CONDITION CODE WAS 0

DEFINE CLUSTER
   (NAME(PKISRVD.ROOTCA.VSAM.ICL) -
    VOL(BH6ST5) -
    RECSZ(1024 32756) -
    INDEXED -
    NOREUSE -
    KEYS(4 0) -
    SHR(2) -
    CYL(3,1) -
    LOG(NONE) -
    OWNER(PKISRVD) ) -
DATA -
   (NAME(PKISRVD.ROOTCA.VSAM.ICL.DA) -
    CISZ(4096) -
    SPANNED) -
INDEX -
   (NAME(PKISRVD.ROOTCA.VSAM.ICL.IX))
IDC0508I DATA ALLOCATION STATUS FOR VOLUME BH6ST5 IS 0
IDC0509I INDEX ALLOCATION STATUS FOR VOLUME BH6ST5 IS 0
IDC0001I FUNCTION COMPLETED, HIGHEST CONDITION CODE WAS 0

IDCAMS  SYSTEM SERVICES
IDC0002I IDCAMS PROCESSING COMPLETE. MAXIMUM CONDITION CODE WAS 0
```

Figure 2-3 Step DEFKSDS output
MKZEROS: Uses IEBGENER to write a record of all binary zeros to a temporary file, as shown in Figure 2-4.

```
DATA SET UTILITY - GENERATE
GENERATE MAXFLDS=4,MAXLITS=80
RECORD FIELD=(20,X'00000000000000000000000000000000',,1),
    FIELD=(20,X'00000000000000000000000000000000',,21),
    FIELD=(20,X'00000000000000000000000000000000',,41),
    FIELD=(20,X'00000000000000000000000000000000',,61)
```

Figure 2-4  Step MKZEROS output

REPROKSD: Writes the temporary file into both VSAM dat sets, as shown in Figure 2-5.

```
IDCAMS  SYSTEM SERVICES
    REPRO INFILE(SYSDATA) -
        OUTDATASET(PKISRVD.ROOTCA.VSAM.OST)
IDC0005I NUMBER OF RECORDS PROCESSED WAS 1
IDC0001I FUNCTION COMPLETED, HIGHEST CONDITION CODE WAS 0

    REPRO INFILE(SYSDATA) -
        OUTDATASET(PKISRVD.ROOTCA.VSAM.ICL)
IDC0005I NUMBER OF RECORDS PROCESSED WAS 1
IDC0001I FUNCTION COMPLETED, HIGHEST CONDITION CODE WAS 0

IDC0002I IDCAMS PROCESSING COMPLETE. MAXIMUM CONDITION CODE WAS 0
```

Figure 2-5  Step REPROKSD output
DEFALTDX: Defines ALTERNATE INDEX and PATH, as shown in Figure 2-6 and Figure 2-7 on page 11.

**IDCAMS SYSTEM SERVICES**

DEFINE ALTERNATEINDEX -
  (NAME(PKISRVD.ROOTCA.VSAM.OST.AIX) -
   RELATE(PKISRVD.ROOTCA.VSAM.OST) -
   VOL(BH6ST5) -
   TRK(5,1) -
   KEYS(24 44) ) -
DATA -
  (NAME(PKISRVD.ROOTCA.VSAM.OST.AIX.DA)) -
INDEX -
  (NAME(PKISRVD.ROOTCA.VSAM.OST.AIX.IX))
IDC0508I DATA ALLOCATION STATUS FOR VOLUME BH6ST5 IS 0
IDC0509I INDEX ALLOCATION STATUS FOR VOLUME BH6ST5 IS 0
IDC0001I FUNCTION COMPLETED, HIGHEST CONDITION CODE WAS 0

DEFINE PATH -
  (NAME(PKISRVD.ROOTCA.VSAM.OST.PATH) -
   PATHENTRY(PKISRVD.ROOTCA.VSAM.OST.AIX))
IDC0001I FUNCTION COMPLETED, HIGHEST CONDITION CODE WAS 0

DEFINE ALTERNATEINDEX -
  (NAME(PKISRVD.ROOTCA.VSAM.OST.STATAIX) -
   RELATE(PKISRVD.ROOTCA.VSAM.OST) -
   VOL(BH6ST5) -
   TRK(5,1) -
   KEYS(40 4) ) -
DATA -
  (NAME(PKISRVD.ROOTCA.VSAM.OST.STATAIX.DA)) -
INDEX -
  (NAME(PKISRVD.ROOTCA.VSAM.OST.STATAIX.IX))
IDC0508I DATA ALLOCATION STATUS FOR VOLUME BH6ST5 IS 0
IDC0509I INDEX ALLOCATION STATUS FOR VOLUME BH6ST5 IS 0
IDC0001I FUNCTION COMPLETED, HIGHEST CONDITION CODE WAS 0

DEFINE PATH -
  (NAME(PKISRVD.ROOTCA.VSAM.OST.STATUS) -
   PATHENTRY(PKISRVD.ROOTCA.VSAM.OST.STATAIX))
IDC0001I FUNCTION COMPLETED, HIGHEST CONDITION CODE WAS 0

*Figure 2-6  Step DEFALTDX output*
DEFINE ALTERNATEINDEX -
(NAME(PKISRVD.ROOTCA.VSAM.ICL.STATAIX) -
RELATE(PKISRVD.ROOTCA.VSAM.ICL) -
VOL(BH6ST5) -
TRK(5,1) -
KEYS(40 4) ) -
DATA -
(NAME(PKISRVD.ROOTCA.VSAM.ICL.STATAIX.DA)) -
INDEX -
(NAME(PKISRVD.ROOTCA.VSAM.ICL.STATAIX.IX))
IDC0508I DATA ALLOCATION STATUS FOR VOLUME BH6ST5 IS 0
IDC0509I INDEX ALLOCATION STATUS FOR VOLUME BH6ST5 IS 0
IDC0001I FUNCTION COMPLETED, HIGHEST CONDITION CODE WAS 0

DEFINE PATH -
(NAME(PKISRVD.ROOTCA.VSAM.ICL.STATUS) -
PATHENTRY(PKISRVD.ROOTCA.VSAM.ICL.STATAIX))
IDC0001I FUNCTION COMPLETED, HIGHEST CONDITION CODE WAS 0

DEFINE ALTERNATEINDEX -
(NAME(PKISRVD.ROOTCA.VSAM.OST.REQAIX) -
RELATE(PKISRVD.ROOTCA.VSAM.OST) -
VOL(BH6ST5) -
TRK(5,1) -
KEYS(32 12) ) -
DATA -
(NAME(PKISRVD.ROOTCA.VSAM.OST.REQAIX.DA)) -
INDEX -
(NAME(PKISRVD.ROOTCA.VSAM.OST.REQAIX.IX))
IDC0508I DATA ALLOCATION STATUS FOR VOLUME BH6ST5 IS 0
IDC0509I INDEX ALLOCATION STATUS FOR VOLUME BH6ST5 IS 0
IDC0001I FUNCTION COMPLETED, HIGHEST CONDITION CODE WAS 0

DEFINE PATH -
(NAME(PKISRVD.ROOTCA.VSAM.OST.REQUESTR) -
PATHENTRY(PKISRVD.ROOTCA.VSAM.OST.REQAIX))
IDC0001I FUNCTION COMPLETED, HIGHEST CONDITION CODE WAS 0

DEFINE ALTERNATEINDEX -
(IDCAMS SYSTEM SERVICES
(NAME(PKISRVD.ROOTCA.VSAM.ICL.REQAIX) -
RELATE(PKISRVD.ROOTCA.VSAM.ICL) -
VOL(BH6ST5) -
TRK(5,1) -
KEYS(32 12) ) -
DATA -
(NAME(PKISRVD.ROOTCA.VSAM.ICL.REQAIX.DA)) -
INDEX -
(NAME(PKISRVD.ROOTCA.VSAM.ICL.REQAIX.IX))
IDC0508I DATA ALLOCATION STATUS FOR VOLUME BH6ST5 IS 0
IDC0509I INDEX ALLOCATION STATUS FOR VOLUME BH6ST5 IS 0
IDC0001I FUNCTION COMPLETED, HIGHEST CONDITION CODE WAS 0

DEFINE PATH -
(NAME(PKISRVD.ROOTCA.VSAM.ICL.REQUESTR) -
PATHENTRY(PKISRVD.ROOTCA.VSAM.ICL.REQAIX))
IDC0001I FUNCTION COMPLETED, HIGHEST CONDITION CODE WAS 0

Figure 2-7 Step DEFA LTDX output (continued)
**BLDINDEX**: Builds the alternative indexes, as shown in Figure 2-8.

```
BLDINDEX INDATASET(PKISRVD.ROOTCA.VSAM.OST) -
OUTDATASET(PKISRVD.ROOTCA.VSAM.OST.AIX)
IDC0652I PKISRVD.ROOTCA.VSAM.OST.AIX SUCCESSFULLY BUILT
IDC0001I FUNCTION COMPLETED, HIGHEST CONDITION CODE WAS 0

BLDINDEX INDATASET(PKISRVD.ROOTCA.VSAM.OST) -
OUTDATASET(PKISRVD.ROOTCA.VSAM.OST.STATAIX)
IDC0652I PKISRVD.ROOTCA.VSAM.OST.STATAIX SUCCESSFULLY BUILT
IDC0001I FUNCTION COMPLETED, HIGHEST CONDITION CODE WAS 0

BLDINDEX INDATASET(PKISRVD.ROOTCA.VSAM.ICL) -
OUTDATASET(PKISRVD.ROOTCA.VSAM.ICL.STATAIX)
IDC0652I PKISRVD.ROOTCA.VSAM.ICL.STATAIX SUCCESSFULLY BUILT
IDC0001I FUNCTION COMPLETED, HIGHEST CONDITION CODE WAS 0

BLDINDEX INDATASET(PKISRVD.ROOTCA.VSAM.OST) -
OUTDATASET(PKISRVD.ROOTCA.VSAM.OST.REQAIX)
IDC0652I PKISRVD.ROOTCA.VSAM.OST.REQAIX SUCCESSFULLY BUILT
IDC0001I FUNCTION COMPLETED, HIGHEST CONDITION CODE WAS 0

BLDINDEX INDATASET(PKISRVD.ROOTCA.VSAM.ICL) -
OUTDATASET(PKISRVD.ROOTCA.VSAM.ICL.REQAIX)
IDC0652I PKISRVD.ROOTCA.VSAM.ICL.REQAIX SUCCESSFULLY BUILT
IDC0001I FUNCTION COMPLETED, HIGHEST CONDITION CODE WAS 0
```

*Figure 2-8 Step BLDINDEX output*

**PRTCLUST**: Prints the VSAM data set record, as shown in Figure 2-9.

