Updates on Digital Certificates Support from z/OS PKI Services and RACF

South California RACF User Group
October 3rd 2013

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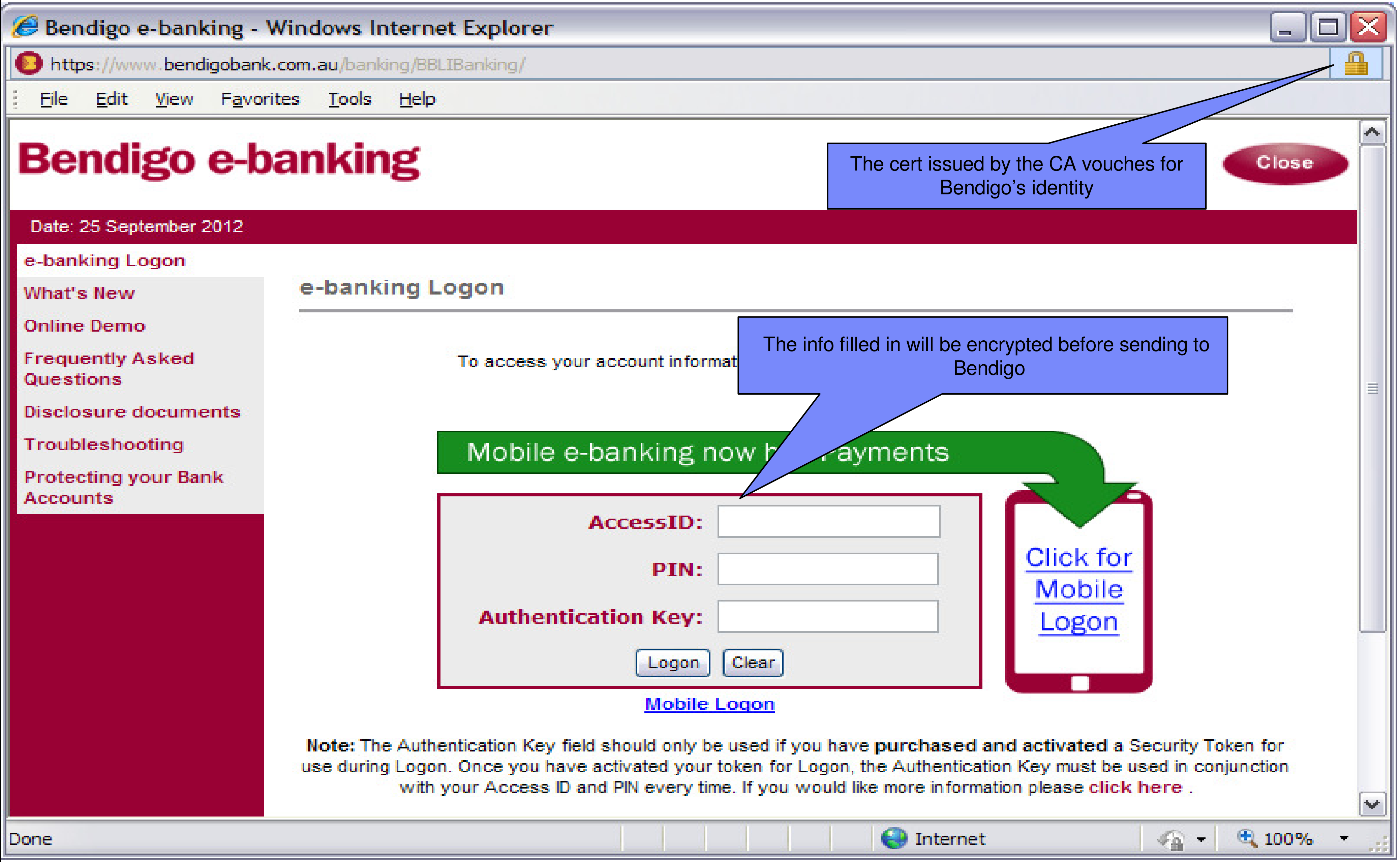
Agenda

- **Overview on Digital certificates support provided by z/OS**
- **Introduction to PKI Services**
- **Updates on digital certificate support**

