z/TPF V1.1

TPF Users Group - Spring 2009

Title: z/TPF Communications and Security Enhancements

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Venue: Communications Subcommittee

AIM Enterprise Platform Software
IBM z/Transaction Processing Facility Enterprise Edition 1.1.0

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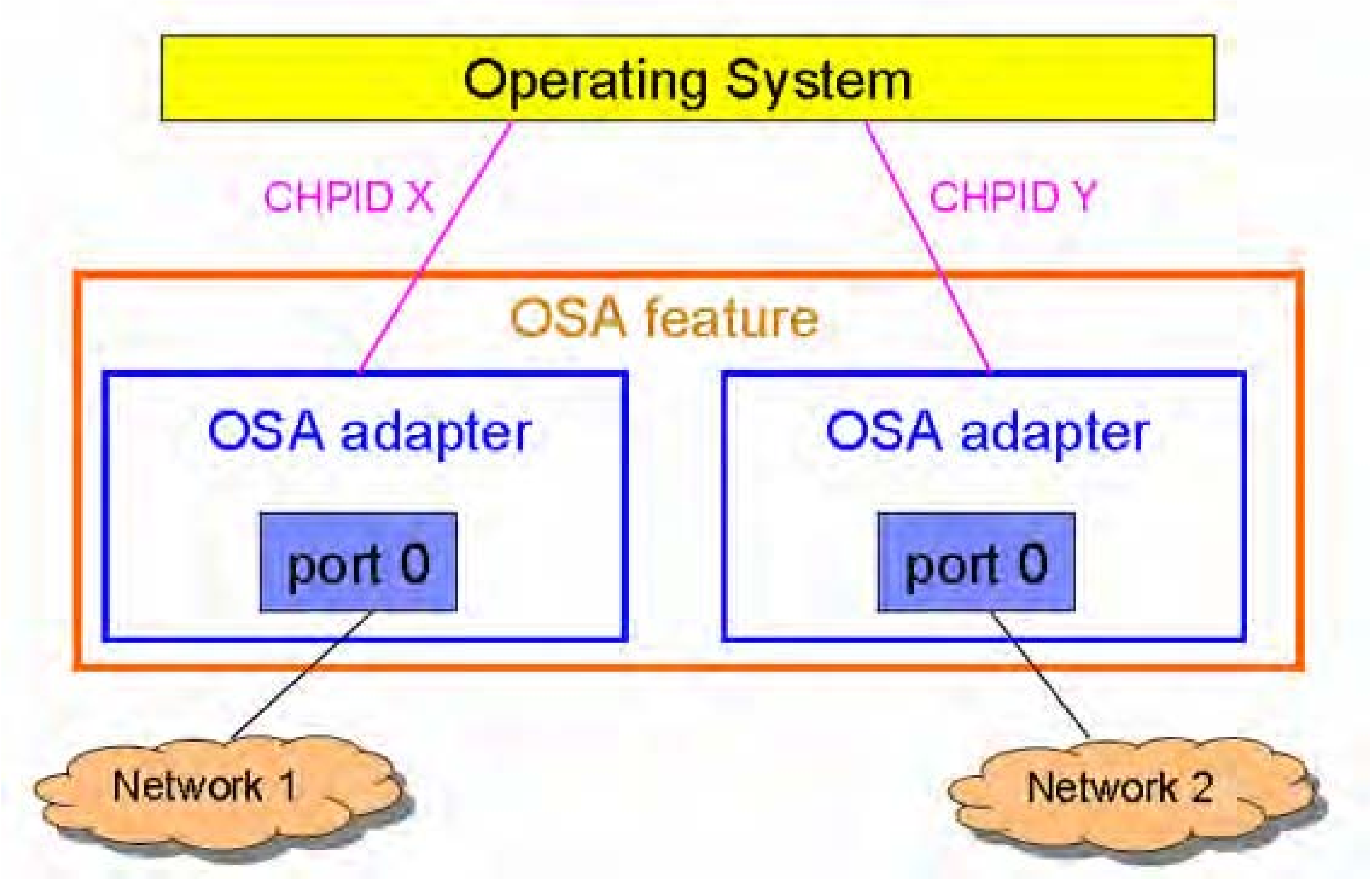
OSA-Express2 and OSA-Express3 Terminology