```
PRINT -
INDATASET(PKISRVD.ROOTCA.VSAM.OST) CHAR
IDCAMS SYSTEM SERVICES
LISTING OF DATA SET -PKISRVD.ROOTCA.VSAM.OST
KEY OF RECORD - ....

IDC0005I NUMBER OF RECORDS PROCESSED WAS 1
IDC0001I FUNCTION COMPLETED, HIGHEST CONDITION CODE WAS 0
IDCAMS SYSTEM SERVICES

PRINT -
INDATASET(PKISRVD.ROOTCA.VSAM.ICL) CHAR
IDCAMS SYSTEM SERVICES
LISTING OF DATA SET -PKISRVD.ROOTCA.VSAM.ICL
KEY OF RECORD - ....

IDC0005I NUMBER OF RECORDS PROCESSED WAS 1
IDC0001I FUNCTION COMPLETED, HIGHEST CONDITION CODE WAS 0
IDCAMS SYSTEM SERVICES

IDC0002I IDCAMS PROCESSING COMPLETE. MAXIMUM CONDITION CODE WAS 0
```

*Figure 2-9 Step PRTCLUST output*
2.1.2 Installing the HTTP Server - Powered by Apache

**Note:** For more information, see the “Installing and configuring IBM HTTP Server on the z/OS V2R2 system” section of Chapter 2 in *IBM HTTP Server - Powered by Apache* SC27-8417.

**Installation process**

Complete the following steps to set up the HTTP server in the environment:

1. Change the directory to `/etc`.
2. Create a directory that is named `websrv1`.
3. Change the permissions for the `websrv1` directory.
4. Change the directory to `/usr/lpp/ihsa_zos/bin`.
5. Install the HTTP server into `wersrv1` directory by using port 80.
6. It is possible that you created `websrv1` with your ID, which makes you the owner. Change the owner of `websrv` and `logs` directories and their contents to `websrv`. The `websrv` user was set up as a user on our system.

**Note:** The `websrv` user ID should exist. Define this user if it was not yet created. Ensure that the home directory of `websrv` points to `/etc/websrv1`, as shown in Example 2-1.

*Example 2-1  Display home directory of user websrv*

```
tso lu websrv noracf omvs
```

USER=WEBSRV

```
OMVS INFORMATION
----------
UID= 0000000345
HOME= /etc/websrv1
PROGRAM= /bin/sh
CPUTIMEMAX= NONE
ASSIZEMAX= NONE
FILEPROCMA= NONE
PROCUSERMAX= NONE
THREADSMAX= NONE
MMAPAREAMAX= NONE
***
```
The commands that are used in the installation process are shown in Figure 2-10.

```
cd /etc
mkdir websrv1
chmod 770 websrv1
cd /usr/lpp/ihsa_zos/bin
install_ihs /etc/websrv1 80
KWRES01:/usr/lpp/ihsa_zos/bin: >install_ihs /etc/websrv1 80
Copying install directory and creating symlinks...
Updating install paths...
cmd: /usr/lpp/ihsa_zos/bin/postinst -i /etc/websrv1 -t install -v PORT=80 -v SERVERNAME=WTSC76.ITSO.IBM.COM

cd /etc/websrv1
chown -R websrv conf
chown -R websrv logs
```

*Figure 2-10  Commands to install the HTTP server into websrv1 directory*

**Verification**

Run the verification commands that are shown in Figure 2-11 to confirm that the installation was successful.

```
KWRES01:/SYSTEM/etc/websrv1/bin: >apachectl -v
Server version: IBM_HTTP_Server/9.0.0.0-PI54808 (Unix)
Server built:   Jan 20 2016 17:19:40
KWRES01:/SYSTEM/etc/websrv1/bin: >apachectl configtest
Syntax OK
```

*Figure 2-11  Verifying the installation*

The base installation into websrv1 is now complete.

### 2.1.3 Using the set up script to create certificates and key rings

In this section, we describe using the set up script to create certificates and key rings for the PKI instance and web server and set up authorization in RACF.

The IKYSETUP REXX procedure creates the certificate, private key, and keyring that are needed for the ROOTCA certificate authority.

**IKYSETUP functions**

The IKYSETUP REXX performs the following steps:

1. Creates users and groups.
2. Allows administrators to access PKI VSAM databases.
3. Creates the CA certificate.
4. Backs up the CA certificate.
5. Marks the CA certificate as HIGHTRUST.
6. Saves the CA certificate to a data set.
7. Creates the RA certificate.
8. Backs up RA certificate.
9. Creates the PKI Services keyring.
10. Creates the Web server SSL certificate and keyring.
11. Saves the web server's root CA certificate to a data set for OPUT.
12. Gives PKISRVD access to BPX.SERVER.
13. Allows the PKI Services daemon to act as a CA.
14. Allows the Web server to access its keyring.
15. Allows the Web server to switch identity to PKISERV.
16. Allows the PKI Services daemon to use ICSF.
17. Creates the STARTED class profile for the daemon.
18. Allows PKISERV to request certificate functions.
19. Creates the profile to protect PKI Admin functions.

Copy the SYS1.SAMPLIB(IKYSETUP) member into the SETUP data set. Modify the REXX procedure to reflect our environment.

Set up the Distinguished Name (DN) of our certificate authority that is defined in Figure 2-12 on page 16. The suffix of this DN must match the suffix that is set up for the LDAP directory (suffix value from the ds.profile file set up in step 2 of “Setting up the LDAP server” on page 31).
The first area to change in the IKYSETUP REXX relates to the CA content. Figure 2-12 shows the REXX procedures before and after the changes. Our changes are marked in bold.

**Before the changes**

```rexx
ca_domain = "" /* @L4A*/
if LENGTH(ca_domain) > 8 then /* @L4A*/
    ca_domain_trunc = LEFT(ca_domain,8) /* @L4A*/
else /* @L4A*/
    ca_domain_trunc = ca_domain /* @L4A*/

OrgUnit = STRIP(ca_domain "Human Resources Certificate Authority") /* @L4A*/
ca_dn= "OU('"||OrgUnit||"')", /* @L4C*/
    "O('Your Company')",
    "C('Your Country 2 Letter Abbreviation')" /* @L4C*/
ca_label = STRIP(ca_domain "Local PKI CA") /* Label for CA certificate with the CA Domain name*/
```

**After the changes**

```rexx
ca_domain = "ROOTCA" /* @L4A*/
if LENGTH(ca_domain) > 8 then /* @L4A*/
    ca_domain_trunc = LEFT(ca_domain,8) /* @L4A*/
else /* @L4A*/
    ca_domain_trunc = ca_domain /* @L4A*/

OrgUnit = STRIP(ca_domain "IBM PKI RedBooks") /* @L4A*/
ca_dn= "OU('"||OrgUnit||"')", /* @L4C*/
    "O('IBM')",
    "C('US')" /* @L4C*/
ca_label = STRIP(ca_domain "ROOTCA PKI CA") /* Label for CA certificate with the CA Domain name*/
```

*Figure 2-12  CA content changes to IKYSETUP*
The next change refers to the Registration Authority (RA). Figure 2-13 shows the before and after values.

**Before the changes**
ra_label = STRIP(ca_domain "Local PKI RA") /*Label for RA Certificate @01C*/

**After the changes**
ra_label = STRIP(ca_domain "PKI RA") /*Label for RA Certificate @01C*/

*Figure 2-13  RA changes*

The Web server DN was also changed. The before and after values are shown in Figure 2-14.

**Before the changes**
web_dn=,
  "CN('www.YourCompany.com')", 
  "O('Your Company')", 
  "L('Your City')", 
  "SP('Your Full State or Province Name')", 
  "C('Your Country 2 Letter Abbreviation')"

**After the changes**
web_dn=,
  "CN('wtsc76.itso.ibm.com')", 
  "O('IBM')", 
  "L('Poughkeepsie')", 
  "SP('New York')", 
  "C('US')"

*Figure 2-14  Web dn changes*

The sample web server protection directives that are supplied by PKI use SSLring for the web server's SAF key ring. The value that is shown in Figure 2-15 is not changed. If the value is changed, the KeyFile directive in the samples/vhost443.conf and samples/vhost1443.conf files must be modified when the web server is configured.

web_ring = "SSLring" /* SAF keyring for web server */

*Figure 2-15  SSLring for web server's SAF keyring*

**Running the IKYSETUP REXX procedure**

Before the IKYSETUP REXX procedure is run, the REXX procedure is reviewed to confirm that it performed as expected by using the **RUN(NO)** option. By using this option, we can see which commands and values are generated without running the commands. Enter the following command:

EX 'PKI.QUICK.SETUP(IKYSETUP)' 'RUN(NO)'

The IKYSETUP REXX writes to a log data set KWRES01.ROOTCA.IKYSETUP.LOG. Examine the contents to ensure that the generated commands are satisfactory. Enter the following command to run the REXX procedure:

EX 'PKI.QUICK.SETUP(IKYSETUP)' 'RUN(YES)'
During execution (with the NO or YES value set), IKYSETUP displays the prompt that is shown in Figure 2-16. A memorable passphrase is required, which is needed if the key must be restored. Enter the passphrase, press Enter, and the processing continues.

