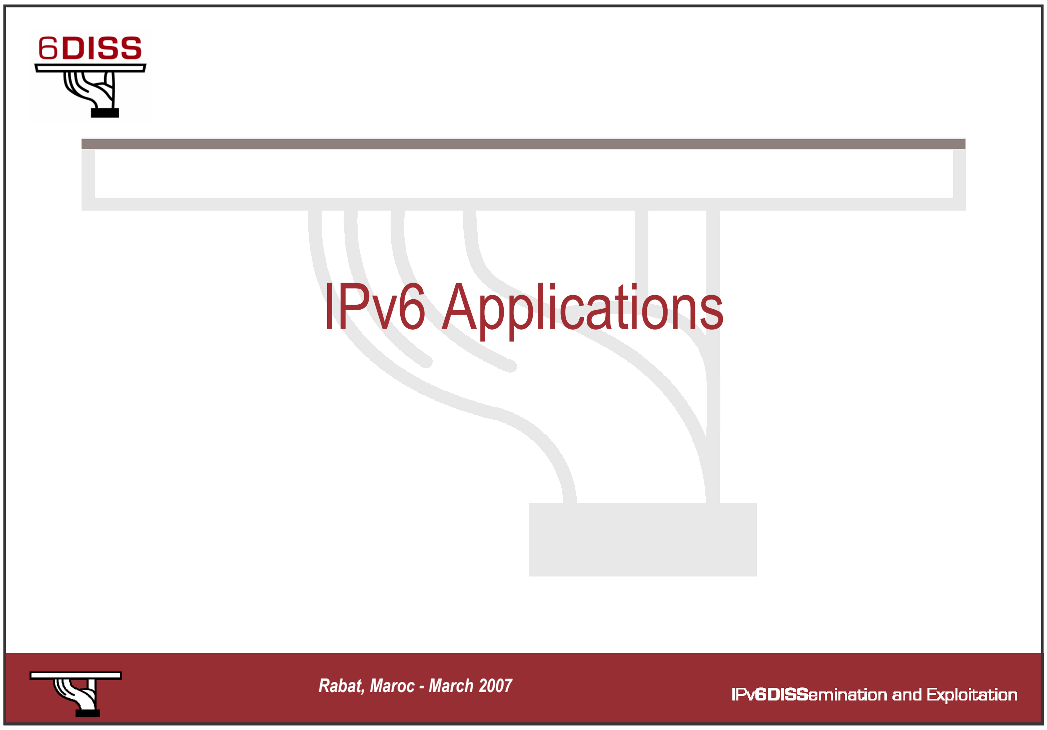
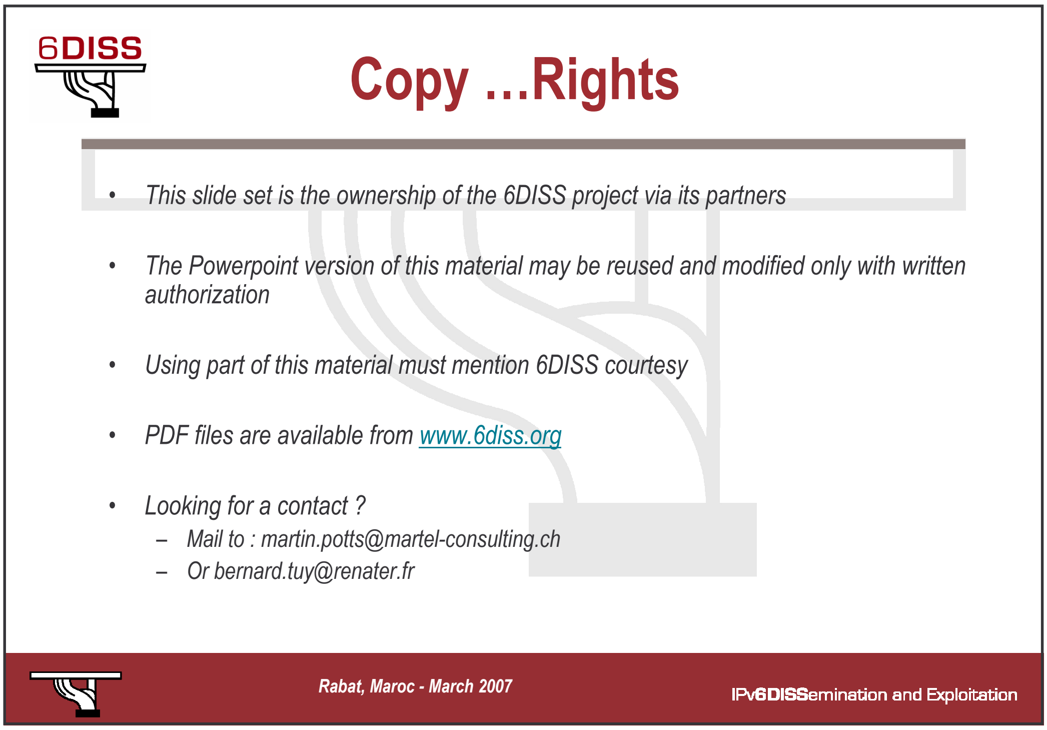