- **OSA feature is the physical card that plugs into the I/O cage on the System z server**
- **OSA adapter is a physical OSA adapter residing on a physical card**
  - One OSA feature contains either 1 or 2 OSA adapters depending on type (like 1 GbE or 10 GbE)
  - Each OSA adapter is accessed via a separate CHPID
  - An OSA adapter can be shared by multiple LPARs
  - Prior to z10, each OSA adapter had a single network port connecting to an Ethernet network

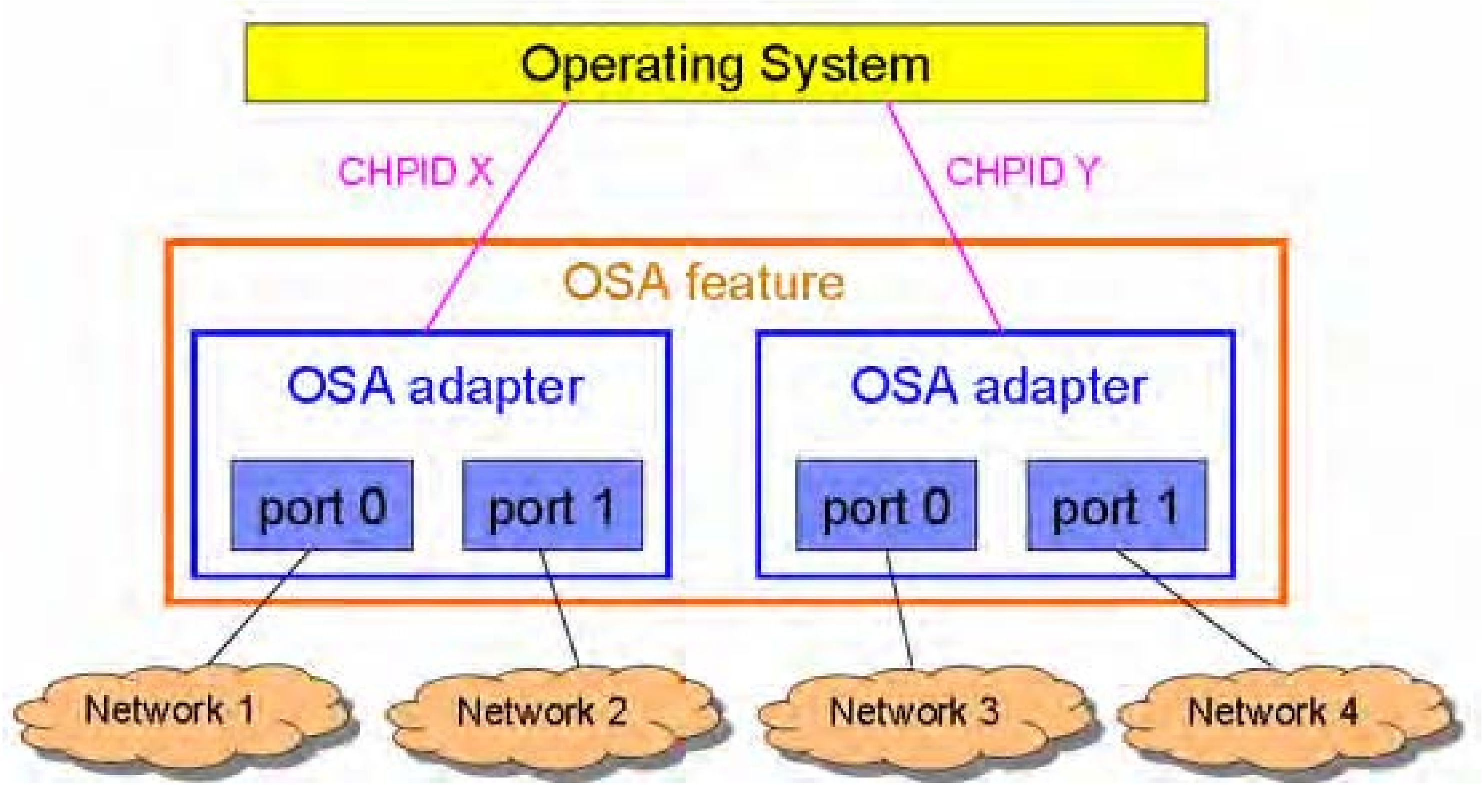
OSA Feature with 2 Adapters each with 1 Network Port