```
Creating the CA certificate ...
RACDCERT GENCERT CERTAUTH SUBJECTSDN(OU('ROOTCA IBM PKI RedBooks') O('IBM') C('US')) WITHLABEL('ROOTCA PKI CA') NOTAFTER(DATE(2036/08/15)) SIZE(2048)
```

Enter a passphrase to protect the key. You will need this value later if you need to restore the key.

Attention, the value will be displayed in the screen:

```
```

Figure 2-16  IKYSETUP REXX passphrase prompt

The KWRES01.ROOTCA.IKYSETUP.LOG data set shows all of the generated RACF commands and their results. Near the end of the data set, a section is included that provides information that is needed for the PKI Services UNIX set up, as shown in Figure 2-17 on page 19. This information is used to customize the PKI Services UNIX files. The line that is indicated in bold requires an action.
Information needed for PKI Services UNIX set up:

The daemon user ID is:
PKISRVD

The VSAM high-level qualifier is:
PKISRVD
This is needed for the [ObjectStore] section in pkiserv.conf

The PKI Services' DER encoded certificate is in data set:
'PKISRVD.ROOTCA.CACERT.DERBIN'

The webserver's DER encoded root CA certificate is in data set:
'PKISRVD.ROOTCA.WEBROOT.DERBIN'
This must be OPUT to /var/pkiserv/cacert.der with the BINARY option

The fully qualified PKI Services' SAF keyring is:
PKISRVD/CAring.ROOTCA
This is needed for the [SAF] section in pkiserv.conf

The label of the PKI Services' RA certificate is:
ROOTCA PKI RA
This is needed for the [SAF] section in pkiserv.conf
The PKI Services CA DN is:
OU=ROOTCA IBM PKI RedBooks,O=IBM,C=US
The suffix must match the LDAP suffix in slapd.conf

The PKI Services RA DN is:
CN=Registration Authority,OU=ROOTCA IBM PKI RedBooks,O=IBM,C=US
The suffix must match the LDAP suffix in slapd.conf

The recommended location for the pkiserv.conf and pkiserv.tmpl is:
/etc/pkiserv/ROOTCA

Set the following environment variables in pkiserv.envars:
_PKISERV_CA_DOMAIN=ROOTCA
_PKISERV_CONFIG_PATH=/etc/pkiserv/ROOTCA

Set the following environment variable in your virtual host files:
_PKISERV_CONFIG_PATH_ROOTCA =/etc/pkiserv/ROOTCA

The webserver's SAF keyring is:
SSLring
This is needed for the KeyFile directive in virtual host files

The Webserver's DN is:
CN=wtsc76.itso.ibm.com,O=IBM,L=Poughkeepsie,ST=New York,C=US
The left most RDN must be the webserver's fully qualified domain name
The ROOTCA certificate is saved in the PKISRVD.ROOTCA.WEBROOT.DERBIN data set. The certificate is copied into the UNIX file directory /var/pkiserv for the web page user to download the CA certificate.

OPUT or the following command can be used:

cp "//'PKISRVD.ROOTCA.WEBROOT.DERBIN" /var/pkiserv/cacert.der

Note: The /var/pkiserv directory is specified in the HTTP server configuration.

Configuring the PKI Services UNIX aspects

The sample files are under the sample directory where PKI Services is installed. In our system, the directory is /usr/lpp/pkiserv/samples. Each file's role is listed in Table 2-1.

Table 2-1 UNIX PKI Services sample files

<table>
<thead>
<tr>
<th>Data set</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>pkiserv.conf</td>
<td>The configuration file that contains various settings and values.</td>
</tr>
<tr>
<td>pkiserv.envars</td>
<td>The environmental variables file.</td>
</tr>
<tr>
<td>pkiserv.tmpl</td>
<td>The certificate templates file that is used with REXX CGI executable files.</td>
</tr>
<tr>
<td>expiringmsg.form</td>
<td>The form for an email that is sent to a user when a certificate is going to expire.</td>
</tr>
<tr>
<td>pendingmsg.form</td>
<td>The form for an email that is sent to an administrator when requests are pending approval.</td>
</tr>
<tr>
<td>pendingmsg2.form</td>
<td>The form is your company sends an email notification to an administrator about requests that are approved with modifications.</td>
</tr>
<tr>
<td>readymsg.form</td>
<td>The form for an email that is sent to a user when the PKI Services administrator approves a certificate request and the certificate is ready for retrieval.</td>
</tr>
<tr>
<td>rejectmsg.form</td>
<td>The form for an email that is sent to a user when the PKI Services administrator rejects a certificate request.</td>
</tr>
<tr>
<td>renewcertmsg.form</td>
<td>The form for an email that is sent to a user when PKI Services automatically renews an expiring certificate.</td>
</tr>
<tr>
<td>recoverymsg.form</td>
<td>The form for an email that is sent to a user who requested that PKI Services recover a certificate for which PKI Services generated the key pair.</td>
</tr>
</tbody>
</table>

The form data sets must be configured only if you intend to use them.

2.1.4 Configuring the PKI Services UNIX files

This section describes copying and customizing the supplied UNIX PKI Services files into a directory for our rootca.

Copying the sample files

Create a UNIX rootca directory by issuing the following command:

mkdir /etc/pkiserv/rootca
Copy the supplied PKI Services data sets by issuing the following commands:

- cp -p /usr/lpp/pkiserv/samples/pkiserv.conf /etc/pkiserv/rootca
- cp -p /usr/lpp/pkiserv/samples/pkiserv.tmpl /etc/pkiserv/rootca
- cp -p /usr/lpp/pkiserv/samples/pkiserv.envars /etc/pkiserv/rootca
- cp -p /usr/lpp/pkiserv/samples/*.form /etc/pkiserv/rootca

**Customizing pkiserv.conf**

Change the directory to the rootca and open the data set for edit by issuing the following command:

```bash
cd /etc/pkiserv/rootca
edit pkiserv.conf
```

Customize the VSAM data set names to those names that were defined with job IKYCVSAM by issuing the following command:

```bash
C VSAM ROOTCA.VSAM all
```

The update is shown in Figure 2-18.

```bash
# Data set name of the VSAM request (object store) base CLUSTER
ObjectDSN='pkisrvd.ROOTCA.VSAM.ost'

# Data set name of the VSAM object store PATH for the transaction ID
# (TID) alternate index.
# ObjectTidDSN='pkisrvd.ROOTCA.VSAM.ost.path'

# Data set name of the VSAM object store PATH for the status alternate
# index
# ObjectStatusDSN='pkisrvd.ROOTCA.VSAM.ost.status'

# Data set name of the VSAM object store PATH for the requestor
# alternate index
# ObjectRequestorDSN='pkisrvd.ROOTCA.VSAM.ost.requestr'

# Data set name of the VSAM issued certificate list (ICL) base CLUSTER
# ICLDSN='pkisrvd.ROOTCA.VSAM.icl'

# Data set name of the VSAM ICL PATH for the status alternate index
# ICLStatusDSN='pkisrvd.ROOTCA.VSAM.icl.status'

# Data set name of the VSAM ICL PATH for the requestor alternate index
# ICLRequestorDSN='pkisrvd.ROOTCA.VSAM.icl.requestr'
```

*Figure 2-18  Updated pkiserv.conf VSAM specification*
Change the location of where the messages (the .form data sets that were copied) are to be found by issuing the following command:

```
C /etc/pkiserv/ /etc/pkiserv/rootca all
```

The results are shown in Figure 2-19.

```
# full pathname or data set name containing the 'your certificate is
# ready to be retrieved' message form. Defaults to no message issued
ReadyMessageForm=/etc/pkiserv/rootca/readymsg.form

# full pathname or data set name containing the 'your certificate
# request has been rejected' message form. Defaults to no message issued
RejectMessageForm=/etc/pkiserv/rootca/rejectmsg.form

# full pathname or data set name containing the 'your certificate is
# about to expire' message form. Defaults to no message issued
ExpiringMessageForm=/etc/pkiserv/rootca/expiringmsg.form

# full pathname or data set name containing the request(s) pending for
# approval message form. Defaults to no notification sent.
AdminNotifyForm=/etc/pkiserv/rootca/pendingmsg.form

# full pathname or data set name containing the request(s) approved
# with modifications message form. Defaults to no notification sent.
AdminNotifyModForm=/etc/pkiserv/rootca/pendingmsg2.form

# full pathname or data set name containing the renewed certificate
# message form for automatic certificate renewal.
# If absent, automatic certificate renewal is disabled.
RenewCertForm=/etc/pkiserv/rootca/renewcertmsg.form

# full pathname or data set name containing information on
# the list of certificates that match the criteria specified
# to recover key generated certificates.
# If absent, recovery query results will not be sent.
RecoverForm=/etc/pkiserv/rootca/recoverymsg.form
```

*Figure 2-19  Changed message locations*

The CA Keyring, CA Token, and RA label were changed by issuing the following commands:

```
c CAring CAring.ROOTCA

c pkisrvd.PKIToken pkisrvd.rootca.PKIToken

c 'Local PKI RA' 'ROOTCA PKI RA'
```

The updates are shown in Figure 2-20 on page 23.
Chapter 2. Setting up the Root CA environment

Specify the LDAP server and the admin ID and password that must match the LDAP set up. The values are shown in Figure 2-21.