Most common use of Digital certificate



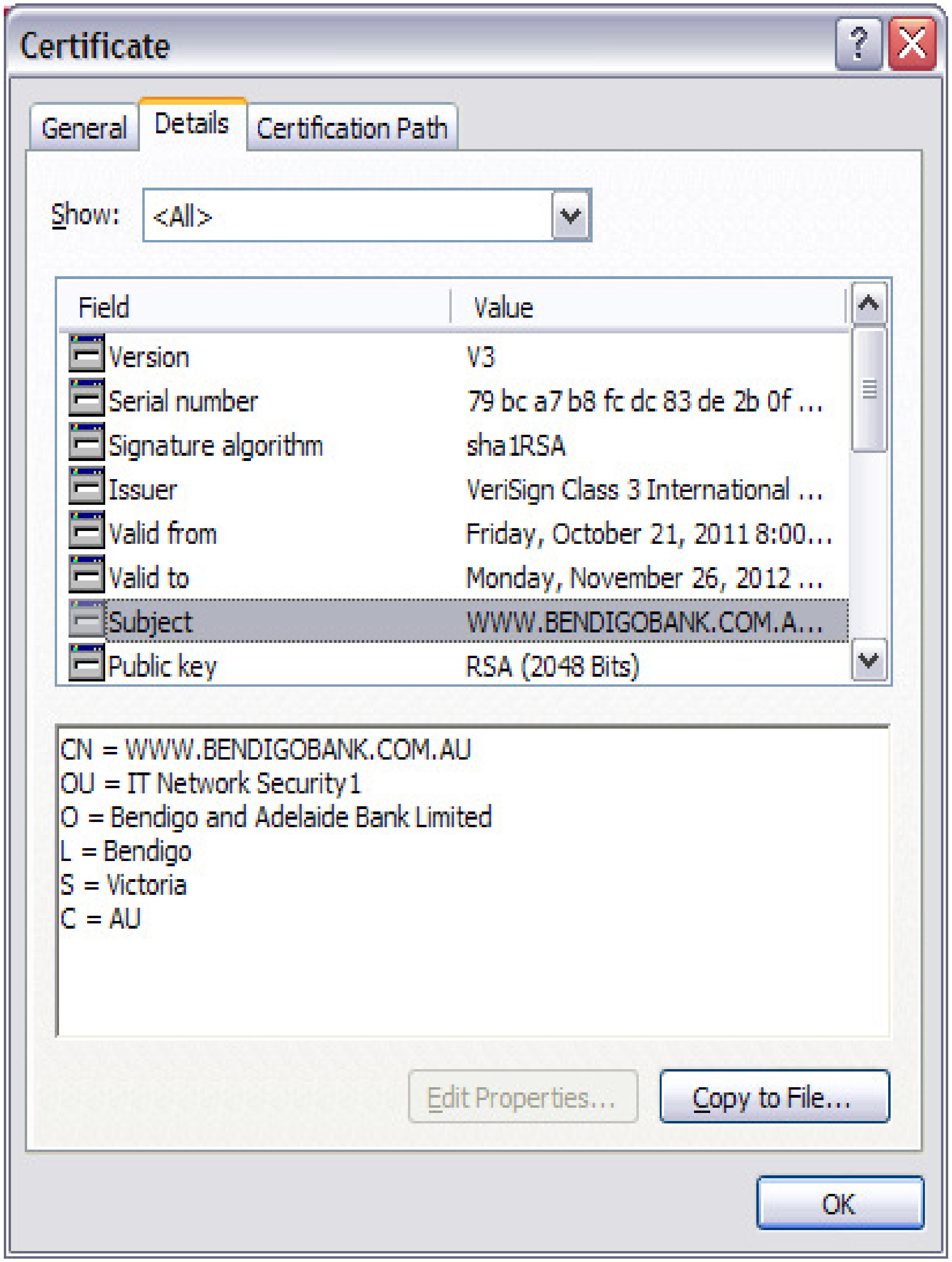
The cert issued by the CA vouches for Bendigo's identity

The info filled in will be encrypted before sending to Bendigo

To access your account informat

Note: The Authentication Key field should only be used if you have **purchased and activated** a Security Token for use during Logon. Once you have activated your token for Logon, the Authentication Key must be used in conjunction with your Access ID and PIN every time. If you would like more information please click here .