IPv6 Applications



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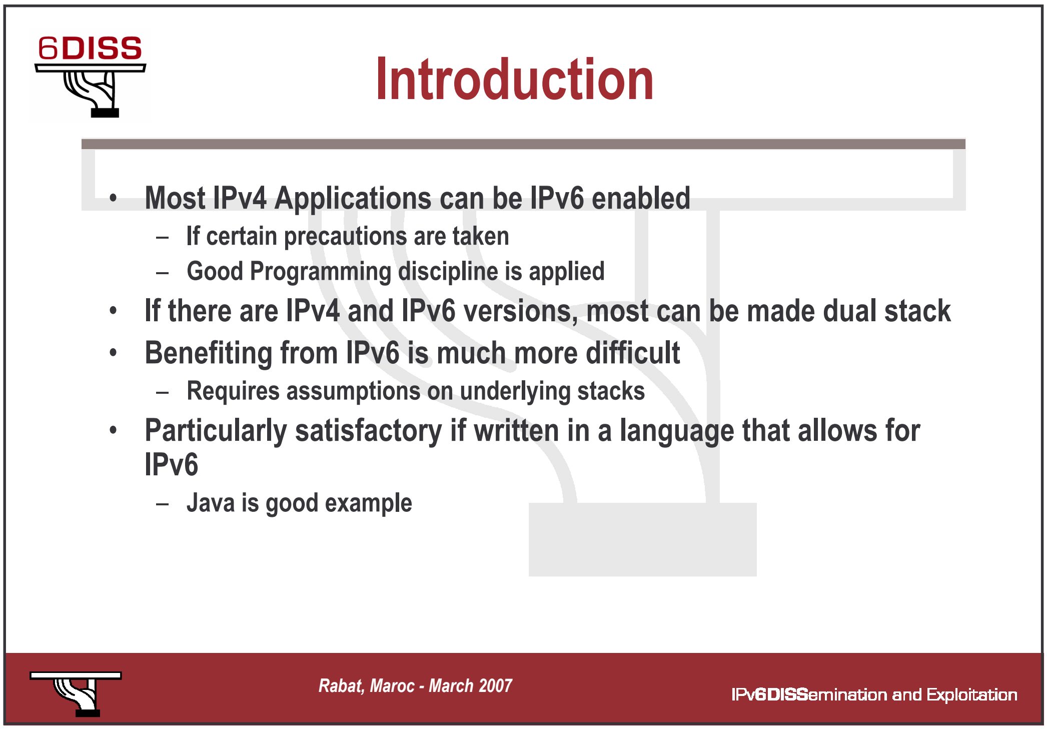
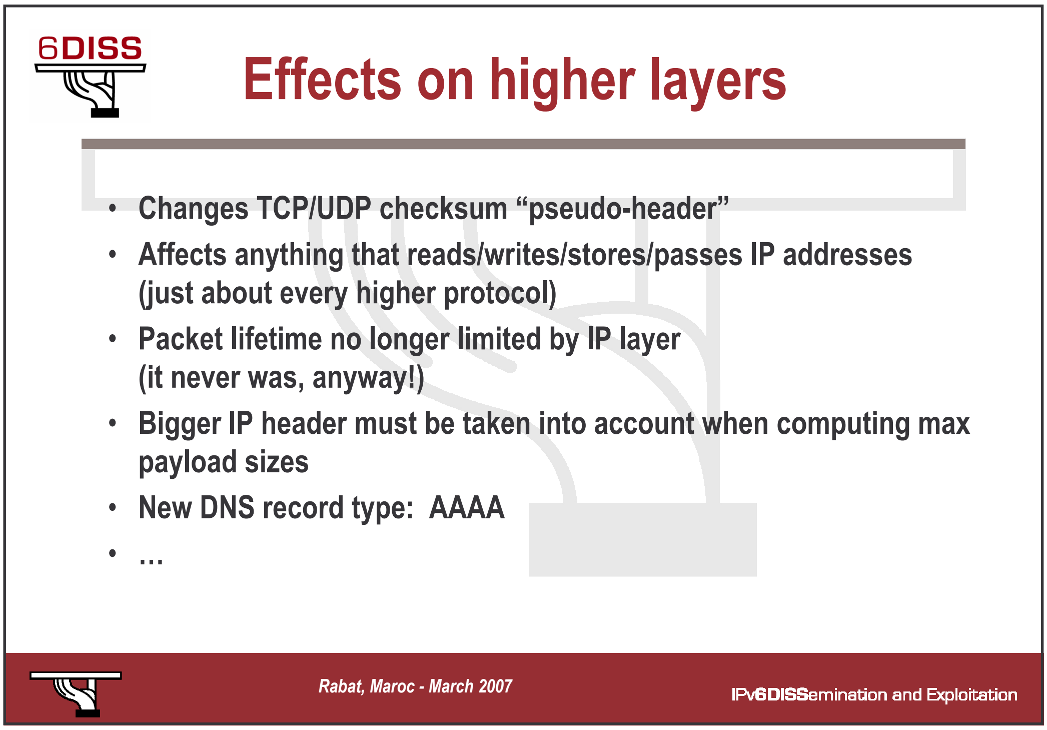