```
NumServers=1
PostInterval=5m
Server1=wtsc76.itso.ibm.com:390
AuthName1=CN=admin
AuthPwd1=secret
```

*Note:* For the product system, you might not want to make the password available in the configuration file. You can make use of the LDAPBIND class profile. For more information, see the “Storing information for encrypted passwords for your LDAP servers” section of z/OS PKI Services Guide and Reference.

Save the `/etc/pkiserv/rootca/pkiserv.conf` updates and close the file.

**Customizing pkiserv.envars**

The next file that is updated is the environmental variables file. Ensure that you are still in the `/etc/pkiserv/rootca:` directory. Edit `pkiserv.envars` with the domain and path variables updates as shown in the following examples:

```
_PKISERV_CA_DOMAIN=ROOTCA

_PKISERV_CONFIG_PATH=/etc/pkiserv/rootca
```

The updated variables are shown in Figure 2-22.

```
# When running as a CA Domain, set the CA Domain name by assigning
# desired value to the _PKISERV_CA_DOMAIN variable.
# Note: The first eight characters must be unique.
#
# example: _PKISERV_CA_DOMAIN=WebAppCA
_PKISERV_CA_DOMAIN=ROOTCA

# Configuration File location and Message configuration Options
#
_PKISERV_CONFIG_PATH=/etc/pkiserv/rootca
```

*Figure 2-22  Domain and Path information*

Save the updates and close the file.
Customizing pkiserv.tmpl
Edit the sample pkiserv.tmpl file and make the following changes:

- `<APPLICATION NAME=PKISERV>`
  
is changed to
- `<APPLICATION NAME=ADMROOTCA>`
- `<FORM name=admform METHOD=GET ACTION="/PKIServ/ssl-cgi/auth/admmain.rexx ">`
  
is changed to
- `<FORM name=admform METHOD=GET ACTION="/Rootca/ssl-cgi/auth/admmain.rexx ">`
- `<APPLICATION NAME=CUSTOMERS>`
  
is changed to
- `<APPLICATION NAME=ROOTCA>`

Then, change all occurrences of “Customers” to “Rootca”.

Review the pkiserv.tmpl file to learn more about the web application.

Customizing notification forms
All of the form files must be updated next to customize the messages. Use the following list command to identify the form files to be changed.

`ls *.form`

The response to the command is shown in Figure 2-23.

```
KWRES01:/SYSTEM/etc/pkiserv/rootca: >ls *.form
expiringmsg.form pendingmsg2.form recoverymsg.form renewcertmsg.form
pendingmsg.form readymsg.form rejectmsg.form
```

*Figure 2-23   List of .form files*

Edit all the *.form files to customize the domain information. Figure 2-24 on page 25 shows the updated expiringmsg.form with the updated values. The other forms should be similar. Use the following commands to customize the domain information:

```bash
c dime-o-cert 'IBM RB ROOTCA' all
c www.dimeocert.com wtsc76.itso.ibm.com all
c Customers Rootca
```
Chapter 2. Setting up the Root CA environment

2.1.5 Customizing PKISERVD started task

The started task JCL was updated to reflect the rootca environment by completing the following tasks:

1. Copy the start procedure from SYS1.IBM.PROCLIB(PKISERVD) to SYS1.PROCLIB(PKISERVD).
2. Edit DIR='/etc/pkiserv/rootca'.

The web pages and web application are now updated to identify it as the ROOTCA application.

From:IBM RB ROOTCA PKI
Subject:Certificate Expiration

Attention - Please do not reply to this message as it was automatically sent by a service machine.

Dear %requestor%,

Thank you for choosing IBM RB ROOTCA PKI. The certificate you requested for subject %dn% expires at %notafter% local time. If you want to renew your certificate, please visit: http://www.dimeocert.com wtsc76.itso.ibm.com/Rootca/public-cgi/camain.rexx

If this is a browser certificate, you must use the same workstation and browser that you used when you requested the original certificate. If this is a server certificate, you will have to submit a PKCS#10 certificate request.

Figure 2-24  Updated expiration message
The updated procedure is shown in Figure 2-25.

```
//***********************************************************************
//* Licensed Materials - Property of IBM                                 *
//* 5650-ZOS                                                            *
//* Copyright IBM Corp. 2001, 2013                                       *
//* Status=HKY7790                                                      *
//*                                                                       
//* Procedure for starting the PKI Services Daemon                      *
//*                                                                       
//PKISERVD PROC REGSIZE=256M,                                          X
//   OUTCLASS='A',                                                    X
//   TZ='EST5EDT',                                                   X
//   FN='pkiserv.envvars',                                             X
//   DIR='/etc/pkiserv/rootca',                                       X
//   STD0='1>DD:STDOUT',                                               X
//   STDE='2>DD:STDERR'                                               X
//                                                                       
//GO EXEC PGM=IKYPKID,REGION=&REGSIZE,TIME=1440,                       
//  PARM=('ENVAR("_CEE_ENVFILE=&DIR/&FN","TZ=&TZ") / &STDO &STDE')     
//STDOUT DD SYSOUT=&OUTCLASS                                          
//STDERR DD SYSOUT=&OUTCLASS                                         
//SYSOUT DD SYSOUT=&OUTCLASS                                         
//CEEDUMP DD SYSOUT=&OUTCLASS                                       
//                                                                       
//***********************************************************************
```

**Figure 2-25  PKI Services Daemon started task JCL**

### 2.1.6 Configuring the HTTP server for PKI services

This section describes how the HTTP Server - powered by Apache was configured for PKI services.

**Note:** For more information, see Chapter 7 of *Cryptographic Services PKI Services Guide and Reference SA23-2286.*

In section “Installing the HTTP Server - Powered by Apache” on page 13, the process that is used to install the http server is described. The following configuration files are updated to include the PKI Services. PKI Services provides sample virtual host files for non-SSL requests, SSL requests, and SSL requests with client authentication on different ports:

- **httpd.conf:** This file is the main HTTP server configuration file.
- **Virtual host files:**
  - **vhost80.conf:** This file is virtual host file for non-SSL requests.
  - **vhost443.conf:** This file is the virtual host file for SSL requests with server authenticating.
  - **vhost143.conf:** This file is the virtual host file for SSL requests with client authentication.
These files are used by the IP-based virtual hosting feature of the IBM HTTP Server. IP-based virtual hosting is a method to apply different directives that are based on the IP address and port on which a request is received.

**Customizing httpd.conf, vhost80.conf, vhost443.conf, and vhost1443.conf files**

The installation process put the httpd.conf file in /etc/websrv1/conf. The following commands were issued:

```bash
cd /etc/websrv1/conf
oedit httpd.conf
```

**Updating httpd.conf**

Complete the following steps:

1. Find and uncomment the four load modules as shown in Figure 2-26. Although shown together, they are in separate parts of the configuration file.

   ```
   LoadModule alias_module modules/mod_alias.so
   LoadModule rewrite_module modules/mod_rewrite.so
   LoadModule authnz_saf_module modules/mod_authnz_saf.so
   LoadModule ibm_ssl_module modules/mod_ibm_ssl.so
   ```

   **Figure 2-26  Four load modules to uncomment**

2. Add the AddType directives for PKI Services, as shown in Figure 2-27.

   ```
   #
   # AddType allows you to add to or override the MIME configuration
   # file mime.types for specific file types.
   #
   #The following four types are for PKI Services
   AddType application/x-x509-user-cert .cer
   AddType application/x-x509-ca-cert .der
   AddType application/octet-stream .msi
   AddType application/pkix-crl .crl
   ```

   **Figure 2-27  Addtype directives for PKI Services**

3. Add include statements to point to the virtual host files, as shown in Figure 2-28.

   ```
   Include conf/vhost80.conf
   Include conf/vhost443.conf
   Include conf/vhost1443.conf
   ```

   **Figure 2-28 include the virtual host files**

**Updating vhost files**

Copy the vhost files into the /etc/websrv1/conf directory by issuing the following command:

```bash
cp /usr/lpp/pkiserv/samples/vhost*.conf /etc/websrv1/conf
```
Add the following statements for each file as described in the figures’ caption:

- Change the `<application-root>` to the system installation directory. The directory is `/usr/lpp/pkiserv` in our system.
- SetEnv statements that are shown in Figure 2-29
- RewriteRule statements that are shown in Figure 2-30 and Figure 2-31 on page 29

**Note:** If you are not using the default ports 80 and 443, you must include the port number in the URL.

- AliasMatch statements that are shown in Figure 2-33 on page 29

**Note:** If your AliasMatch does not point to `/var/pkiserv`, you must add a corresponding DirectoryMatch section as with the section for `/var/pkiserv`.

- ScriptAlias statements that are shown in Figure 2-34 on page 30
- LocationMatch statements that are shown in Figure 2-35 on page 30

**Note:** We are setting up for all the 3 PKI instances, including ROOOTCA, SUBCA1, and SUBCA2 (not the ROOTCA only).