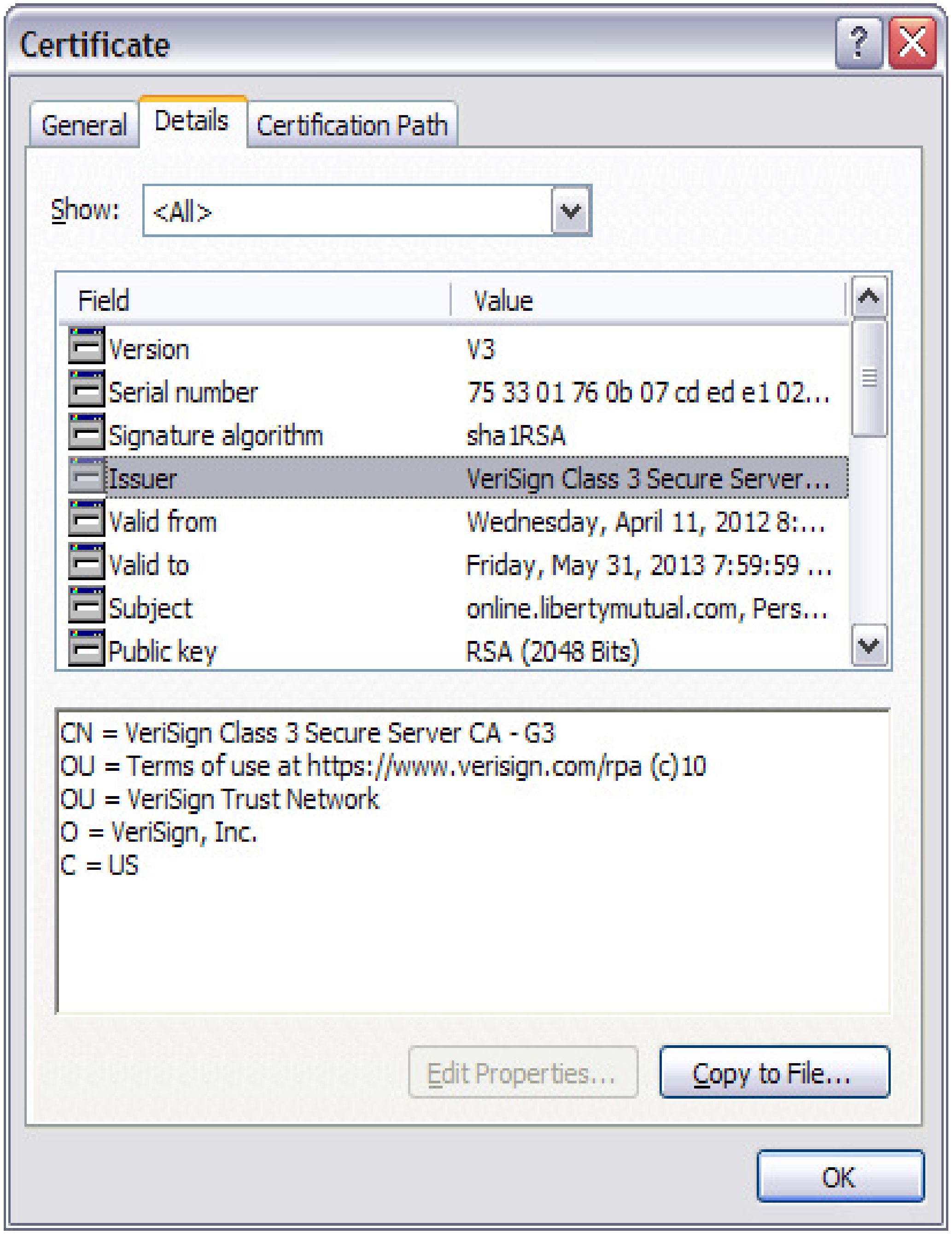
An example of a Digital certificate



Show: <All>

Field	Value
Version	V3
Serial number	79 bc a7 b8 fc dc 83 de 2b 0f ...
Signature algorithm	sha1RSA
Issuer	VeriSign Class 3 International ...
Valid from	Friday, October 21, 2011 8:00...
Valid to	Monday, November 26, 2012 ...
Subject	WWW.BENDIGOBANK.COM.A...
Public key	RSA (2048 Bits)

CN = WWW.BENDIGOBANK.COM.AU
OU = IT Network Security1
O = Bendigo and Adelaide Bank Limited
L = Bendigo
S = Victoria
C = AU



Show: <All>

Field	Value
Version	V3
Serial number	75 33 01 76 0b 07 cd ed e1 02...
Signature algorithm	sha1RSA
Issuer	VeriSign Class 3 Secure Server...
Valid from	Wednesday, April 11, 2012 8:...
Valid to	Friday, May 31, 2013 7:59:59 ...
Subject	online.libertymutual.com, Pers...
Public key	RSA (2048 Bits)

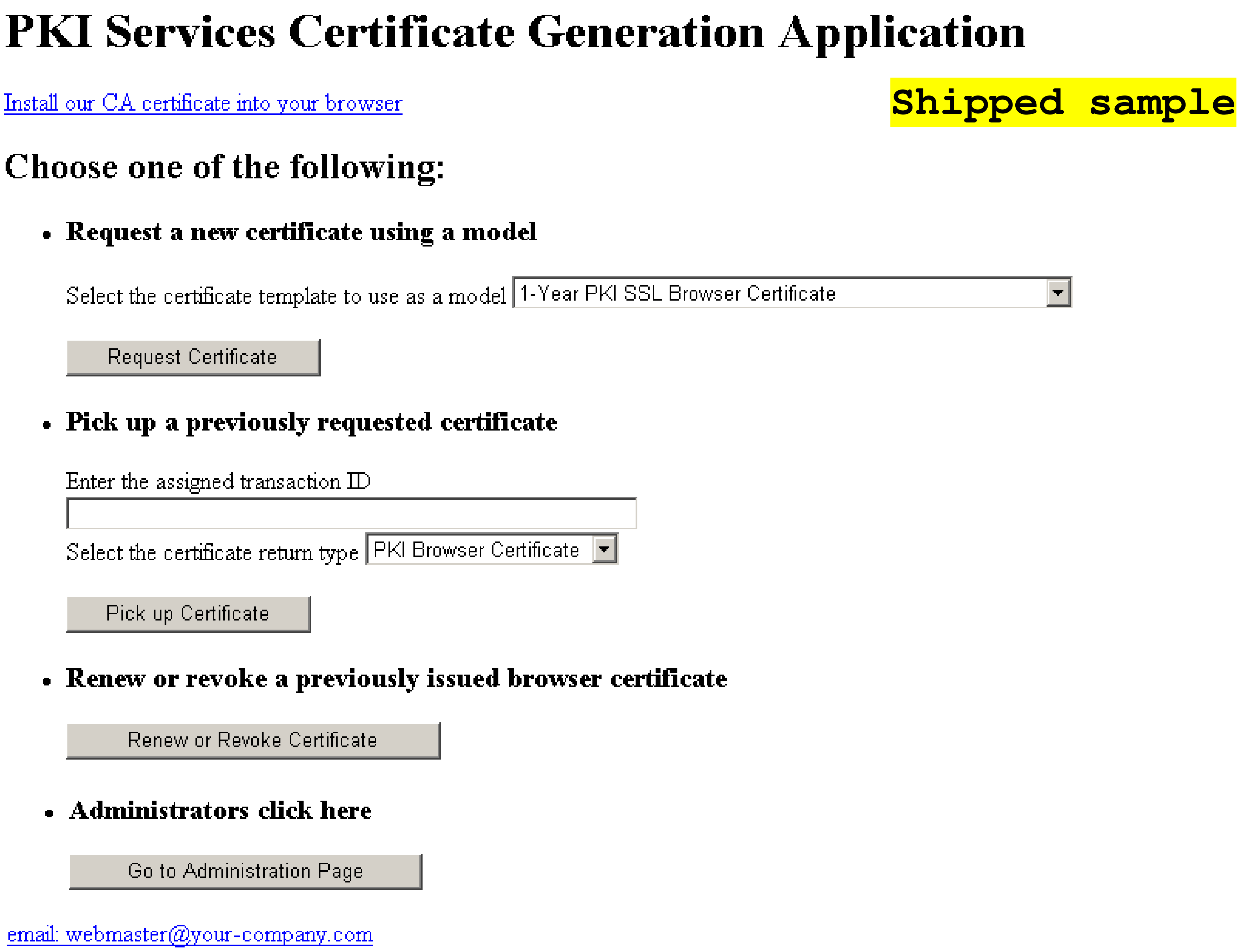
CN = VeriSign Class 3 Secure Server CA - G3
OU = Terms of use at https://www.verisign.com/rpa (c)10
OU = VeriSign Trust Network
O = VeriSign, Inc.
C = US