OSA Multiple Network Port Support

- **Some OSA-Express3 adapters on z10 support multiple network ports. For example:**
  - 1 GbE feature with 2 adapters each having 2 ports
  - 10 GbE feature with 1 adapter that has 2 ports
- **OSA adapter with a single network port has port 0**
- **OSA adapter with two network ports has port 0 and port 1**

OSA Feature with 2 Adapters each with 2 Network Ports



z/TPF OSA Multiple Network Port Support

- **APAR PJ32093 enables z/TPF to connect to different network ports on an OSA adapter**
  - Specify the PORTNUM parameter on the ZOSAE command that defines the OSA connection to z/TPF
  - Default is PORTNUM-0 (port 0)
- **All OSA connections that were defined to z/TPF prior to installing PJ32093 will use port 0**
- **z/TPF systems without PJ32093 applied can only use port 0 on all OSA adapters**

INETD Performance Enhancements

- **Enables Internet Daemon (INETD) listener ECBs to run on all I-streams to perform better in a tightly-coupled environment with multiple INETD servers**
  - Prior to this support all INETD listener ECBs ran on the same I-stream
- **INETD internal logic also changed to process connection requests and messages faster**
  - Applicable for network restart and high volume message rate conditions
- **These changes occur when you apply APAR PJ34780**
  - No INETD definition changes are needed

New NSD Message Weighting Option

- **Network Services Database (NSD) allows you to define properties of an application (where an application is defined by its TCP/IP port number)**
- **NSD resides in the *<i>/etc/services</i>* file**
- **The weight parameter in an NSD entry defines the weighting factor to use for input and output messages of this application when TCP/IP messages are reported in Data Collection**
- **APAR PJ35108 allows weight=0 to be specified**
  - weight=0 means count the messages for this application, but do not include them in the weighted message reports in data collection
  - You can display the raw message counts, even for applications coded as weight=0, using the ZIPDB command

Ability to Trace Variable Amount Data by Application

- **You can control how much data in each packet is traced by the system wide z/TPF IP trace facility**
  - Use the *ZTTCP TRACE SIZE-size* command
- **With APAR PJ35108 you can now specify how much data to trace on a per application basis**
  - Specify the IPTRSIZE parameter on the NSD entry of the application
  - If you do not specify IPTRSIZE for an application, the system wide value (from ZTTCP TRACE SIZE) is used

z/TPF Public Key Infrastructure (PKI) Support

APAR PJ32686

Public Key Cryptography

- **Also known as asymmetric key cryptography**
- **Public key pair**
  - Public key
    - Can be openly distributed
  - Private key
    - Must be kept secret/protected
- **Any data encrypted with a public key can only be decrypted using the corresponding private key**
- **Any data encrypted with a private key can only be decrypted using the corresponding public key**
- **Commonly used algorithm is Rivest, Shamir, and Adleman (RSA)**

Public Key Infrastructure (PKI)

- **Enables users of an unsecure (public) network to securely and privately exchange data**
- **Uses public key cryptography**
- **Public keys are shared/distributed using digital certificates that are created/signed by a trusted authority called a certificate authority (CA)**

z/TPF PKI Support Concepts

- **Allows you to create, manage, and use RSA key pairs in a secure manner**
  - Extends z/TPF secure key management support
- **Supports 1024-bit and 2048-bit RSA key pairs**
- **Key pair is referenced by name**
- **Private key value is secured – not visible to operators, applications, coverage, and so on**
- **Public key value is available to anyone**

ZPUBK GENERATE Command

- **Generates an RSA key pair and adds it to the PKI keystore**
- **Specify the name of the key pair (for example, KEYPAIR1)**
  - The key pair name is how subsequent operator commands and APIs will reference/use this key pair
- **Specify the key length (1024-bit or 2048-bit)**

```
ZPUBK GENERATE KEYPAIR-KEYPAIR1 CIPHER-RSA1024
```

```
PUBK0001I  KEYPAIR-KEYNAME1 BEING GENERATED
PUBK0002I  KEYPAIR-KEYNAME1 GENERATED AND ADDED TO PKI MASTER KEYSTORE
PUBK0003I  KEYPAIR-KEYNAME1 ADDED TO PKI MEMORY KEYSTORE ON ALL PROCESSORS
```

