

بنام خدا

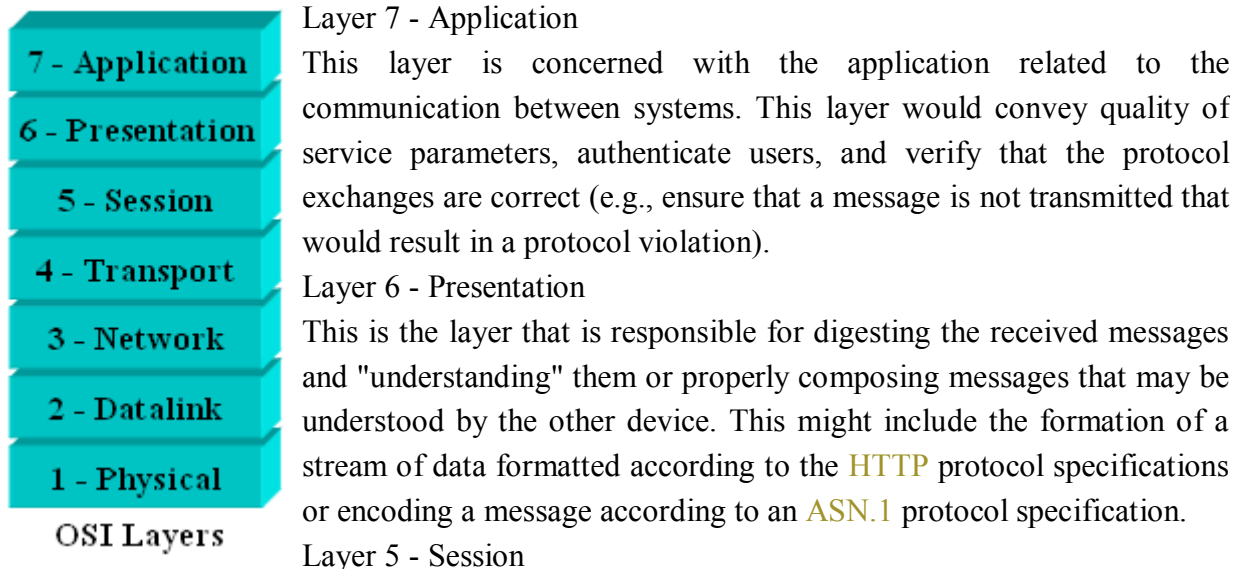
عنوان تحقیق

Open System Interconnection (OSI)

تهیه و تدوین : هلیا اصغری

Open System Interconnection (OSI)

OSI is a seven-layer network model specified by ISO. It is formally referred to as the *Basic Reference Model for Open Systems Interconnection*. The seven layers are:



Layer 4 - Transport

This is the layer at which differentiation is made between applications or services on the network from the underlying protocols. In the world of IP, this equates to **TCP** and **UDP**, though **TCP** also falls a little into layer 5, as well.

Layer 3 - Network

The network layer defines the protocol that allows for communication between various system and applications on any number of network links. The **Internet Protocol** is an example of a protocol that operates at Layer 3.

Layer 2 - Datalink

The datalink layer is the lowest layer at which some defined message is transmitted. This layer includes protocols like Ethernet. Messages at this layer contain sufficient information about the destination to be properly delivered to the proper network interface on a host on a single *link*.

Layer 1 - Physical

This layer refers to the physical medium (e.g., fiber optic cable, twisted-pair cable, coaxial cable, etc.) through which a device is connected.

OSI Addressing

Addresses in the OSI network are used to uniquely identify originators and destinations for applications used over the network. The OSI addressing scheme uses a mixture of identifiers for the type of network, access points into the network and the stack, from the subnetwork.

OSI addresses can be divided into the following parts:

- Network Services Access Point (NSAP) is a unique address in an OSI network that identifies the network service.
- Selectors (TSEL, SSEL, and PSEL) identify services of peer entities. For example, the TSEL identifies the service provided by the transport layer.

SunLink OSI 8.1 also requires a Subnetwork Point of Attachment (SNPA) to identify a unique point at which the subnetwork is connected to the NSAP.

These are described in more detail in the following sections. Figure 7-1 on page 105 shows a general view of the parts of addresses and how they relate to the OSI Reference Model.

The OSI address format uses the NSAP address plus the selectors (TSEL, SSEL, and PSEL), to connect applications through peer entities in the OSI layers. The SNPA, although not part of the OSI address format, identifies the mapping between the NSAP and the subnetwork. These address components are described in more detail in the following sections.