Digital certificate support from z/OS

1. Support through RACF
   - RACDCERT command
     - Read, write functions on certificates, key rings, certificate filters
   - R_Datalib callable services
     - Read, write functions on certificates in a key ring
     - Called by System SSL APIs which are used by FTP, Telnet…
   - initACEE callable services
     - Using certificate to authenticate to RACF
   - R_PKIServ callable services
     - Interface to call PKI Services
2. Support through PKI Services
3. Support through System SSL

PKI Services - Certificate Authority on z/OS

- PKI Services provides a full functioning Certificate Authority
- Provides more functions than RACDCERT Command as a Certificate Authority.
- Provides full certificate life cycle management
  - Request, create, renew, revoke certificate
  - Generation and administration of certificates via customizable web pages
- Continues adding new support in every release



PKI Services Certificate Generation Application

Install our CA certificate into your browser

Shipped sample

Choose one of the following:

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

  Select the certificate template to use as a model: 1-Year PKI SSL Browser Certificate

- **Pick up a previously requested certificate**

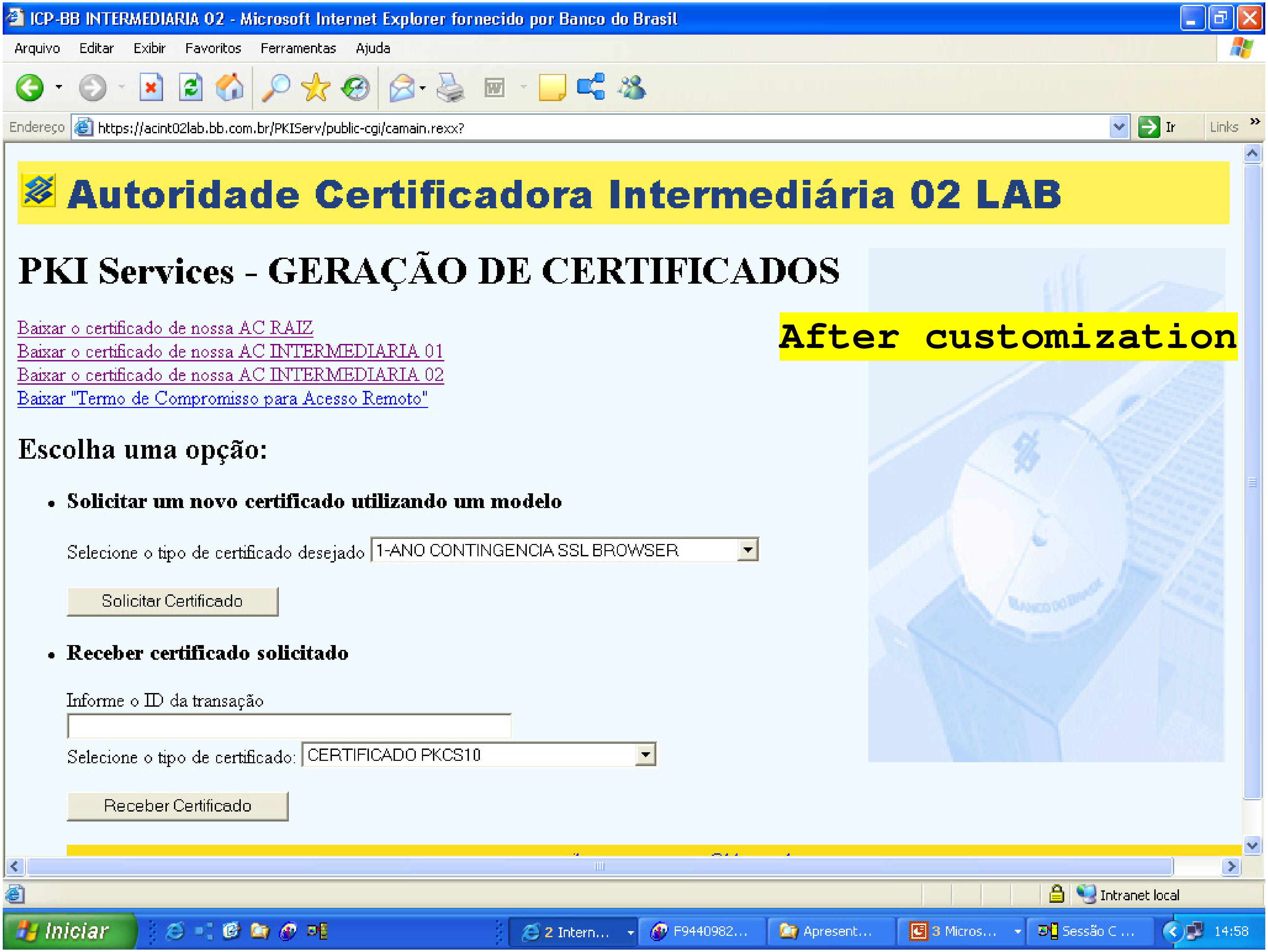
  Enter the assigned transaction ID

  Select the certificate return type: PKI Browser Certificate

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

- **Administrators click here**

email: webmaster@your-company.com



ICP-BB INTERMEDIARIA 02 - Microsoft Internet Explorer fornecido por Banco do Brasil
Arquivo Editar Exibir Favoritos Ferramentas Ajuda
Endereço
Ir
Links
Intranet local
Iniciar
2 Intern...
F9440982...
Apresent...
3 Micros...
Sessão C ...
14:58

https://acint02lab.bb.com.br/PKIServ/public-cgi/camain.rexx?

Autoridade Certificadora Intermediária 02 LAB

PKI Services - GERAÇÃO DE CERTIFICADOS

After customization

Baixar o certificado de nossa AC RAIZ
Baixar o certificado de nossa AC INTERMEDIARIA 01
Baixar o certificado de nossa AC INTERMEDIARIA 02
Baixar "Termo de Compromisso para Acesso Remoto"

Escolha uma opção:

- **Solicitar um novo certificado utilizando um modelo**

  Selecione o tipo de certificado desejado: 1-ANO CONTINGENCIA SSL BROWSER

  Solicitar Certificado

- **Receber certificado solicitado**

  Informe o ID da transação

  Selecione o tipo de certificado: CERTIFICADO PKCS10

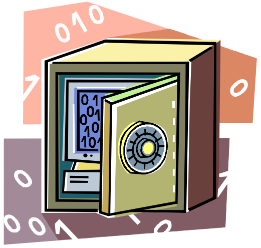
  Receber Certificado

Benefits of using z/OS PKI Services (1 of 2)

- Supports popular protocols