```bash
SetEnv _PKISERV_CONFIG_PATH_ROOTCA "/etc/pkiserv/rootca"
SetEnv _PKISERV_CONFIG_PATH_ADMROOTCA "/etc/pkiserv/rootca"
SetEnv _PKISERV_CONFIG_PATH_SUBCA1 "/etc/pkiserv/subca1"
SetEnv _PKISERV_CONFIG_PATH_ADMSUBCA1 "/etc/pkiserv/subca1"
SetEnv _PKISERV_CONFIG_PATH_SUBCA2 "/etc/pkiserv/subca2"
SetEnv _PKISERV_CONFIG_PATH_ADMSUBCA2 "/etc/pkiserv/subca2"
```

**Figure 2-29** SETENV statements for vhost80, vhost443, vhost1443

```bash
RewriteRule ^/(AdmRootca|Rootca)/ssl-cgi/(.*) https://wtsc76.itso.ibm.com:1443/$1/ssl-cgi-bin/$2 [R,NE]
RewriteRule ^/(AdmSubca1|Subca1)/ssl-cgi/(.*) https://wtsc76.itso.ibm.com:1443/$1/ssl-cgi-bin/$2 [R,NE]
RewriteRule ^/(AdmSubca2|Subca2)/ssl-cgi/(.*) https://wtsc76.itso.ibm.com:1443/$1/ssl-cgi-bin/$2 [R,NE]
RewriteRule ^/(AdmRootca|Rootca)/clientauth-cgi/(.*) https://wtsc76.itso.ibm.com:1443/$1/clientauth-cgi-bin/$2 [R,NE]
RewriteRule ^/(AdmSubca1|Subca1)/clientauth-cgi/(.*) https://wtsc76.itso.ibm.com:1443/$1/clientauth-cgi-bin/$2 [R,NE]
RewriteRule ^/(AdmSubca2|Subca2)/clientauth-cgi/(.*) https://wtsc76.itso.ibm.com:1443/$1/clientauth-cgi-bin/$2 [R,NE]
```

**Figure 2-30** RewriteRule statements for vhost80
### Chapter 2. Setting up the Root CA environment

#### Figure 2-31 RewriteRule statements for vhost443

<table>
<thead>
<tr>
<th>Rule</th>
<th>URL</th>
<th>Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>RewriteRule ^/(AdmRootca</td>
<td>Rootca)/public-cgi/(.*)</td>
<td><a href="http://wtsc76.itso.ibm.com/$1/public-cgi/$2">http://wtsc76.itso.ibm.com/$1/public-cgi/$2</a> [R,NE,L]</td>
</tr>
<tr>
<td>RewriteRule ^/(AdmSubca1</td>
<td>Subca1)/public-cgi/(.*)</td>
<td><a href="http://wtsc76.itso.ibm.com/$1/public-cgi/$2">http://wtsc76.itso.ibm.com/$1/public-cgi/$2</a> [R,NE,L]</td>
</tr>
<tr>
<td>RewriteRule ^/(AdmSubca2</td>
<td>Subca2)/public-cgi/(.*)</td>
<td><a href="http://wtsc76.itso.ibm.com/$1/public-cgi/$2">http://wtsc76.itso.ibm.com/$1/public-cgi/$2</a> [R,NE,L]</td>
</tr>
<tr>
<td>RewriteRule ^/(AdmRootca</td>
<td>Rootca)/ssl-cgi/(.*)</td>
<td><a href="https://wtsc76.itso.ibm.com/$1/ssl-cgi-bin/$2">https://wtsc76.itso.ibm.com/$1/ssl-cgi-bin/$2</a> [R,NE]</td>
</tr>
<tr>
<td>RewriteRule ^/(AdmSubca1</td>
<td>Subca1)/ssl-cgi/(.*)</td>
<td><a href="https://wtsc76.itso.ibm.com/$1/ssl-cgi-bin/$2">https://wtsc76.itso.ibm.com/$1/ssl-cgi-bin/$2</a> [R,NE]</td>
</tr>
<tr>
<td>RewriteRule ^/(AdmSubca2</td>
<td>Subca2)/ssl-cgi/(.*)</td>
<td><a href="https://wtsc76.itso.ibm.com/$1/ssl-cgi-bin/$2">https://wtsc76.itso.ibm.com/$1/ssl-cgi-bin/$2</a> [R,NE]</td>
</tr>
<tr>
<td>RewriteRule ^/(AdmRootca</td>
<td>Rootca)/clientauth-cgi/(.*)</td>
<td><a href="https://wtsc76.itso.ibm.com:1443/$1/clientauth-cgi-bin/$2">https://wtsc76.itso.ibm.com:1443/$1/clientauth-cgi-bin/$2</a> [R,NE,L]</td>
</tr>
<tr>
<td>RewriteRule ^/(AdmSubca1</td>
<td>Subca1)/clientauth-cgi/(.*)</td>
<td><a href="https://wtsc76.itso.ibm.com:1443/$1/clientauth-cgi-bin/$2">https://wtsc76.itso.ibm.com:1443/$1/clientauth-cgi-bin/$2</a> [R,NE,L]</td>
</tr>
<tr>
<td>RewriteRule ^/(AdmSubca2</td>
<td>Subca2)/clientauth-cgi/(.*)</td>
<td><a href="https://wtsc76.itso.ibm.com:1443/$1/clientauth-cgi-bin/$2">https://wtsc76.itso.ibm.com:1443/$1/clientauth-cgi-bin/$2</a> [R,NE,L]</td>
</tr>
</tbody>
</table>

#### Figure 2-32 RewriteRule statements for vhost1443

<table>
<thead>
<tr>
<th>Rule</th>
<th>URL</th>
<th>Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>RewriteRule ^/(AdmRootca</td>
<td>Rootca)/public-cgi/(.*)</td>
<td><a href="http://wtsc76.itso.ibm.com/$1/public-cgi/$2">http://wtsc76.itso.ibm.com/$1/public-cgi/$2</a> [R,NE,L]</td>
</tr>
<tr>
<td>RewriteRule ^/(AdmSubca1</td>
<td>Subca1)/public-cgi/(.*)</td>
<td><a href="http://wtsc76.itso.ibm.com/$1/public-cgi/$2">http://wtsc76.itso.ibm.com/$1/public-cgi/$2</a> [R,NE,L]</td>
</tr>
<tr>
<td>RewriteRule ^/(AdmSubca2</td>
<td>Subca2)/public-cgi/(.*)</td>
<td><a href="http://wtsc76.itso.ibm.com/$1/public-cgi/$2">http://wtsc76.itso.ibm.com/$1/public-cgi/$2</a> [R,NE,L]</td>
</tr>
<tr>
<td>RewriteRule ^/(AdmRootca</td>
<td>Rootca)/ssl-cgi/(.*)</td>
<td><a href="https://wtsc76.itso.ibm.com/$1/ssl-cgi-bin/$2">https://wtsc76.itso.ibm.com/$1/ssl-cgi-bin/$2</a> [R,NE,L]</td>
</tr>
<tr>
<td>RewriteRule ^/(AdmSubca1</td>
<td>Subca1)/ssl-cgi/(.*)</td>
<td><a href="https://wtsc76.itso.ibm.com/$1/ssl-cgi-bin/$2">https://wtsc76.itso.ibm.com/$1/ssl-cgi-bin/$2</a> [R,NE,L]</td>
</tr>
<tr>
<td>RewriteRule ^/(AdmSubca2</td>
<td>Subca2)/ssl-cgi/(.*)</td>
<td><a href="https://wtsc76.itso.ibm.com/$1/ssl-cgi-bin/$2">https://wtsc76.itso.ibm.com/$1/ssl-cgi-bin/$2</a> [R,NE,L]</td>
</tr>
</tbody>
</table>

#### vhost80

The AliasMatch statements are for the CRL, as shown in Figure 2-33.

<table>
<thead>
<tr>
<th>Rule</th>
<th>URL</th>
<th>Path</th>
</tr>
</thead>
<tbody>
<tr>
<td>AliasMatch /rootca/crls/(.*)</td>
<td>/var/pkiserv/rootca/$1</td>
<td></td>
</tr>
<tr>
<td>AliasMatch /subca1/crls/(.*)</td>
<td>/var/pkiserv/subca1/$1</td>
<td></td>
</tr>
<tr>
<td>AliasMatch /subca2/crls/(.*)</td>
<td>/var/pkiserv/subca2/$1</td>
<td></td>
</tr>
</tbody>
</table>

#### Figure 2-33 AliasMatch to be added to vhost80 only
Figure 2-34  ScriptAliasMatch statements

LocationMatch statements are added for vhost443 and vhost1443 only, as shown in Figure 2-35.

Figure 2-35  LocationMatch statements for vhost443 and vhost1443
Customizing the IHSSRVER started task

Copy the HTTP server started procedure from the sample job in the HTTP samp1ib. Our procedure is in HAP.SHAPJCL3(HAPCPROC). Copy it to SYS1.PROCLIB(IHSSRVER).

Update the directory set up for web server, as shown in the following example:

```bash
DIR='/etc/websrv1',
```

The started task is shown in Figure 2-36.

```bash
//*---------------------------------------------------------
// IHSSRVER  PROC ACTION='start',  
//          DIR='/etc/websrv1', 
//          CONF='conf/httpd.conf' 
//*---------------------------------------------------------
// IHS  EXEC PGM=BPXBATCH, 
//      PARM='SH &DIR/bin/apachectl -k &ACTION -f &CONF -DNO_DETACH', 
//      MEMLIMIT=512M 
// STDOUT DD  PATH='&DIR/logs/proc.output', 
//           PATHOPTS=(OWRONLY,OCREAT,OTRUNC), 
//           PATHMODE=(SIRUSR,SIWUSR,SIRGRP,SIWGRP) 
// STDERR DD  PATH='&DIR/logs/proc.errors', 
//           PATHOPTS=(OWRONLY,OCREAT,OTRUNC), 
//           PATHMODE=(SIRUSR,SIWUSR,SIRGRP,SIWGRP) 
//* SYSMDUMP DD ... 
//  PEND 
//* ===================================================================== */
// PROPRIETARY-STATEMENT: */ 
// Licensed Material - Property of IBM */ 
// */ 
// 5724-I63, 5724-H88, 5655-N01, 5733-W61, 5655-M23 */ 
// (C) Copyright IBM Corp. 2006 */ 
// All Rights Reserved */ 
// US Government Users Restricted Rights - Use, duplication or */ 
// disclosure restricted by GSA ADP Schedule Contract with IBM Corp.*/ 
//* ===================================================================== */
```

Figure 2-36  IHSSRVER started task procedure

Define the IHSSRV started task to RACF by issuing the following commands:

```bash
RDEFINE STARTED IHSSRV** STDATA(USER(WEBSRV))
SETROPTS RACLIST(STARTED) GENERIC(STARTED) REFRESH
```

2.1.7 Setting up the LDAP server

The LPAP is used to maintain information about PKI Services certificates in a centralized location. The z/OS LDAP server was configured by using LDBM (file-based backend). No IBM DB2® is required.

Note: For more information about setting up the LDAP server, see Chapter 3 of Cryptographic Services PKI Services Guide and Reference SA23-2286.
Complete the following steps to set up and configure the LDAP server:

1. Copy ds.profile from /usr/lpp/ldap/etc to the home directory by using the following command:

   `cp /usr/lpp/ldap/etc/ds.profile /u/kwres01/ds.profile`

2. Update it after /usr/lpp/ldap/examples/sample_server/ds.README, with the following information:

   - `LDBM_SUFFIX="o=The Firm"` (To enable the one year browser certificate be posted because it was created by using organization=The Firm)
   - `LDBM_SUFFIX="c=us"` (To enable the ROOTCA, SUBCA1, and SUBCA2 certificates to be posted because they were created by using country=us)

   ```
   OUTPUT_DATASET = LDAPCFG.GLD.CNFOUT
   OUTPUT_DATASET_VOLUME = BH6CAT
   LDBM_DATABASEDIRECTORY =/var/ldap/ldbm
   SCHEMAPATH=/var/ldap/schema
   ADMINDN=cn=Admin
   ADMINPW=secret
   PROG_SUFFIX = XX
   APF_JOBCARD_1 = //LDAPAPF JOB MSGCLASS=H,NOTIFY=&SYSUID,
   APF_JOBCARD_2 = // MSGLEVEL=(1,1),CLASS=A
   PRGCTRL_JOBCARD_1 = //LDAPPC JOB MSGCLASS=H,NOTIFY=&SYSUID,
   PRGCTRL_JOBCARD_2 = // MSGLEVEL=(1,1),CLASS=A
   DB2_JOBCARD_1 =//LDAPDB2 JOB MSGCLASS=H,NOTIFY=&SYSUID,
   DB2_JOBCARD_2 = // MSGLEVEL=(1,1),CLASS=A
   RACF_JOBCARD_1 = //LDAPRACF JOB MSGCLASS=H,NOTIFY=&SYSUID,
   RACF_JOBCARD_2 = // MSGLEVEL=(1,1),CLASS=A
   ```

3. Run the dsconfig utility under /usr/lpp/ldap/sbin by using the following command:

   `/usr/lpp/ldap/sbin/dsconfig -i /u/kwres01/ds.profile`

4. Open the LDAPCFG.GLD.CNFOUT data set:

   a. Submit the job in the RACF member. The job defines all of the RACF information for the LDAP server.
   b. Submit the job in the APF member. A PROG member for the data sets to APF Authorize is in LDAPCFG.GLD.CNFOUT. Before submitting this job, this PROG member must be moved to the PARMLIB. To make the APF changes permanent, the PROG member must be added to the APF list that was created at IPL time.

5. Set up the started task by copying LDAPCFG.GLD.CNFOUT(GLDSRV) to SYS1.PROCLIB(GLDSRV).
6. Update LDAPCFG.GLD.CNFOUT(DSCONFIG) with listen ldap://:390.
7. Start the ldap server by using the -S GLDSRV command.
8. Add the schema that is needed by PKI by issuing the following commands:
   \[ \text{ldapmodify -h wtsc76.itso.ibm.com -p 390 -D cn=admin -w secret -f /usr/lpp/ldap/etc/schema.user.ldif} \]
   \[ \text{ldapmodify -h wtsc76.itso.ibm.com -p 390 -D cn=admin -w secret -f /usr/lpp/ldap/etc/schema.IBM.ldif} \]
9. Add a member to LDAPCFG.GLD.CNFOUT(SUFFIX), as shown in Figure 2-37.

```
   dn: c=us
   objectclass: top
   objectclass: country
   c: us

   dn: o=The Firm
   objectclass: top
   objectclass: organization
   o: The Firm
```

**Figure 2-37 LDAPCFG.GLD.CNFOUT member SUFFIX**

10. Run the ldapadd command to add the suffix by specifying the following information:

```
    ldapadd -h wtsc76.itso.ibm.com -p 390 -D cn=admin -w secret -f "'ldapcfg.gld.cnfout(suffix)'"
```

11. Verify that the suffix was added by specifying the following information:

```
    ldapsearch -h wtsc76.itso.ibm.com -p 390 -D cn=admin -w secret -b "o=The Firm"
    "objectclass=*"
```

   The response is shown in Figure 2-38.

```
   o=The Firm
   objectclass=top
   objectclass=organization
   o=The Firm
```

**Figure 2-38 LDAP suffix verification**

**Note:** For the production system, you might not want to make the LDAP password available in the configuration file after the initial setup.

For more information, see this website:

https://ibm.biz/Bdr3fE
2.1.8 Preparing ROOTCA for use

Complete the following steps to prepare to start the rootca:

1. Start the rootca by using the following command:
   
s pkiservd,jobname=rootca,dir='/etc/pkiserv/rootca'
   
   (or just s pkiservd,jobname=rootca)

2. Modify the ACL entry for CRL (which has critical attribute) so that any user can see the CRL:
   a. Create a file that is named changeacl.ldif with the content that is shown in Figure 2-39.

   Figure 2-39   ACL entry modifications

   
   | dn: OU=ROOTCA ITSO PKI Redbooks,O=IBM,C=US |
   | changetype: modify |
   | aclentry: group:cn=anybody:normal:rsc:system:rsc:critical:rsc |

   b. Issue the following command:

   "ldapmodify -h wtsc76.itso.ibm.com -p 390 -D cn=admin -w secret -f changeacl.ldif"

3. Start the HTTP server by specifying the $IHSSERVER command.
2.1.9 Enabling ROOTCA for use from the browser

Complete the following steps:

1. Enter the http://wtsc76.itso.ibm.com/Rootca/public-cgi/camain.rexx URL into a browser and the window that is shown in Figure 2-40 opens.

   ![PKI Services Certificate Generation Application](image)

   *Figure 2-40   PKI Services Certificate Generation Application*

   2. Click **Install Certificate** to enable SSL sessions for PKI Services.

   **Note:** You are accessing the rootca certificate that is in `/var/pkiserv`, which is specified in `vhost80.conf`. 
3. The window that is shown in Figure 2-41 opens. The certificate must be installed in the Trusted Root certificate Authorities store. Select **Install Certificate**.

*Figure 2-41  Certificate store*

4. Follow the wizard through to completion.

The certificates are successfully placed in the Trusted Root Certification Authorities store.
Setting up SUBCA1 and SUBCA2 under ROOTCA

This chapter describes how to set up the intermediate CAs SUBCA1 and SUBCA2 and includes the following topics:

- “Creating SUBCA1 certificate request” on page 38
- “Creating SUBCA1 certificate request” on page 38
- “Retrieving SUBCA1 certificate” on page 43
- “Adding the SUBCA1 certificate to RACF” on page 45
- “Creating and customizing the UNIX files for SUBCA1” on page 47
- “Creating the VSAM data sets for SUBCA1” on page 49
- “Creating certificate, key ring, and authorization for SUBCA1” on page 49
- “Starting SUBCA1” on page 50
- “SUBCA2 set up” on page 53
3.1 SUBCA1 set up

The first intermediate certificate authority that is set up is named subca1. As an intermediate certificate authority, the digital certificate that is representing the SUBCA1 CA is digitally signed by the root certificate authority.

We must establish the chain of trust. If the root certificate authority is trusted, any certificates that are issued by the Intermediate also are trusted.

All of the ROOTCA configurations are used as the base for SUBCA1.

3.1.1 Creating SUBCA1 certificate request

Complete the following steps to create the PKCS#10 request by using the RACF RACDCERT commands:

1. Use the ISPF command shell to issue the following RACDCERT GENCERT command, which generated a certificate and a public and private key pair (the created certificate is not used, only the key pair is used going forward):

   ```
   RACDCERT CERTAUTH GENCERT SUBJECTSDN(OU('SUBCA1 ITSO PKI Red Book') O('IBM') C('US')) WITHLABEL('SUBCA1 PKI CA')
   ```

2. Create the PKCS#10 certificate request by using RACDCERT GENREQ. Use the public and private key pair that was created in the previous step. The request is to be saved in the PKISRVD.SUBCA1.REQ data set. On the ISPF command shell, enter the following command:

   ```
   RACDCERT CERTAUTH GENREQ(LABEL('SUBCA1 PKI CA')) DSN('PKISRVD.SUBCA1.REQ')
   ```
3.1.2 Requesting the SUBCA1 certificate to be signed by ROOTCA

SUBCA1 must make a request to the Rootca. Enter the following URL in a browser:

http://wtsc76.itso.ibm.com/Rootca/public-cgi/camain.rexx

Figure 3-1 shows the page that is displayed. Choose 5-Year PKI Intermediate CA Certificate from the drop-down list and then, click Request Certificate.

![Figure 3-1 Intermediate CA certificate application](image-url)
You are prompted to enter information about the certificate, as shown in Figure 3-2.

![5-Year PKI Intermediate CA Certificate](image)

**Figure 3-2** Top part of 5-Year PKI Intermediate CA Certificate form

Although most fields on this page are optional, the Pass phrase for securing this request field must be completed.

**Note:** Enter and remember a meaningful pass phrase. The pass phrase is used later to retrieve the digital certificate that was created by PKI services.
3. Scroll down the web page and see that to complete the certificate request, you must enter a Base64 encoded PKCS#10 certificate request, as shown in Figure 3-3.

![Figure 3-3 PKCS#10 option](image)

This information is needed because a CA certificate is being requested. CA certificates for z/OS PKI Services are required to be in RACF.

**Note:** Do not submit the certificate request or close browser window. We return to this window later in the process.
4. Open the data set **PKISRVD.SUBCA1.REQ**, which was created in “Creating SUBCA1 certificate request” on page 38. The content is shown in Figure 3-4.