The NSAP is independent of the subnetwork to which it is connected, while the format and content of the SNPA depends on the subnetwork.

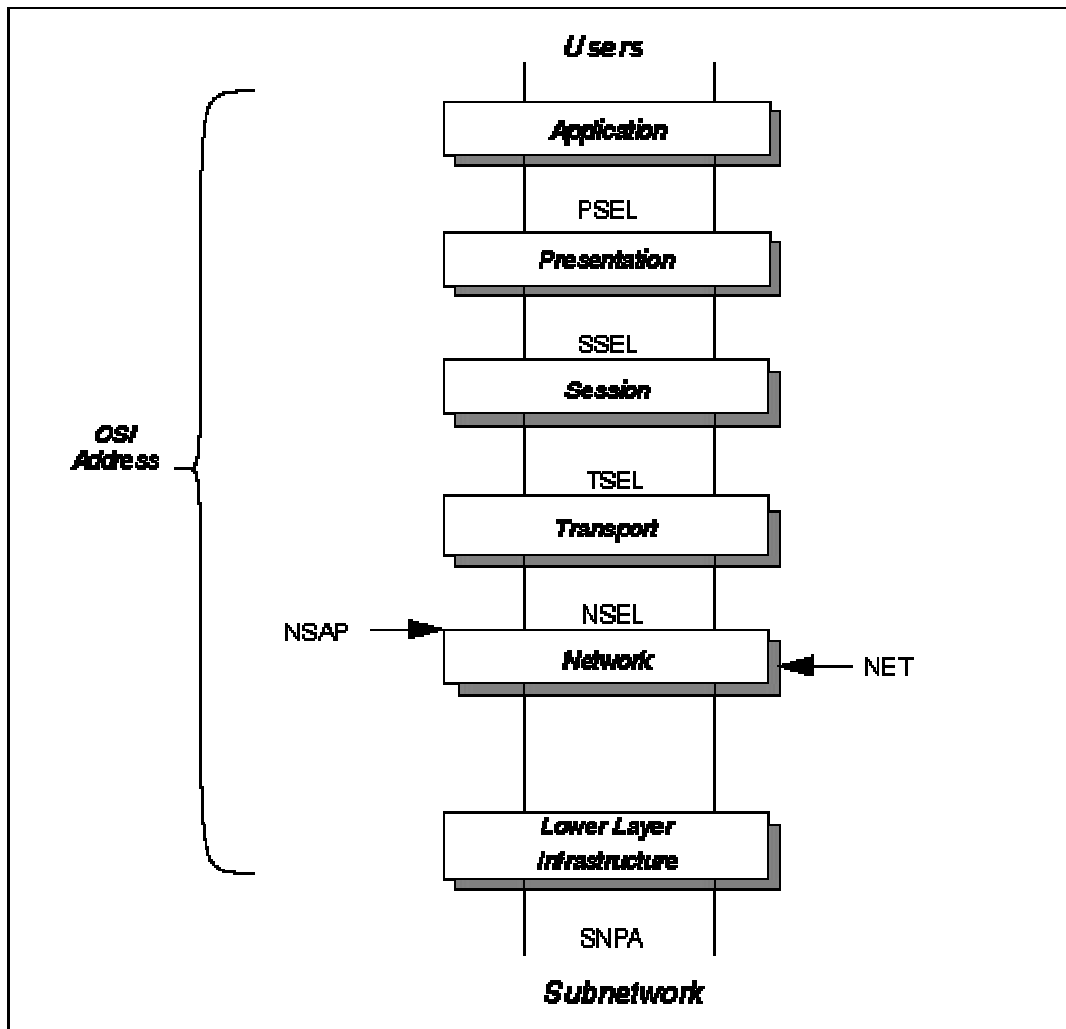


Figure 7-1

Subnetwork Point of Attachment (SNPA)

The SNPA address uniquely identifies a method of access in an OSI subnetwork. It maps the subnetwork to the NSAP. For example, the SNPA can be the physical address. The format of the SNPA depends on the subnetwork:

- For 802.x, 802.3 and FDDI LANs, the SNPA is the six-byte Ethernet-style address, described by the Medium Access Control layer address (MAC) and the Link Selector (LSEL) 0xfe.
- For a PSDN, the SNPA is the X.121 address. A 14-digit X.121 address, plus 1-digit for the X.121 prefix is supported by SunLink OSI 8.1 for the X.25 over CONS. The X.121 address is derived from the NSAP address for CONS 1980 or the AEF for CONS 1984/1988. This is described in more detail later in this chapter.