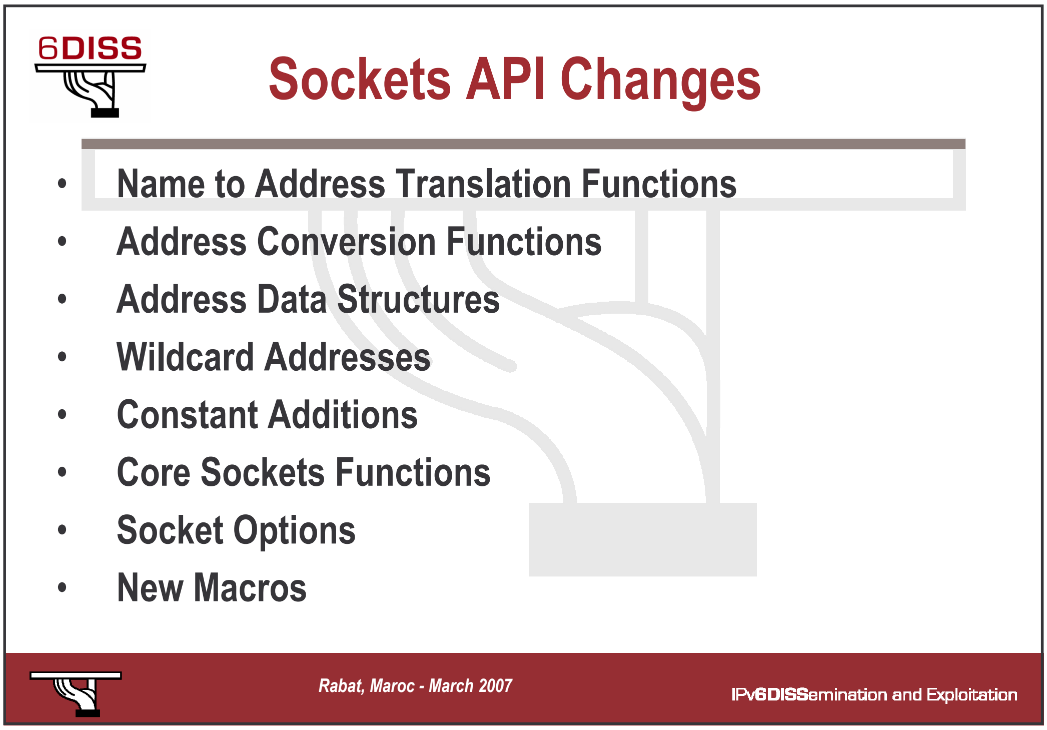
Introduction

- Most IPv4 Applications can be IPv6 enabled
  - If certain precautions are taken
  - Good Programming discipline is applied
- If there are IPv4 and IPv6 versions, most can be made dual stack
- Benefiting from IPv6 is much more difficult
  - Requires assumptions on underlying stacks
- Particularly satisfactory if written in a language that allows for IPv6
  - Java is good example



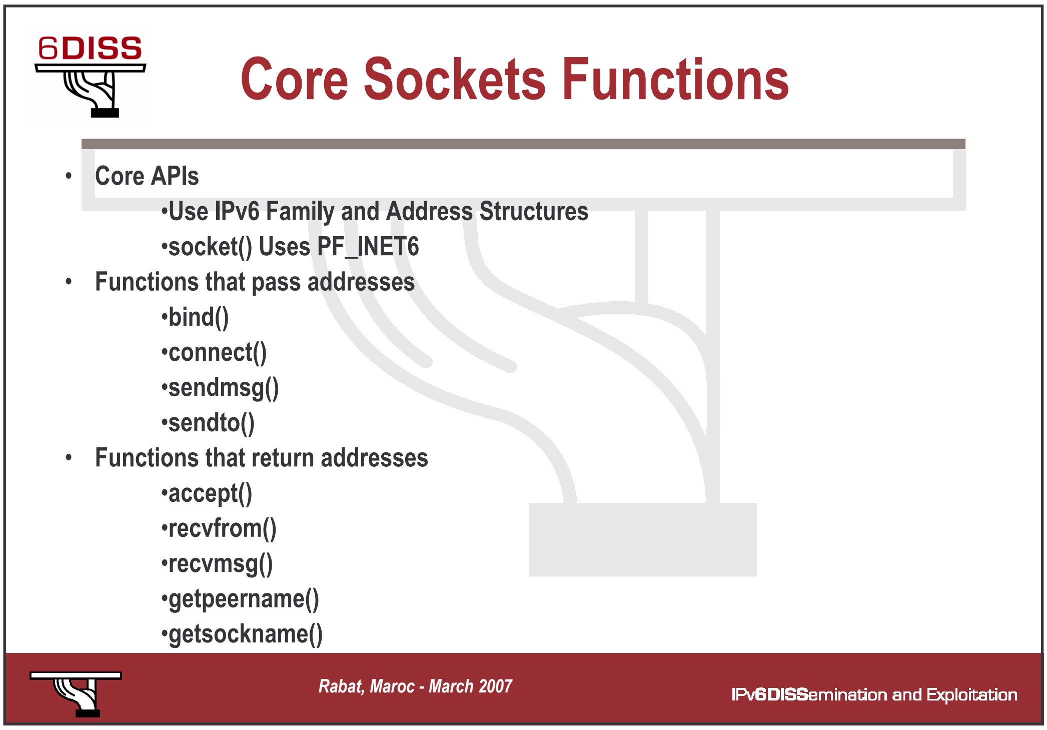
Effects on higher layers

- Changes TCP/UDP checksum “pseudo-header”
- Affects anything that reads/writes/stores/passes IP addresses (just about every higher protocol)
- Packet lifetime no longer limited by IP layer (it never was, anyway!)
- Bigger IP header must be taken into account when computing max payload sizes
- New DNS record type: AAAA
- …