```
-----BEGIN NEW CERTIFICATE REQUEST-----
MIIC0zCCAbpCAQAwPTELMAkGA1UEBhMCVMxOgNVBAMTA01CTTEgMB4GA1UE
CzXMU1VCCQExEIEfTSBSQSkqUmVqMgMwHwYDVR0AMBBBDAEFdBgNVHSAkRGFp
DwAwggEKAoIBAQCCqRy97NEPzLiatXJ3PvLF03XXXV7j/c0u6IdIgoFiedvnZwQL
iu2ktxCDJK1U1uYALQx70Ohhw4w5JFlBoRpdqgbfx901sT4/cX66wFJ2kYzE
D90sST/VpMo0CvJh/c/r2q9/kd6huXVPIy5HVB8Y6X00fsZVPW6unI0KHUNQzC0W
weVoYuthcd5I8KVM+j7Hrzn8xtrzqJKcyIeddb9GVLmvpGe36CLPXnToF+9qB15Z
tf7n2BEePrSBv+pgyzNvaiWXFW/gLbqN2wwUT1P7GZxiuAHBSzZ3H7FbgGAyxC
NO/a1OKPemcT4Y6jqr09CI9uI5V遂4s1OAgMBAAAGgUTBPiXmqorki96w8BCQ4x
QJ5MBMF0GAIUdDqQQ6Q6eG6G0IhqqD18ZVFG9g1zhHFDAPB9VNRHMBAfBEBTAS
AQH/MA4GAIUdDwE9wAEWIBbJANBqkhqiG9vBAQsFAAOC9EAB17I7EQMnMC2
5NyY4S6z2MfWEYNOF0nIztc1qfD6t2V91iImPTafW130esz2JMPsglpTdbvW9
ehQaqv27K8hGrtc1n2iF00RQVQHFM3F0CaeyebXquf8z1iKvfbFXPLBHYQyAqKr9
D5xKx4ef10A/jR/JYOMOKUJcb7L46Hvbm1ar3LxvG6K0FYj92gfpznBqTbwZ
22w6AiaadboO8rvMc7aTT41mRvnx15jIFSY8B6pB1ZIFQrKj3q6s0e1T21i1nC
qKuCG9hd4c0owoBSk/UFTOTMGB3CXeuNRYPWSa+5z63msP44+fWlOJatdBsWRO+5
vbo5/7XHAR==
-----END NEW CERTIFICATE REQUEST-----
```

*Figure 3-4  Contents of PKCS#10 certificate request in Base64 format*

5. Select the contents of the certificate request, including the comment lines at the top and bottom of the window. Select **Copy** from the toolbar.

6. Return to the web browser, where the request form for the 5-year PKI intermediate CA certificate should be still open. Paste the PKCS#10 request in the provided field, as shown in Figure 3-3 on page 41.

Do not complete any other information in the optional fields of the web form.

*Note: Entering information into the optional fields on the web form overrides the information in the PKCS#10 file.*

7. Click **Submit certificate request** to complete request. A page opens in which it is confirmed the request was submitted successfully, as shown in Figure 3-5.

*Figure 3-5  Request submitted successfully*
Chapter 3. Setting up SUBCA1 and SUBCA2 under ROOTCA

The default configuration of PKI Services is to automatically approve all intermediary certificate requests and to generate all pending certificates every 3 minutes. By using this configuration, you can retrieve your certificate after the next scheduled update.

3.1.3 Retrieving SUBCA1 certificate

To retrieve the certificate, return to main user page by using the following URL (see Figure 3-6):

http://wtsc76.itso.ibm.com/Rootca/public-cgi/camain.rexx

![PKI Services Certificate Generation Application main page](image)

**Figure 3-6**  PKI Services Certificate Generation Application main page

Complete the following steps:

1. Under Pick up a previously requested certificate, enter the assigned transaction ID that you received in 3.1.2, “Requesting the SUBCA1 certificate to be signed by ROOTCA” on page 39.

2. Select **PKI Server certificate** from the drop-down menu.

**Note:** Record the transaction ID because it is required to retrieve the digital certificate along with the pass phrase that was defined in the request.
3. Click **Pick up certificate**.
   The window that opens is shown in Figure 3-7.

![Retrieve Your PKI Server Certificate window](image)

**Retrieve Your PKI Server Certificate**

Please bookmark this page

Since your certificate may not have been issued yet, we recommend that you create a bookmark to this location so that when you return to this ID, this is the easiest way to check your status.

Enter values for the following field(s)

Enter the assigned transaction ID

[Transaction ID]

If you specified a pass phrase when submitting the certificate request, type it here, exactly as you typed it on the request form

[Pass phrase]

Continue

Home Page

email: webmaster@your-company.com

Figure 3-7  Retrieve Your PKI Server Certificate window

4. Enter the pass phrase that you used for the certificate request and click **Continue**.
   If the certificate was not yet issued, the PKI Services web application returns the error message that is shown in Figure 3-8.

![Request was not successful](image)

**Request was not successful**

Please correct the problem or report the error to your Web admin person

INV1002I SAF Service IRRSPF00 Returned SAF RC - 6 RACF RC - 6 RACF RSN - 56
Request is still pending approval or yet to be issued

Home Page

email: webmaster@your-company.com

Figure 3-8  Request is yet to be issued

If this error is shown, wait for a few minutes and then, try again.
Chapter 3. Setting up SUBCA1 and SUBCA2 under ROOTCA

3.1.4 Adding the SUBCA1 certificate to RACF

Complete the following steps to add the SUBCA1 certificate to the RACF database:

1. Copy the certificate from the browser. Ensure that the complete certificate is copied, including the comment lines.
2. Return to the 3270 emulation and open the 3.4 data set list utility.
3. Copy the PKISRVD.SUBCA1.REQ data set by entering a “/” character (without the quotes) in front of the data set and selecting option 17 - copy.
4. Choose a new data set name PKISRVD.SUBCA1.CRT.
5. Open PKISRVD.SUBCA1.CRT in edit mode and delete its content.
6. Paste the certificate from the PKI services web page as shown in Figure 3-10 on page 46 and Figure 3-11 on page 46. Make sure to copy the entire certificate, which might require more than one paste to the data set (depending on how many lines you can see on the 3270 panel). Use the paste next function if your emulator supports it.
7. Save the data set and then, go to the ISPF command shell. Enter the following command to add the certificate to RACF without specifying the label. It is added under the original label SUBCA1 PKI CA:

```
RACDCERT CERTAUTH ADD('PKISRVD.SUBCA1.CRT')
```

8. To review this certificate, enter the following command:

```
RACDCERT CERTAUTH LIST(label('SUBCA1 PKI CA'))
```

The response is shown in Figure 3-12 on page 47.
Chapter 3. Setting up SUBCA1 and SUBCA2 under ROOTCA

3.1.5 Creating and customizing the UNIX files for SUBCA1

The intermediate certificate authority is set up by using the same base infrastructure as the root CA. The web server and LDAP setup from the previous chapter is used.

In this section, we describe the process that was used to create the new PKI services certificate authority.

Creating Subca1 directory

From your 3270 emulation ISPF, go to the ISPF command shell (option 6) and enter OMVS. After you are in UNIX System Services, complete the following steps:

1. Browse to the following PKI directory:
   cd /etc/pkiserv
2. Create a directory that is named subca2 by using the following command:
   mkdir subca1
3. Copy the contents of rootca to subca1. The following copied files are then customized for subca1:
   cp -p /etc/pkiserv/rootca/pkiserv.conf /etc/pkiserv/subca1
   cp -p /etc/pkiserv/rootca/pkiserv.tmpl /etc/pkiserv/subca1
   cp -p /etc/pkiserv/rootca/pkiserv.envvars /etc/pkiserv/subca1
   cp -p /etc/pkiserv/rootca/*.*.form /etc/pkiserv/subca1

---

**Figure 3-12** Listing of SUBCA1 PKI CA digital certificate in RACF

The intermediate certificate for SUBCA1 is generated, signed by the Root CA (see Issuers' name), and is now in RACF.
Customizing pkiserv.conf for Subca1
Complete the following steps:
1. Open the pkiserv.conf file by using the following command (the file contains the configuration setting for PKI Services):
   
   oedit pkiserv.conf

2. Change all occurrences of rootca to subca1. Notice that upper and lowercase letters are used in different places.
3. Save and close pkiserv.conf.

Customizing pkiserv.tmpl for Subca1
Complete the following steps:
1. Open the pkiserv.tmpl file by using the following command (this file contains the templates that are used to build the HTML windows and forms that are used in the web pages):
   
   oedit pkiserv.tmpl

2. Change all occurrences of rootca to subca1. Notice that upper and lowercase letters are used in different places.
3. Save pkiserv.tmpl.

Customizing pkiserv.envars for Subca1
The steps are as follows:
1. Open the pkiserv.envars file by using the following command (this file contains the Subca1 environmental variable for PKI services):
   
   oedit pkiserv.envars

2. Change all occurrences of rootca to subca1. Notice that upper and lowercase letters are used in different places.
3. Save and close pkiserv.envars.

Customizing *.forms for Subca1
Edit all of the *.form files to customize the domain information. Change all occurrences of rootca to subca1. Notice that upper and lowercase letters are used in different places.

Changing the file owner
Complete the following steps:
1. Check the file permission bits and owner of the configuration files by using the following command:

   ls -lt

   You can see that all files belong to the user ID that copied the files from rootca. This status must be changed so that the task that is started later can pick up the files (PKISRVD is our STC user for the PKI services daemon started task).

2. Change the file owner to PKI Services daemon user ID PKISRVD by using the following command:

   chown PKISRVD *.*
3.1.6 Creating the VSAM data sets for SUBCA1

In “Defining the ROOTCA VSAM data sets” on page 7, the job IKYCVSAM was copied from SYS1.SAMPLIB to your set up data set to create the VSAM files for the root CA. Copy this data set and make the following edits:

- Change the job name.
- Issue the `c ROOTCA SUBCA1 all` change command.

Submit the job. The SUBCA1 VSAM data sets are shown in Figure 3-13.