Note - The SNPA is not a defined part of the OSI scheme. It is required in all networks as the mapping between the NSAP address and the subnetwork.

Network Service Access Point (NSAP)

The NSAP address is used to identify a network layer service provider. It is the entry point of a network layer entity for a network service user, and is unique in the OSI network domain. The global OSI domain is divided into network addressing domains for which an addressing authority ensures unique address identifiers within that domain. The NSAP address can be a maximum of 20 bytes in length.

The addressing used in SunLink OSI 8.1 conforms to ISO 8348/AD2, "Network Services Definition, Addendum 2, Covering Network Layer Addressing" and Annex A of the X.213 Recommendation in relation to handling NSAP addresses.

The general format of the NSAP is composed of several components, that indicate the addressing authority, the format of the address, and the access point for network services. The addressing authority determines the actual format of the NSAP. Figure 7-2 illustrates how these components fit together.

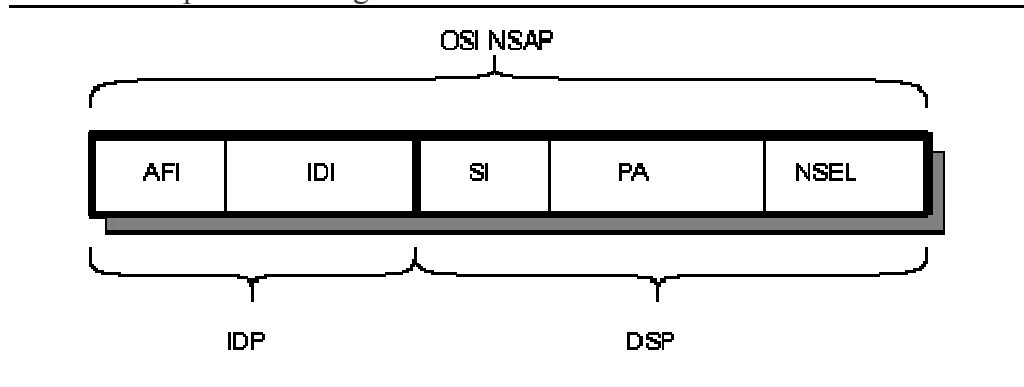


Figure 7-2

where:

- AFI - Authority and Format Identifier (2 bytes)
- IDI - Initial Domain Identifier
- SI - Subnetwork Identifier
- PA - Point of Attachment
- NSEL - Network Selector (1 byte)
- IDP - Initial Domain Part
- DSP - Domain Specific Part
- NSAP - Network Service Access Point (maximum 20 bytes)

The NSAP components are explained in the following sections:

Initial Domain Part (IDP)

The IDP identifies the addressing authority for the overall NSAP address. Its syntax is in BCD-encoded decimal digits. It comprises the AFI and the IDI:

Authority and Format Identifier (AFI) The AFI is a 2-digit number in the range 36 to 59 which:

- Identifies the authority that allocates and identifies the format for this NSAP address.

- Determines if a leading zero in an IDI is significant. For example, both AFI 36 and 52 specify an IDI that is an X.121 address and specify decimal syntax for the DSP. However, the AFI 36 indicates that a leading zero in the IDI is not significant, while AFI 52 indicates that a leading zero in the IDI is significant.
- Specifies the syntax of the DSP. For example, an AFI of 44 specifies a syntax of decimal digits for the DSP. An AFI of 50 specifies a syntax of national characters for the DSP

The authority and format identified by the valid AFIs are indicated in [Table 7-3 on page 111](#).

Initial Domain Identifier (IDI) The IDI format and syntax is determined by the AFI. It can determine the type of addresses used in a subnetwork (such as a telephone number), or it can identify the authority that allocated it. For example, an AFI of 38 specifies an IDI that is a three-digit country code whereas an AFI of 47 specifies an IDI determined by OSI 6523-ICD. The authority and format identified by valid AFIs are indicated in [Table 7-1](#).

| Table 7-1 IDI Format | Description |
|-------------------------------------|--|
| X.121 | Up to 14-digit address used across Packet-Switched Data Networks plus 1 digit for the prefix digit. Allocated according to CCITT Recommendation X.121. |
| ISO DCC | 3-digit Data Country Code. |
| F.69 | Up to 8-digit telex number allocated according to CCITT Recommendation F.69. |
| E.163 | Up to 12-digit Public Switched Telephone Number (PSTN) allocated according to CCITT Recommendation E.163. |
| E.164 | Up to 15-digit ISDN number allocated according to CCITT Recommendation E.164. |
| ISO 6523-ICD | 4-digit International Code Designator. |
| Local | Null IDI. |

For the currently valid AFIs, ISO 8348/AD2 specifies the maximum length and syntax for the IDI and DSP fields.