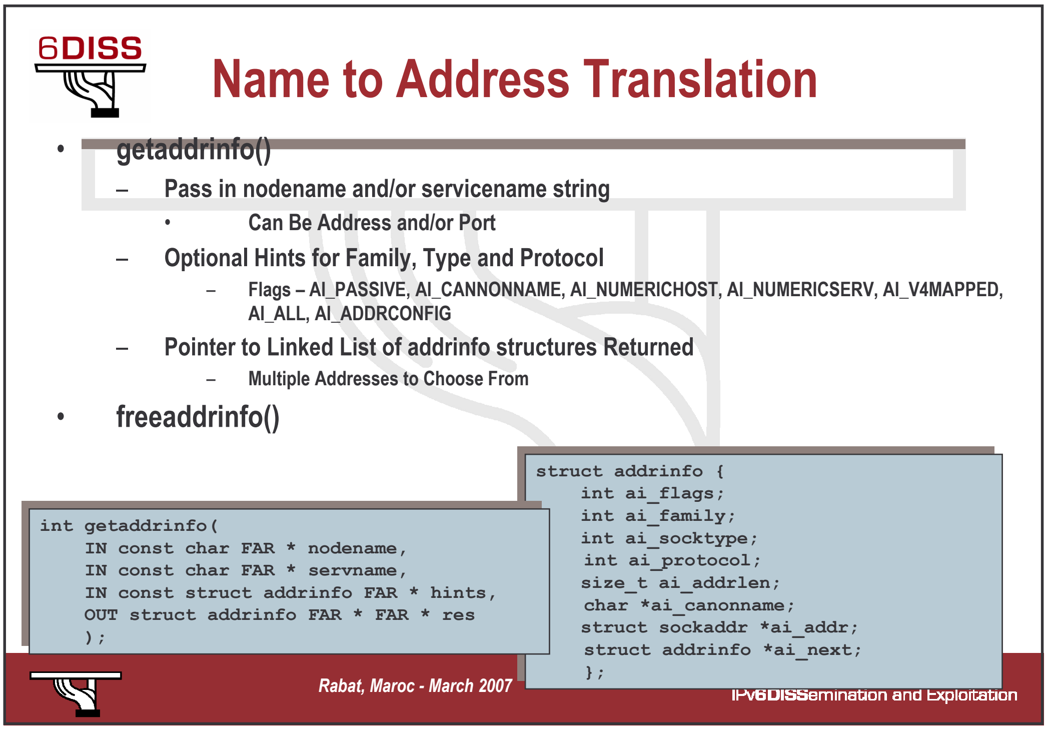
Sockets API Changes

- Name to Address Translation Functions
- Address Conversion Functions
- Address Data Structures
- Wildcard Addresses
- Constant Additions
- Core Sockets Functions
- Socket Options
- New Macros



Core Sockets Functions

- Core APIs
  - •Use IPv6 Family and Address Structures
  - •socket() Uses PF_INET6
- Functions that pass addresses
  - •bind()
  - •connect()
  - •sendmsg()
  - •sendto()
- Functions that return addresses
  - •accept()
  - •recvfrom()
  - •recvmsg()
  - •getpeername()
  - •getsockname()

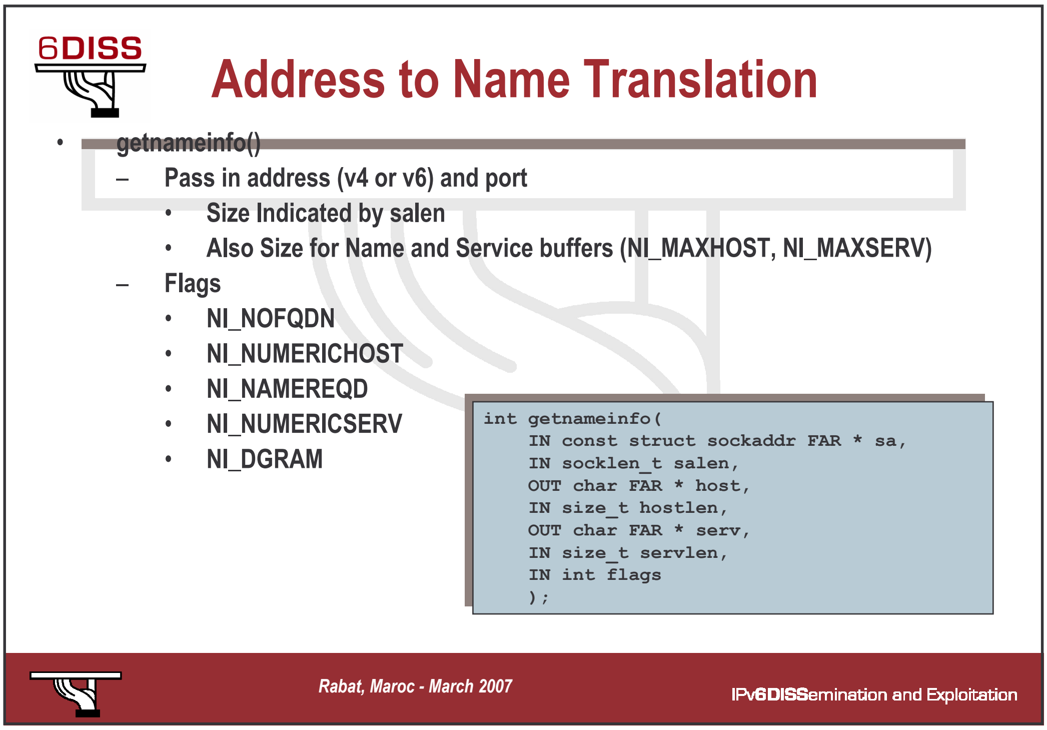


Name to Address Translation

- getaddrinfo()
  - Pass in nodename and/or servicename string
    - Can Be Address and/or Port
  - Optional Hints for Family, Type and Protocol
    - Flags – AI_PASSIVE, AI_CANNONNAME, AI_NUMERICHOST, AI_NUMERICSERV, AI_V4MAPPED, AI_ALL, AI_ADDRCONFIG
  - Pointer to Linked List of addrinfo structures Returned
    - Multiple Addresses to Choose From
- freeaddrinfo()

```
struct addrinfo {
    int ai_flags;
    int ai_family;
    int ai_socktype;
    int ai_protocol;
    size_t ai_addrlen;
    char *ai_canonname;
    struct sockaddr *ai_addr;
    struct addrinfo *ai_next;
    };
```