  - Support Simple Certificate Enrollment Protocol (SCEP) for routers to request certificates automatically
  - Support Certificate Management Protocol (CMP) clients to communicate with PKI Services
  - Provide certificate status through Certificate Revocation List(CRL) and Online Certificate Status Protocol (OCSP)
- Provide customizable features that the other CAs may not have
  - Provide expiration notification and automatic renewal
  - Provide options for requestor to generate his own key pair or request the PKI CA to generate it
  - Support the creation of custom extensions

Benefits of using z/OS PKI Services (2 of 2)

- Relatively low MIPS to drive thousands of certificates
- Leverage existing z/OS skills and resources
- Run in separate z/OS partitions (integrity of zSeries® LPARs)
- Scalable (Sysplex exploitation)
- The CA’s private key can be protected under Crypto hardware
- Not a priced product. Licensed with z/OS
  - ➢Cost efficient for banks, government agencies to host Digital Certificate management



Major Prerequisite Products

- **RACF (or equivalent)**
  - For storing PKI CA certificate
  - For authorization
- **IBM z/OS HTTP Server / Websphere Application Server**
  - For web page interface
- **LDAP Directory (z/OS or other platforms)**
  - For publishing issued certificates and CRLs
  - For email notification
- **ICSF (optional)**
  - For more secure CA private key
  - For PKI CA to generate key pair
- **z/OS Communications Server (optional)**
  - For email notification
- **DB2 (optional)**
  - An alternative for PKI backend VSAM stores

New Enhancements on Digital Certificate Support for z/OS V2R1

- PKI Services
  - Support secure key in TKDS
  - Create Extended Validation (EV) certificates
  - Provide granular administration authorization control
  - Ability to restrict a subordinate CA from signing another subordinate CA
  - optionally issue console message when CRL processing ends

- RACF
  - Support secure key in TKDS
  - Enhance certificate chain display and management
  - Prevention of a careless mistake in the certificate request processing
  - Health check of expiring/expired certificates
  - Unload more information from a certificate in SMF records

Secure TKDS Support

- Unlike the keys stored in the ICSF Public Key Data Set (PKDS), the keys stored in the Token Key Data Set (TKDS) are clear keys, not secure keys.
- “**Secure Key**” means that sensitive key material is always wrapped under a master key.
- In Web Deliverable #12, ICSF supports secure key on TKDS.
- To enable the applications to use the secure key in TKDS, RACF, PKI Services and System SSL need to be updated accordingly.