```
PKISRVD.SUBCA1.VSAM.ICL.DA
PKISRVD.SUBCA1.VSAM.ICL.IX
PKISRVD.SUBCA1.VSAM.ICL.REQAIX
PKISRVD.SUBCA1.VSAM.ICL.REQAIX.DA
PKISRVD.SUBCA1.VSAM.ICL.REQAIX.IX
PKISRVD.SUBCA1.VSAM.ICL.REQUESTR
PKISRVD.SUBCA1.VSAM.ICL.STATAIX
PKISRVD.SUBCA1.VSAM.ICL.STATAIX.DA
PKISRVD.SUBCA1.VSAM.ICL.STATAIX.IX
PKISRVD.SUBCA1.VSAM.ICL.STATUS
PKISRVD.SUBCA1.VSAM.OST
PKISRVD.SUBCA1.VSAM.OST.AIX
PKISRVD.SUBCA1.VSAM.OST.AIX.DA
PKISRVD.SUBCA1.VSAM.OST.AIX.IX
PKISRVD.SUBCA1.VSAM.OST.DA
PKISRVD.SUBCA1.VSAM.OST.IX
PKISRVD.SUBCA1.VSAM.OST.PATH
PKISRVD.SUBCA1.VSAM.OST.REQAIX
PKISRVD.SUBCA1.VSAM.OST.REQAIX.DA
PKISRVD.SUBCA1.VSAM.OST.REQAIX.IX
PKISRVD.SUBCA1.VSAM.OST.REQUESTR
PKISRVD.SUBCA1.VSAM.OST.STATAIX
PKISRVD.SUBCA1.VSAM.OST.STATAIX.DA
PKISRVD.SUBCA1.VSAM.OST.STATAIX.IX
PKISRVD.SUBCA1.VSAM.OST.STATUS
```

Figure 3-13  SUBCA1 VSAM data sets list

3.1.7 Creating certificate, key ring, and authorization for SUBCA1

Because most of the set-up steps were done for ROOTCA through IKYSETUP, we do not need to run IKYSETUP again for SUBCA1. Only profiles that are specific for SUBCA1 must be created. Complete the following steps to create the RACF key ring for SUBCA1 and connect the corresponding certificates to the key ring (the PKI user ID also is authorized to use the new domain):

1. Create a Registration Authority (RA) certificate with digital certificate that is signed by subca1, as shown in the following example:

   ```
   RACDCERT ID(PKISRVD) GENCERT SUBJECTSDN(CN('Registration Authority') OU('SUBCA1 ITSO PKI Red Book') 0('IBM') C('US')) KEYUSAGE(HANDSHAKE) SIGNWITH(CERTAUTH LABEL('SUBCA1 PKI CA')) NOTAFTER(DATE(2020/11/19)) WITHLABEL('SUBCA1 PKI RA')
   ```
2. Create the PKI Services key ring for SUBCA1 and connect the CA and RA certificates to it by issuing the following commands:

RACDCERT ADDRING(CAring.SUBCA1) ID(PKISRVD)

RACDCERT ID(PKISRVD) CONNECT(CERTAUTH LABEL('SUBCA1 PKI CA') RING(CAring.SUBCA1) USAGE(PERSONAL) DEFAULT)

RACDCERT ID(PKISRVD) CONNECT(LABEL('SUBCA1 PKI RA') RING(CAring.SUBCA1) USAGE(PERSONAL))

RACDCERT ID(PKISRVD) CONNECT(CERTAUTH LABEL('ROOTCA PKI CA') RING(CAring.SUBCA1))

3. List the content of the ring by issuing the following command. The response is shown in Figure 3-14:

RACDCERT ID(PKISRVD) LISTRING(CAring.SUBCA1)

<table>
<thead>
<tr>
<th>Certificate Label</th>
<th>Cert Owner</th>
<th>USAGE</th>
<th>DEFAULT</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUBCA1 PKI CA</td>
<td>CERTAUTH</td>
<td>PERSONAL</td>
<td>YES</td>
</tr>
<tr>
<td>SUBCA1 PKI RA</td>
<td>ID(PKISRVD)</td>
<td>PERSONAL</td>
<td>NO</td>
</tr>
</tbody>
</table>

Figure 3-14  SUBCA1 CAring response

4. Use the following definitions to allow the PKI Services user ID PKISERV to request certificate functions:

RDEFINE FACILITY IRR.RPKISERV.*.SUBCA1
PERMIT IRR.RPKISERV.*.SUBCA1 CLASS(FACILITY) ID(PKISERV) ACCESS(CONTROL)

5. Create the profile to protect PKI Admin functions by issuing the following commands:

RDEFINE FACILITY IRR.RPKISERV.PKIADMIN.SUBCA1
PERMIT IRR.RPKISERV.PKIADMIN.SUBCA1 CLASS(FACILITY) ID(PKIGRP) ACCESS(UPDATE)
PERMIT IRR.RPKISERV.PKIADMIN.SUBCA1 CLASS(FACILITY) ID(PKISERV) ACCESS(NONE)
SETROPTS RACLIST(FACILITY) REFRESH

6. Connect the SUBCA1 PKI CA certificate to the HTTP server key ring by using the following commands:

RACDCERT ID(WEBSRV) CONNECT(CERTAUTH LABEL('SUBCA1 PKI CA') RING(SSLring))

3.1.8 Starting SUBCA1

Complete the following steps to start the SUBCA1 domain:

1. Issue the following command to start SUBCA1:

s pkiservd,jobname=subca1,dir="/etc/pkiserv/subca1"

2. Complete the following steps to modify the ACL entry for CRL (which includes a critical attribute) so that any user can see the CRL:

a. Create a file that is named changeacl.ldif that includes the content that is shown in Figure 3-15 on page 51.
b. Issue the following command:

```
ldapmodify -h wtsc76.itso.ibm.com -p 390 -D cn=admin -w secret -f changeacl.ldif
```

3. Stop and restart the HTTP server to pick up the update on the SSLring keyring by using the following commands:

```
S IHSSRVER,ACTION='STOP'
S IHSSRVER
```

4. Enter the URL http://wtsc76.itso.ibm.com/Subca1/public-cgi/camain.rexx into a browser and the window that opens is shown in Figure 3-16.

```
dn: OU=SUBCA1 ITSO PKI Red Book,O=IBM,C=US
changetype: modify
aclentry: group:cn=anybody:normal:rsc:system:rsc:critical:rsc
```

Figure 3-15 ACL entry modifications

Figure 3-16 SUBCA1 User page
5. Test the admin page by using the following URL:

   http://wtsc76.itso.ibm.com/AdmSubca1/public-cgi/camain.rexx

   The window that opens is shown in Figure 3-17.

**Figure 3-17  SUBCA1 admin start page**

**SUBCA1 PKI Administrators Start Page**

*Install the CA certificate to enable SSL sessions for PKI Services*

*Choose one of the following:*

*Manage existing certificates and certificate requests*

[Administration Page]

*Go to the Subca1's requestor home page*

[Subca1's requestor's Home Page]

*email: webmaster@your-company.com*


### 3.2 SUBCA2 set up

The SUBCA2 set-up is the same as SUBCA1. Follow the same steps and change all of the SUBCA1 references to SUBCA2.

Access SUBCA2 User page by using the following URL:

http://wtsc76.itso.ibm.com/Subca2/public-cgi/camain.rexx

The page that opens is shown in Figure 3-18.

![SUBCA2 User page](Figure 3-18)

#### PKI Services Certificate Generation Application

*Install the CA certificate to enable SSL sessions for PKI Services*

*Choose one of the following:*

- **Request a new certificate using a model**

  Select the certificate template to use as a model
  
  ![Select certificate template](Select the certificate template to use as a model)

  ![Request Certificate](Request Certificate)

- **Pick up a previously requested certificate**

  Enter the assigned transaction ID

  ![Enter assigned transaction ID](Enter the assigned transaction ID)

  Select the certificate return type

  ![Select certificate return type](Select certificate return type)

  ![Pick up Certificate](Pick up Certificate)

- **Renew or revoke a previously issued browser certificate**

  ![Renew or Revoke Certificate](Renew or Revoke Certificate)

- **Recover a previously issued certificate whose key was generated by PKI Services**

  ![Recover Certificate](Recover Certificate)

*email: webmaster@your-company.com*
SUBCA2 User also can be accessed by using the following URL:
http://wtsc76.itso.ibm.com/AdmSubca2/public-cgi/camain.rexx

The page that opens is shown in Figure 3-19.

![SUBCA2 PKI Administrators Start Page](image)

**SUBCA2 PKI Administrators Start Page**

*Install the CA certificate to enable SSL sessions for PKI Services*

**Choose one of the following:**

- Manage existing certificates and certificate requests

  ![Administration Page](image)

- Go to the Subca2's requestor home page

  ![email: webmaster@your-company.com](image)

*Figure 3-19  SUBCA2 admin start page*

The three instances of PKI Services are now successfully set up with minimal configuration needed.

For more information about how to use the user and admin web pages, see the following YouTube® video:

https://youtu.be/U0qk6siKkA

More configurations are available for production. For more information, see Chapter 2 of z/OS PKI Services Guide and Reference.
Related publications

The publications that are listed in this section are considered particularly suitable for a more detailed discussion of the topics that are covered in this book.

IBM Redbooks

The IBM Redbooks publication *Managing Digital Certificates Across the Enterprise*, SG24-8336 provides more information about the topic in this document.

You can search for, view, download or order this document and other Redbooks, Redpapers, Web Docs, draft, and other materials, at the following website:

ibm.com/redbooks

Other publications

The following publications are also relevant as further information sources:

- *Cryptographic Services PKI Services Guide and Reference*, SA23-2286
- *IBM HTTP server - powered by Apache*, SC27-8417
- *IBM Tivoli Directory Server Administration and Use for z/OS*, SC23-6788

Help from IBM

IBM Support and downloads

ibm.com/support

IBM Global Services

ibm.com/services