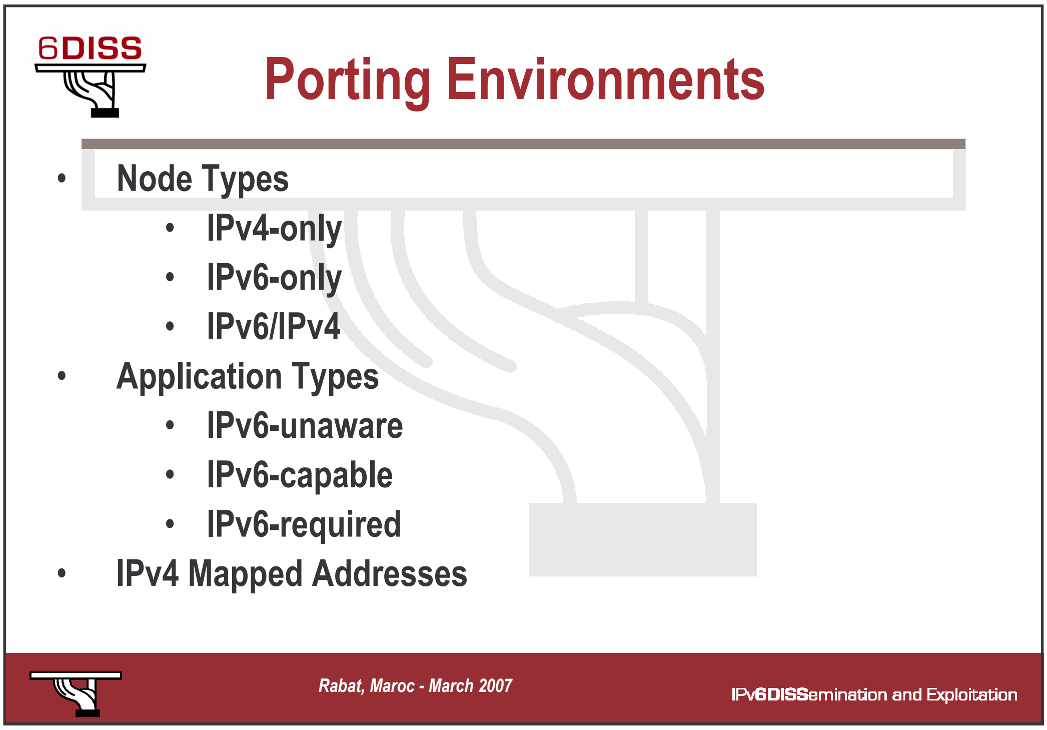
```
int getaddrinfo(
    IN const char FAR * nodename,
    IN const char FAR * servname,
    IN const struct addrinfo FAR * hints,
    OUT struct addrinfo FAR * FAR * res
    );
```



Address to Name Translation

- getnameinfo()
  - Pass in address (v4 or v6) and port
    - Size Indicated by salen
    - Also Size for Name and Service buffers (NI_MAXHOST, NI_MAXSERV)
  - Flags
    - NI_NOFQDN
    - NI_NUMERICHOST
    - NI_NAMEREQD
    - NI_NUMERICSERV
    - NI_DGRAM

```
int getnameinfo(
    IN const struct sockaddr FAR * sa,
    IN socklen_t salen,
    OUT char FAR * host,
    IN size_t hostlen,
    OUT char FAR * serv,
    IN size_t servlen,
    IN int flags
    );
```



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Porting Environments

- Node Types
  - IPv4-only
  - IPv6-only
  - IPv6/IPv4
- Application Types
  - IPv6-unaware
  - IPv6-capable
  - IPv6-required
- IPv4 Mapped Addresses