PKI Services
Secure TKDS Support

- Starting in V2R1, PKI Services can
  - have its CA certificate created using secure TKDS key
  - create secure keys in the TKDS during certificate creation and return a PKCS#12 package containing the secure key to the requestor
    - through new / updated **System SSL APIs** to envelop the secure key to be exported

- Provides better security on the key generation capability in PKI Services

PKI Services
Secure TKDS Support - Configuration

- PKI Services IKYSETUP (A REXX script to set up authorization for PKI):
  - Update the script to pick the desire secure TKDS key to generate the CA certificate
    - key_type=8: Secure RSA in TKDS
    - key_type=9: Secure NISTECC in TKDS
    - key_type=10: Secure BPECC in TKDS

- PKI Service configuration (pkiserv.conf):
  - Specify T for the **SecureKey** entry in the PKI Services configuration file to enable secure key generation:

```
[SAF]
...
TokenName=PKISRVD.PKIToken
SecureKey=T
```

Secure TKDS Support
Clear Key Restriction

- ICSF can now restrict use of TKDS clear keys:
  - With WD#12, ICSF checks a new RACF resource profile in the CRYPTOZ class to restrict the use of clear keys in the PKCS#11 services
    - CLEARKEY.<token-label>

- Insufficient access to CLEARKEY.<token specified in pkiserv.conf> will cause unexpected result on key generation from PKI Services even if no configuration update is made to have the new secure key support

PKI Services
Extended Validation Certificates

- An Extended Validation Certificate (EV) is an X.509 certificate issued according to a specific set of identity verification criteria.
- These criteria require extensive verification of the requesting entity's identity by the certificate authority (CA).
- In V2R1 PKI Services is adding support for the relative distinguished names (RDN) that are required by Extended Validation certificates.
- RDNs needed for an EV certificate:
  - **businessCategory** (2.5.4.15) - Required
  - **jurisdictionOfIncorporationCountryName** (1.3.6.1.4.1.311.60.2.1.3) - Required
  - **jurisdictionOfIncorporationStateOrProvinceName** (1.3.6.1.4.1.311.60.2.1.2) - Optional
  - **jurisdictionOfIncorporationLocalityName** (1.3.6.1.4.1.311.60.2.1.1) - Optional

PKI Services
Granular Administrative Access Control

- Prior to V2R1, all PKI Administrators have full control over a single PKI CA domain.
- Starting in V2R1, PKI Services adds granular administration authorization control:
  - Enables multiple PKI Services administrators to perform different actions on different types of certificates within a domain.
    - Eg. an administrator can be authorized to approve a server digital certificate, but not be authorized to approve a SCEP digital certificate.
- Authorization is based on the domain, action and the template:
  - A switch is provided to turn on this granular check
  - A new class PKISERV is created for resources used by different types of administration functions
  - If granular checking is on, these resources will be checked, in addition to the existing authority check on the administrative functions
  - Example:
    - READ access to
      - *MYDOMAIN.QUERYREQS.1YBSSL and MYDOMAIN.QUERYCERTS.1YBSSL*
    - Allow the administrator to perform QUERYREQS and QUERYCERTS on the requests and certificates respectively, created with the '1-Year PKI SSL Browser Certificate' template in domain named MYDOMAIN.

PKI Services
Granular Administrative Access Control

- Enabling Granular Administrative Access Control:
  - Use the IKYSETUP script (A REXX script to set up authorization for PKI) to set up protection profiles in the new PKISERV class:
    - Specify **AdminGranularControl** equals 1 to set up granular control
    - Provide the template nick names you want to act on and assign the corresponding administration groups for setting up new profiles in the **PKISERV** class
  - Specify T for the **AdminGranularControl** entry in the PKI Services configuration file (pkiserv.conf):

```
AdminGranularControl = T
```

PKI Services
CA Path Length Enforcement

- PKI Services can issue intermediate Certificate Authority certificates. All CA Certificates must contain the Basic Constraints extension, which identifies:
  - Whether the certificate is a CA (required)
  - The maximum depth of the certification path (optional)
- PKI Services only create the CA indication field, but not the path length value. Although it is optional, many customers would like to have that value set to control the number of CAs that can follow
- Starting in V2R1 PKI Services can optionally create the path length value in the Basic Constraints extension.
- This allows a CA to restrict a subordinate CA from signing another subordinate CA through the path length constraint value.

PKI Services
CA Path Length Enforcement

- PKI Service configuration (pkiserv.conf):
  - Specify T for the **EnablePathLenConstraint** entry
  - Specify the length for the **PathLength** to be included in the Basic Constraints extension of intermediate CA certificates created by this CA

```
[CertPolicy]
...

EnablePathLenConstraint=T
PathLength=1
```

PKI Services
CRL Notification

- PKI Services can create Certificate Revocations Lists (CRLs) on regular intervals and post them to LDAP or an HTTP server.
- Starting in V2R1 PKI Services can be configured to optionally issue console message when CRL processing ends:
  - **IKYP044I** CRL number *crl-serial-number* processing for CA domain ca-domain completed successfully
  - **IKYP045I** CRL number *crl-serial-number* processing for CA domain ca-domain failed
  - CRL Notification console messages are optional

- A console message for CRL completion can act as a trigger for some automation processing, eg. CRLs can be saved for either legal reasons or a matter of policy

PKI Services
CRL Notification

- PKI Service configuration (pkiserv.conf):
  - Specify '**file**' for the **CRLWTONotification** entry
    - This keyword will be ignored if large CRL posting support is disabled (EnableLargeCRLPosting=F) or no http protocol CRL distribution point URI is defined

```
[CertPolicy]
...
CRLWTONotification=file
```