ZPUBK ACTIVATE Command

- **Activates an RSA key pair**

```
ZPUBK ACTIVATE KEYPAIR-KEYPAIR1

PUBK0011I  KEYPAIR-KEYNAME1 NOW ACTIVE IN PKI MASTER KEYSTORE
PUBK0012I  KEYPAIR-KEYNAME1 NOW ACTIVE IN PKI MEMORY KEYSTORE
           ON ALL PROCESSORS
```

Other Operator Commands

- **ZPUBK DEACTIVATE**
  - Deactivates an RSA key pair
- **ZPUBK DELETE**
  - Deletes an RSA key pair from the PKI keystore
- **ZPUBK DISPLAY**
  - Displays information about public key pairs in the PKI keystore
- **ZPUBK EXTRACT**
  - Extracts a public key to a file that can then be sent to a remote platform

Installation Instructions

1. **Define the PKI master keystore**
   - Define #IPKI fixed file records
2. **Define the PKI memory keystore**
   - Use the PKEYS macro in SIP
3. **Initialize the PKI master keystore**
   - Use the ZPUBK INITIALIZE and CONFIRM INITIALIZE commands
4. **Create RSA key pair(s)**
   - Use the ZPUBK GENERATE command
   - Must make a backup copy of the PKI keystore before continuing
     - Use the ZKEYS BACKUP command
5. **Activate RSA key pair(s)**
   - Use the ZPUBK ACTIVATE command

RSA Key Pairs are Created… Now What?

- **A z/TPF generated RSA key pair can be used:**
  - By Secure Sockets Layer (SSL) applications
    - Requires a digital certificate to be created that contains the RSA public key created by z/TPF
  - To securely import a symmetric key
    - You must send one of the following to the remote key manager that is exporting the symmetric key:
      - A digital certificate containing the z/TPF RSA public key
      - A file containing the z/TPF RSA public key (create the file using the ZPUBK EXTRACT command)

Creating a Digital Certificate

1. **z/TPF operator creates an RSA key pair called KEYPAIR1**
2. **Create a file (called myinfo.cfg in this example) containing the subject information needed to create a certificate request**
3. **Issue the ZPUBK REQCERT command. Input includes:**
   - Key pair name (KEYPAIR1) that says which public key to use
   - Name of the file (myinfo.cfg) containing the subject information
   - Name of the file (mycert.fil) into which to build the certificate request (PKCS #10 format)
4. **Send (FTP) the certificate request to the certificate authority (CA) that will create the digital certificate**
5. **From the CA, send (FTP) the certificate to your z/TPF system**

Self-Signed Certificates

- **A self-signed certificate is where the subject and issuer of the certificate are the same**
- **In production typically the only nodes that have/create self-signed certificates are CAs**
- **It is often convenient to have self-signed certificates for test systems**
- **To create a self-signed certificate on z/TPF**
  - Specify the SSIGNED option on the ZPUBK REQCERT command
  - Creates a certificate (self-signed) rather than a certificate request

OpenSSL Programming Model

- **z/TPF supports OpenSSL APIs**
- **SSL server applications must issue APIs specifying:**
  - Name of file containing the node’s digital certificate
  - Name of file containing node’s private key
- **When SSL client authentication is being used, SSL client applications must also issue those APIs**

Updating SSL Applications to Use z/TPF RSA Key Pairs

- **Application program still uses standard OpenSSL APIs to indicate the name of the file that contains the digital certificate**
- **Application program still uses standard OpenSSL APIs to indicate the name of the file that contains the private key**
  - Instead of pointing to a real file that contains the RSA private key, the application specifies a file name with a special prefix (/tpfpubk) that tells z/TPF that the name that follows is really the name of the RSA key pair to use and not to try and open/use a file in the file system

SSL Example of How to Specify a z/TPF RSA Private Key

- **SSL application wants to use key pair named KEYPAIR1**
- **Input to the *SSL_CTX_use_PrivateKey_file* API includes a pointer to the file name containing the private key**
  - Set the file name to **/tpfpubk/ keypair1.pem**
- **The private key value is *not* copied into the application program's memory space**
  - Only the key pair name (KEYPAIR1) is saved in the SSL structure in the application's memory space