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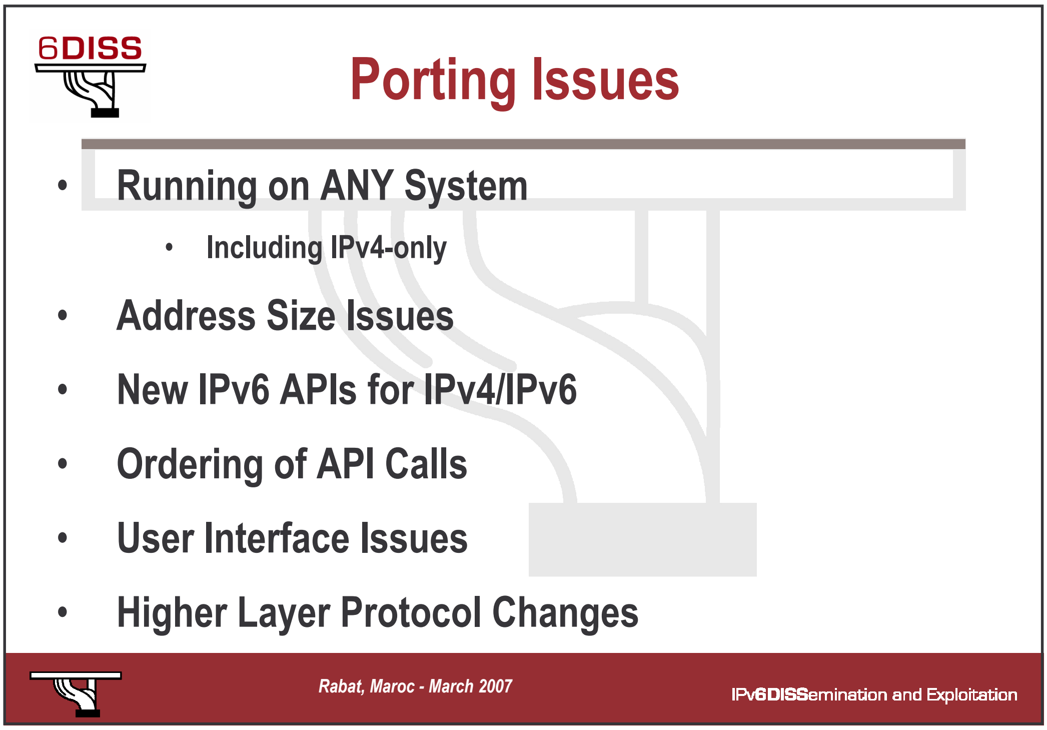
IPv**6DISS**emination and Exploitation



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Porting Issues

- Running on ANY System
  - Including IPv4-only
- Address Size Issues
- New IPv6 APIs for IPv4/IPv6
- Ordering of API Calls
- User Interface Issues
- Higher Layer Protocol Changes

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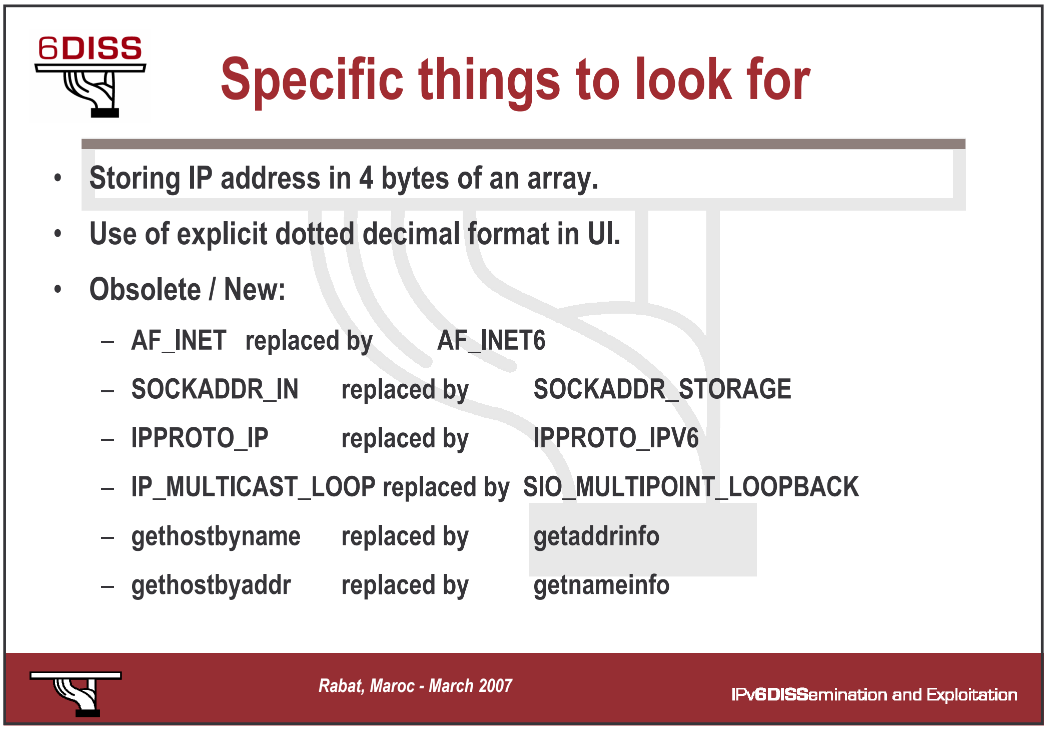