RACF
Secure TKDS Support

- RACDCERT GENCERT / REKEY command and panels:
  - New sub keyword TOKEN is added to indicate the generation of secure TKDS key. For examples:
    - Generate a certificate with RSA key stored in a token called MY.PKCS11.TOKEN1 in TKDS
      - RACDCERT GENCERT SUB(CN('Company A')) WITHLABEL('New RSA cert') RSA**(TOKEN(MY.PKCS11.TOKEN1))**
    - Generate a certificate with NISTECC key stored in a token called MY.PKCS11.TOKEN2 in TKDS
      - RACDCERT GENCERT SUB(CN('Company A')) WITHLABEL('New ECC cert') NISTECC**(TOKEN(MY.PKCS11.TOKEN2))**

- R_datalib callable service:
  - For the existing private key type X'00000002' - ICSF key token label, if the first character is an '=' sign, it is a key token from the TKDS, otherwise it is from the PKDS.
  - New private key types will be handled by functions DataGetFirst and DataGetNext
    - X'0000000B' RSA key token label in the TKDS
    - X'0000000D' ECC key token label in the TKDS
    - X'0000000E' DSA key token label in the TKDS

Secure TKDS Support
Clear Key Restriction

- ICSF can now restrict use of TKDS clear keys:
  - With WD#12, ICSF checks a new RACF resource profile in the CRYPTOZ class to restrict the use of clear keys in the PKCS#11 services
    - CLEARKEY.<token-label>
- Insufficient access to CLEARKEY.SYSTOK-SESSION-ONLY will cause the failure on the generation of clear TKDS key from RACDCERT

  Note: SYSTOK-SESSION-ONLY is an ICSF predefined temporary token name

RACDCERT ADD enhancement

- **RACDCERT ADD** certificate chain enhancement:
  - When importing a **PKCS#12** or **PKCS#7** certificate chain using the RACDCERT ADD command, only the end entity certificate can be named using a specified label.
  - RACDCERT generates labels for the rest of the certificates in the chain, but previously **did not display what labels** had been added.
  - Starting in V2R1, RACDCERT will **display the generated labels** of any certificates in the chain that were added.

```
RACDCERT ID(COOPER) ADD('COOPER.CERTS.MYPKCS12') WITHLABEL(‘MyCert’)
Certificate with label ‘MyCert’ is added under ID COOPER
Certificate with label ‘LABEL00000002’ is added under CERTAUTH
Certificate with label ‘LABEL00000003’ is added under CERTAUTH
```

New RACDCERT LISTCHAIN

- Starting in V2R1 RACF is adding the ability to list a certificate chain with the introduction of the RACDCERT LISTCHAIN command.
- **RACDCERT LISTCHAIN Syntax:**

```
RACDCERT [ ID(certificate-owner)| SITE | CERTAUTH]
     LISTCHAIN (LABEL('label-name'))
```

- Information provided:
  - Certificate details for the specified certificate
  - Details for each issuing certificate which is in RACF
  - Summary of the Chain:
    - Number of certificates in the chain
    - Whether RACF contains the complete chain
      - *– chain is complete*
      - *– chain is incomplete*
    - Indication of expired certificate(s), if any
      - *– chain contains expired certificate(s)*
    - List of rings that all certificates in chain share

RACDCERT LISTCHAIN Example

```
RACDCERT LISTCHAIN(LABEL('samplecert'))


Certificate 1:
  Digital certificate information for user CHOI:
  Label: samplecert
  ...
  Ring Associations:
    Ring Owner: COOPER
    Ring:
      >testring<

Certificate 2:
  Digital certificate information for CERTAUTH:
  Label: sampleCA
  ...
  Ring Associations:
  Ring Owner: COOPER
  Ring:
  >testring<
```

```
Certificate 3:
  Digital certificate information for CERTAUTH:
  Label: MasterCA
  ...
  Ring Associations:
  Ring Owner: COOPER
  Ring:
    >testring<

Chain information:
  Chain contains 3 certificate(s), chain is complete
  Chain contains ring in common: COOPER/testring
```

RACDCERT CHECKCERT

- RACDCERT CHECKCERT enhancement:
  - Not only list one certificate, but the whole chain of certificates
  - LISTCHAIN is used to list certificates in RACF, while CHECKCERT is to list certificates in a dataset (which is going to be an input to the RACDCERT ADD)
  - Enhancements similar to LISTCHAIN were added to the display text of RACDCERT CHECKCERT, when displaying information on a certificate in a dataset.

RACDCERT GENREQ Help

- Generating a Certificate Request (CSR) from RACDCERT GENREQ requires an existing certificate in RACF with a private key (usually a self signed certificate created with GENCERT).
- Don't delete that cert!
  - A common issue encountered by RACDCERT users is deleting the original certificate from RACF after the CSR has been generated... erroneously concluding that the certificate had no use.
  - If the original certificate is deleted from RACF after the CSR is created, the private key is also deleted, rendering any signed certificate based on this CSR useless (oops!).
- We can help!
  - Starting in V2R1 RACDCERT will prevent the deletion of a certificate that has been used for generating a request with GENREQ.
  - Force override mechanism is provided to delete this certificate when needed

Health Checks
RACF_CERTIFICATE_EXPIRATION

- **The RACF_CERTIFICATE_EXPIRATION health check finds the certificates in the RACF database expired or about to expire**
  - Expiration window is an installation-defined value with a default of 60 days.
  - Valid expiration window values are 0-366 days
- **For each certificate, the check displays:**
  - The certificate “owner” ('SITE', 'CERTAUTH', or 'ID(*user_id*)')
  - The certificate label
  - The end date
  - The trust status
  - The number of rings to which the certificate is connected
- **The check only flags as exceptions those certificates which are TRUSTED.**