For IDIs with variable-length formats, ISO requires that IDIs are padded to the maximum length to identify the end of the IDP and the beginning of the DSP. For each variable-length IDI (binary and decimal syntax), ISO allocates two AFI values, where:

- Leading zeroes in the IDI are significant. Therefore, the network layer pads with ones.
- Leading zeroes in the IDI are not significant. Therefore, the network layer pads with zeroes.

For example, AFIs of 36 and 52 both specify a decimal-syntax IDI that is a variable-length X.121 address. However, an AFI of 36 indicates that leading zeroes are not significant, and zeroes are used to pad the IDI to its maximum size. The AFI of 52 indicates that leading zeroes are significant, so ones are used to pad IDIs.

Table 7-2 lists the AFIs that specify variable-length IDIs and whether leading zeroes are significant.

| Table 7-2 AFI Value | IDI Format | DSP Syntax | Leading Zero Significant |
|--------------------------------|-------------------|-------------------|---------------------------------|
| 36 | X.121 | Decimal | No |
| 37 | | Binary | No |
| 52 | | Decimal | Yes |
| 53 | | Binary | Yes |
| 40 | F.69 | Decimal | No |
| 41 | | Binary | No |
| 54 | | Decimal | Yes |
| 55 | | Binary | Yes |
| 42 | E.163 | Decimal | No |
| 43 | | Binary | No |
| 56 | | Decimal | Yes |
| 57 | | Binary | Yes |
| 44 | E.164 | Decimal | No |
| 45 | | Binary | No |
| 58 | | Decimal | Yes |
| 59 | | Binary | Yes |

Domain Specific Part (DSP)

The Domain Specific Part (DSP) is unique within a given addressing authority's domain. Its semantics are determined by the authority defined in the IDI. In some cases, the DSP is null and the IDI number is a public number, similar to a telephone number. There are three network address formats:

- CCITT
- ISO
- Local

Depending on the value of the AFI, a DSP can have a syntax of decimal digits, binary octets (hexadecimal numbers), ISO 646 characters, or characters from a national character set.

While authorities beneath the authority identified by the AFI can control the format and meaning of different parts of the DSP, ISO determines the syntax for the entire DSP. The DSP is comprises the following components:

Subnetwork Identifier (SI) This is a global identifier for the attached subnetwork.

Point of Attachment (PA) This describes the physical attachment address in relation to the network.

Network Selector (NSEL) The last two digits of the NSAP address describe the Network

Selector. This identifies the user of the network layer service, that is, it identifies the transport layer. For all real NSAP address families, SunLink OSI 8.1 assumes that the last byte (two hexadecimal digits) of the NSAP address is the NSEL. While the NSEL is part of the NSAP address, its handling is distinct from the way the rest of an NSAP address is handled.

NSAP Address Field Lengths and Syntax

Table 7-3 is an extension of the ***Maximum NSAP Address Lengths*** table in ISO 8348/AD2. This information is provided for general reference to ensure that you use the correct number of digits for each component in the NSAP address.

The IDP length can be obtained by adding the length of the AFI (2 bytes) to the IDI length. The total length of the NSAP is equal to the sum of the IDP and the DSP.