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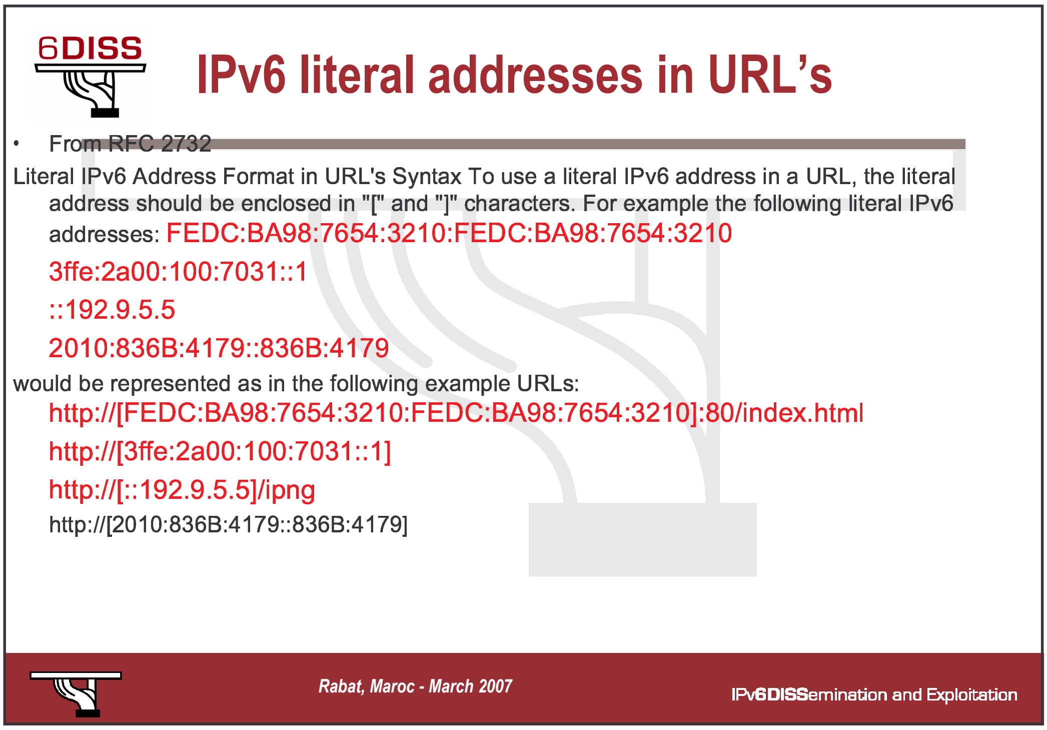
Specific things to look for

- Storing IP address in 4 bytes of an array.
- Use of explicit dotted decimal format in UI.
- Obsolete / New:
  - AF_INET replaced by AF_INET6
  - SOCKADDR_IN replaced by SOCKADDR_STORAGE
  - IPPROTO_IP replaced by IPPROTO_IPV6
  - IP_MULTICAST_LOOP replaced by SIO_MULTIPOINT_LOOPBACK
  - gethostbyname replaced by getaddrinfo
  - gethostbyaddr replaced by getnameinfo



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IPv6 literal addresses in URL’s

- From RFC 2732

Literal IPv6 Address Format in URL's Syntax To use a literal IPv6 address in a URL, the literal address should be enclosed in "[" and "]" characters. For example the following literal IPv6 addresses: FEDC:BA98:7654:3210:FEDC:BA98:7654:3210

3ffe:2a00:100:7031::1

::192.9.5.5

2010:836B:4179::836B:4179

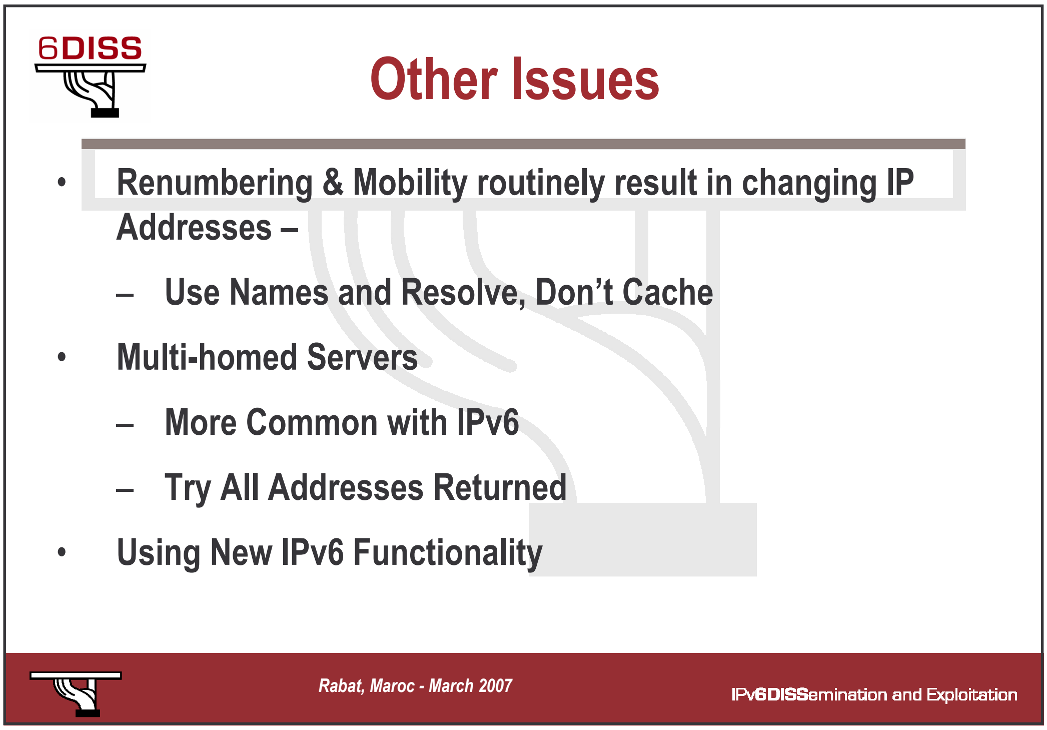
would be represented as in the following example URLs:

http://[FEDC:BA98:7654:3210:FEDC:BA98:7654:3210]:80/index.html

http://[3ffe:2a00:100:7031::1]