Middleware Using OpenSSL Accessing RSA Private Keys

- **Some middleware opens/reads the private key file to determine whether the private key is encrypted and if so, prompts the operator for the password**
- **Some middleware also compares the public key information in the private key file to the public key in the certificate to make sure they match**
- **When you create an RSA key pair on z/TPF**
  - A dummy private key file is created in the /tpfpubk directory
  - This file includes:
    - An unencrypted private key (no password needed)
      - **This is NOT the real private key value!**
    - The real public key value
- **Allows middleware to continue to work without any changes to the middleware**
  - Middleware does not have access to the real private key value

SSL Considerations

- **SSL applications on z/TPF can use:**
  - Remote generated RSA keys
    - Keys do not reside in the PKI keystore
    - Private key resides in a file in the file system
    - This was the only method supported before PJ32686
  - z/TPF generated RSA keys
    - Keys reside in the PKI keystore
    - This is the method added by PJ32686
    - There is no impact to CPU performance using z/TPF generated keys compared to using remote generated RSA keys

Data Encryption Outside the Scope of SSL

- **If you create a symmetric key on z/TPF and one z/TPF complex is the only one that needs to use that key**
  - Key distribution is not an issue
  - Example – z/TPF application encrypts data before writing it out to the z/TPF database and that application reads the data (and decrypts) it later on
- **If you want to exchange data with another platform and the data is encrypted at the application level using a symmetric key**
  - A key distribution mechanism is needed

Solving the Symmetric Key Distribution Problem

- **z/TPF now supports RSA key wrapping to securely import symmetric keys**
- **Remote key manager that creates the symmetric key (KEY1) will wrap (encrypt) KEY1 using z/TPF's public key**
- **The remote key manager sends the encrypted KEY1 value to z/TPF**
  - How this is done is not architected (not standardized)
- **New *tpf_secure_key_import* API on z/TPF unwraps (decrypts) the KEY1 value (using z/TPF's private key) and adds KEY1 to the symmetric key keystore**
  - The KEY1 value is never in the clear during the key exchange

How Does the Remote Key Manager get Public Key Value

- **Remote key manager needs z/TPF’s public key to be able to securely send a wrapped symmetric key to z/TPF**
- **Can extract the public key on z/TPF**
  - Use the ZPUBK EXTRACT command
  - Creates a public key file containing the public key
  - Can send (secure FTP) the public key file to the remote key manager
- **The other (and more commonly used) option is to send z/TPF’s certificate to the remote key manager**
  - Certificate contains z/TPF’s public key

Initial z/TPF PKI Support Summary (APAR PJ32686)

- Create and manage RSA public key pairs in a secure manner on z/TPF
  - Create, activate, deactivate, display, delete RSA public key pairs
  - Backup and restore the PKI keystore
- Use the RSA keys generated on z/TPF to create digital certificate requests as well as self-signed digital certificates
- Enable z/TPF SSL applications and middleware to use private keys generated by z/TPF
- Ability to extract a public key from the z/TPF keystore that can be distributed to remote partners such as key managers
- Ability to import a symmetric key in a secure manner using public key cryptography

z/TPF PKI Support Phase 2 (statement of direction)

- **New operator command to display contents of a digital certificate in human-readable format**
- **New operator command to convert a digital certificate from PEM to DER format**
  - Some keys managers only support DER format
- **Allow applications and middleware to use RSA directly:**
  - APIs to encrypt/decrypt user data using RSA public key cryptography
  - APIs to create and verify RSA digital signatures

z/TPF Security Book

- **Security is a very important issue for all customers**
- **All security related information for z/TPF is being incorporated into a single *z/TPF Security* book**
- **New information is also being added to this book**
- **The book is coming soon to a z/TPF Information Center near you**

z/TPF Security Book Contents (subject to change)

- **Security Concepts**
- **Symmetric Cryptography with Clear Key APIs**
- **Message Digest APIs**
- **Secure Key Management**
- **Internet Security**
- **Secure Sockets Layer**
- **Protecting Data in Flight**
- **Protecting Data at Rest**
- **Protecting Data in Use**
- **z/TPF Operator Security**
- **Database Security**
- **Program Security**
- **Memory Security**

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