| Table 7-3 AFI Value | IDI Format | DSP Format | NSAP (Binary DSP) | NSAP (Dec) | IDI Length | IDP Length | DSP Length |
|--------------------------------------|-------------------|-------------------|--------------------------|-------------------|-------------------|-------------------|-------------------|
| 36 | X.121 | Decimal | 20 | 40 | 14 | 16 | 24 |
| 37 | | Binary | 17 | 39 | 14 | 16 | 9 |
| 38 | ISO DCC | Decimal | 20 | 40 | 3 | 5 | 35 |
| 39 | | Binary | 17 | 40 | 3 | 5 | 14 |
| 40 | F.69 | Decimal | 20 | 40 | 8 | 10 | 30 |
| 41 | | Binary | 17 | 40 | 8 | 10 | 12 |
| 42 | E.163 | Decimal | 20 | 40 | 12 | 14 | 26 |
| 43 | | Binary | 17 | 39 | 12 | 14 | 10 |
| 44 | E.164 | Decimal | 20 | 40 | 15 | 17 | 23 |
| 45 | | Binary | 18 | 40 | 15 | 17 | 9 |
| 46 | ISO 6523-ICD | Decimal | 20 | 40 | 4 | 6 | 34 |
| 47 | | Binary | 16 | 39 | 4 | 6 | 13 |
| 48 | Local | Decimal | 20 | 40 | Null | 2 | 38 |
| 49 | | Binary | 16 | 40 | Null | 2 | 15 |
| 50 | | Character | 20 | 40 | Null | 2 | 19 |
| 51 | | National Char | 15 | 37 | Null | 2 | 7 |
| 52 | X.121 | Decimal | 20 | 40 | 14 | 16 | 24 |
| 53 | | Binary | 17 | 39 | 14 | 16 | 9 |
| 54 | F.69 | Decimal | 20 | 40 | 8 | 10 | 30 |
| 55 | | Binary | 17 | 40 | 8 | 10 | 12 |
| 56 | E.163 | Decimal | 20 | 40 | 12 | 14 | 26 |
| 57 | | Binary | 17 | 39 | 12 | 14 | 10 |
| 58 | E.164 | Decimal | 20 | 40 | 15 | 17 | 23 |
| 59 | | Binary | 18 | 40 | 15 | 17 | 9 |

Types of NSAP Addresses

The NSAP that you use to configure your system depends on the type of network and the standards to which it conforms. The types of NSAPs are known as families and the

following can be used in SunLink OSI 8.1:

- **nbs** for network addresses conforming to the National Institute of Standards and Technology (NIST).
- **osinet** for network address conforming to the Open Systems Interconnection Network (OSINET).
- **Us-gossip-v1** for network addresses conforming to U.S. Government Open Systems Interconnection Profile, Version 1 (U.S. GOSIP, v1).
- **Us-gossip-v2** for network addresses conforming to U.S. Government Open Systems Interconnection Profile, Version 2 (U.S. GOSIP, version 2).
- **User-defined** to specify NSAPs that are not covered by the above specifications, in decimal.
- **Hex-pub** to specify NSAPs that not covered by the above specifications, in hexadecimal format.
- **Free-form** to specify NSAPs that do not conform to other specifications. The contents of the NSAP are not verified.

The configuration of these is explained in more detail in "[Network Layer Addresses](#)" on [page 73](#). All types of NSAPs are treated in exactly the same way by SunLink OSI 8.1. Some combinations of families are interchangeable. Any valid NSAP address can be in the **user-defined** or **hex-pub** families, whereas the **nbs**, **osinet**, **us-gossip-v1**, and **us-gossip-v2** families require specific values for the IDP and parts of the DSP. All NSAP addresses in all families are handled identically in SunLink OSI 8.1.

The characteristics and requirements of each family as used in SunLink OSI 8.1 are described in the following examples:

nbs NSAP Address

- AFI of 49 and a null IDI
- A subnetwork number that is 1-byte long (00 to FF) or 5 bytes long where the first octet is non-zero (for example, 01 00 00 00 to FF FF FF FF)
- A seven-byte station id
- A one-byte NSEL

osinet NSAP Address

- An AFI of 47 and an IDI of 4
- A two-byte organization number
- A two-byte subnetwork number
- A six-byte station id (often a MAC address)
- A one-byte NSEL

us-gossip-v1 NSAP Address

- An AFI of 47 and an IDI of 5
- A two-byte organization id
- A two-byte subnetwork id

- An End System id of between four and eight bytes
- A one-byte NSEL

us-gossip-v2 NSAP Address

- An AFI of 47 and IDI of 5
- A data format identifier of 0x80
- A two-byte reserved field for 0
- A three-byte administration authority id
- A two-byte routing domain id
- A two-byte area id
- A six-byte End System id
- A one-byte NSEL

User-defined NSAP Address All valid BCD NSAP addresses of up to 20-bytes in length. That is, all NSAP addresses that meet the requirements of ISO 8348/AD2 can be in this family. Each component (AFI, IDI and DSP) of the NSAP address is checked separately for validity.

Hex-pub NSAP Address All valid hexadecimal NSAP address of up to 20-bytes in length. Hex-pub is the same as the user-defined family because all valid NSAP addresses can be in this family. A check is made that the first two digits are a valid AFI and that there is an even number of digits. Other checks are also made based on the value of the AFI to ensure that a valid NSAP has been specified.