Health Checks RACF_CERTIFICATE_EXPIRATION (Exception)

```
CHECK(IBMRACF,RACF_CERTIFICATE_EXPIRATION)
START TIME: 02/28/2013 09:23:37.747549
CHECK DATE: 20111010  CHECK SEVERITY: MEDIUM

                  Certificates Expiring within 60 Days

S Cert Owner   Certificate Label                End Date   Trust Rings
- ------------ -------------------------------- ---------- ----- -----
E CERTAUTH     VERISIGN CLASS 1 INDIVIDUAL      2008-05-12 Yes     0
E ID(MARKN)    MARK-001                         2012-11-11 Yes     0
E ID(MARKN)    MARK0001                         2012-11-05 Yes     0
  ID(CERTAUTH) START_OFF_M001__END_OFF_M001     2012-01-25 No      0
  ID(MARKN)    START_OFF_M001__END_OFF_M001     2012-01-25 No      0
  ID(SITE)     START_OFF_M001__END_OFF_M001     2012-01-25 No      0
  CERTAUTH     START_OFF_M365__END_OFF_M001     2012-01-25 No      0
  ID(CERTAUTH) START_OFF_M365__END_OFF_M001     2012-01-25 No      0
  CERTAUTH     ICP-Brasil CA                    2011-11-30 No      0
  CERTAUTH     MICROSOFT ROOT AUTHORITY - 01    2002-12-31 No      0
  CERTAUTH     VERISIGN CLASS 3 PUBLIC          2004-01-07 No      0
  CERTAUTH     VERISIGN CLASS 2 PUBLIC          2004-01-06 No      0

* Medium Severity Exception *

IRRH276E One or more certificates expired or are expiring within
the warning period.

  Explanation:  The RACF_CERTIFICATE_EXPIRATION check found one or more
    certificates that expired or are expiring within the warning period.
```

IRRDBU00: Additional Certificate Information

- **The RACF Database Unload Utility (IRRDBU00) unloads basic information about digital certificates into the General Resource Certificate Data Record which contains:**
  - The record type (“0560”)
  - The name of the general resource profile which contains the certificate
  - The class (“DIGTCERT”)
  - The date and time from which the certificate is valid
  - The date and time after which the certificate is no longer valid
  - The type of key associated with the certificate
  - The key size
  - The last eight bytes of the last certificate signed with this key
  - A sequence number for certificates within a ring
- **What's missing? The issuer's distinguished name (IDN) and the subject's DN (SDN) of the certificate!**
  - This information is encoded within the certificate
  - Maps to the profile name, but given the profile name, you can't get the IDN or SDN

IRRDBU00: Additional Certificate Information

- **A new record type (“1560”) is planned to contain:**
  - The issuer's distinguished name
  - The subject's distinguished name
  - The hashing algorithm used for the signing the certificate
- **The “1560” record links to the “0560” record using the profile name**
  - DFSORT's JOINKEY operator can be used when processing IRRDBU00 output
- **The Mapping of the1560 Record is:**

		Position		
Field Name	Type	Start	End	Comments
CERTN_RECORD_TYPE	**Int**	**1**	**4**	**Record type of the certificate information record (1560).**
CERTN_NAME	**Char**	**6**	**251**	**General resource name as taken from the profile name.**
CERTN_CLASS_NAME	**Char**	**253**	**260**	**Name of the class to which the general resource profile belongs.**
CERTN_ISSUER_DN	**Char**	**262**	**1285**	**Issuer’s distinguished name. (1024 characters)**
CERTN_SUBJECT_DN	**Char**	**1287**	**2310**	**Subject’s distinguished name. (1024 characters)**
CERTN_SIG_ALG	**Char**	**2312**	**2327**	**Certificate signature algorithm. Valid values are md2RSA, md5RSA, sha1RSA, sha1DSA, sha256RSA, sha224RSA, sha384RSA, sha512RSA, sha1ECDSA, sha256ECDSA, sha224ECDSA, sha384ECDSA, sha512ECDSA, and UNKNOWN.**

References

- **IBM Education Assistant web site:**

  http://publib.boulder.ibm.com/infocenter/ieduasst/stgv1r0/index.jsp

- **RACF web site:**

  http://www.ibm.com/servers/eserver/zseries/zos/racf

- **PKI Services web site:**

  http://www.ibm.com/servers/eserver/zseries/zos/pki

- **IBM Redbooks**

  z/OS V1 R8 RACF Implementation (SG24-7248)

- **Security Server Manuals:**

  RACF Command Language Reference (SC22-7687)

  RACF Security Administrator's Guide (SC28-1915)

- **Cryptographic Server Manual**

  Cryptographic Services PKI Services Guide and Reference (SA22-7693)

  Cryptographic Services System Secure Sockets Layer Programming (SC24-5901)

  Writing PKCS#11 Applications (SA23-2231)

- **RFCs**

  RFC2459 - Internet X.509 Public Key Infrastructure Certificate and CRL Profile

  RFC5280 - Internet X.509 Public Key Infrastructure Certificate and Certificate Revocation List (CRL) Profile

  RFC4210 - Internet X.509 Public Key Infrastructure Certificate Management Protocol (CMP)

  RFC4211 - Internet X.509 Public Key Infrastructure Certificate Request Message Format (CRMF)