Free-form NSAP Address The **free-form** address can be any 40-digit hexadecimal or 20-character string. SunLink OSI 8.1 does not verify that the entered NSAP address conforms to ISO 8348-AD2.

X.25 over CONS NSAP For networks with 1984 X.25 supporting Address Extension Facilities (AEF), you can use a real NSAP address. For networks with 1980 X.25 over CONS, you need to use a special X.25 address that is based on the SNPA (that is, the X.121 address) plus the following:

- A prefix of 52, if the X.121 address begins with a zero. For example, if the X.121 address is 04325223, then the NSAP is 5204325223. If the address is specified in binary, use a prefix of 53.
- A prefix of 36, if the X.121 address begins with a non-zero number. For example, if the X.121 address is 31311432, then the NSAP is 3631311432. If the address is specified in binary, use a prefix of 37.
- Padding digits where the resulting NSAP address does not have an even number of digits. For example, an X.121 address that starts with a zero and has an odd number of digits requires the addition of a 1 after the prefix of 52, thus 024094322 becomes 52102409432. An X.121 address that starts with a non-zero and has an odd number of digits requires the addition of a 0 after the prefix of 36; thus, 24037121005 become 36024037121005.

Using Null CLNP For CLNP over X.25 networks which use the inactive or null protocol, you need to specify the X.121 address of the remote system in place of the NSAP and

SNPA. For systems using null CLNP over a LAN, you must specify the MAC address of the remote system, instead of the NSAP and SNPA.

Since the null protocol does not perform routing functions, you must either specify a direct route for the remote system (using Route Manager), or specify that the default route is a direct route to that system (using ES-IS Configuration).

Selectors

The selector identifies the user of a service, that is, the entity in the next layer above. For example, the Transport Selector (TSEL) identifies the session entity.

Figure 7-3 indicates the relationships between the selectors and the access points that describe them.

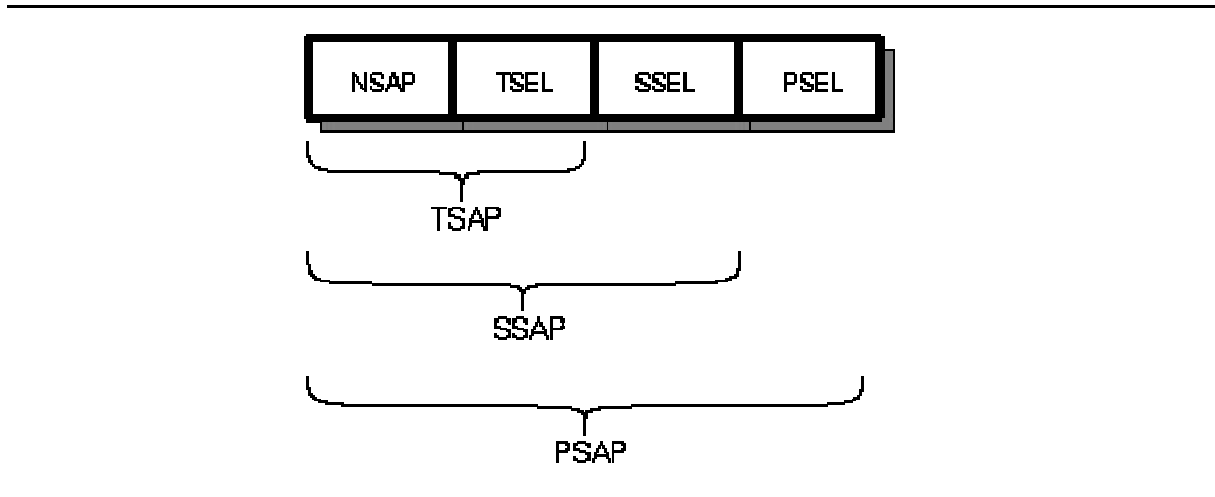


Figure 7-3

where:

- NSAP - Network Service Access Point
- TSEL - Transport Selector
- SSEL - Session Selector
- PSEL - Presentation Selector
- TSAP - Transport Service Access Point
- SSAP - Session Service Access Point
- PSAP - Presentation Service Access Point

The following selectors are used in OSI addressing:

- Transport Selector (TSEL) is used by the transport service to identify a session layer entity. The TSEL plus the NSAP address is known as the TSAP address.
- Session Selector (SSEL) is used by the session layer to identify a presentation layer entity. The SSEL plus the TSAP address is known as the SSAP address.

Resources: *Understanding OSI, Overview of OSI Addressing, www.oracle.com*