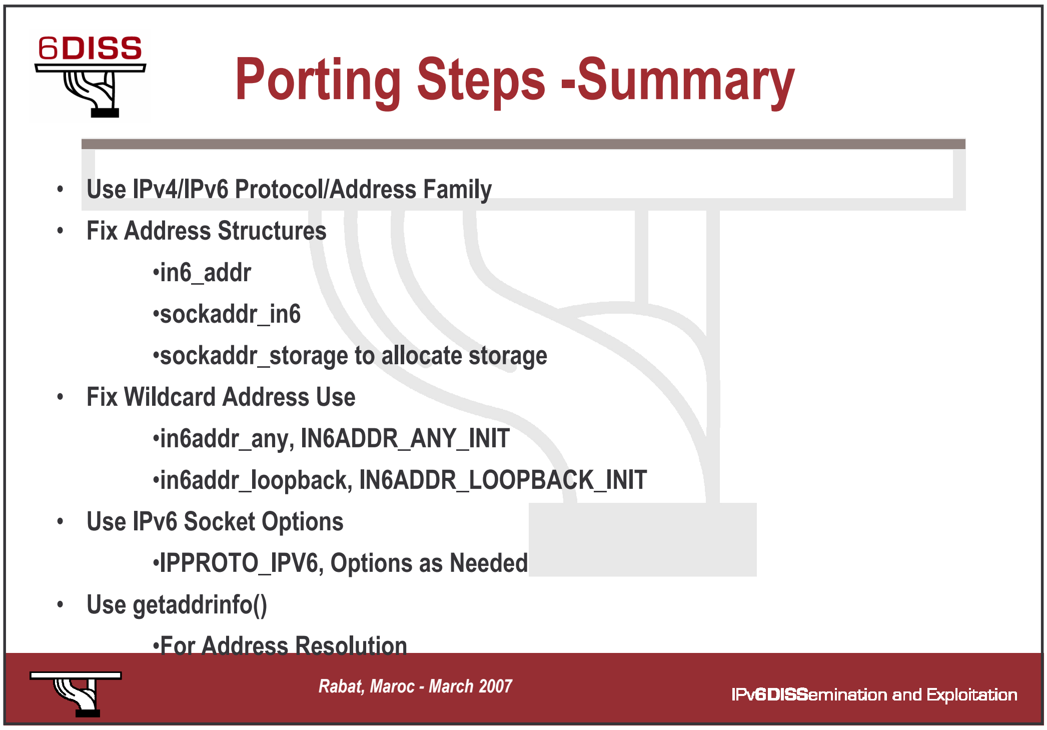
http://[::192.9.5.5]/ipng

http://[2010:836B:4179::836B:4179]



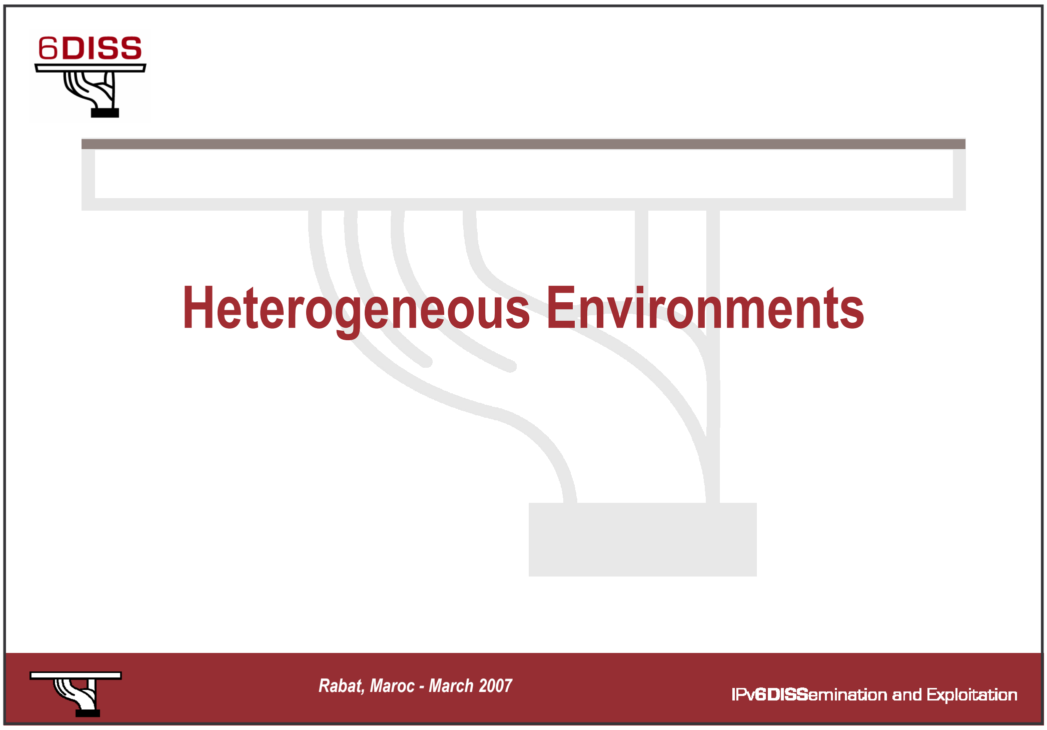
Other Issues

- Renumbering & Mobility routinely result in changing IP Addresses –
  - Use Names and Resolve, Don’t Cache
- Multi-homed Servers
  - More Common with IPv6
  - Try All Addresses Returned
- Using New IPv6 Functionality



Porting Steps -Summary

- Use IPv4/IPv6 Protocol/Address Family
- Fix Address Structures
  - •in6_addr
  - •sockaddr_in6
  - •sockaddr_storage to allocate storage
- Fix Wildcard Address Use
  - •in6addr_any, IN6ADDR_ANY_INIT
  - •in6addr_loopback, IN6ADDR_LOOPBACK_INIT
- Use IPv6 Socket Options
  - •IPPROTO_IPV6, Options as Needed
- Use getaddrinfo()
  - •For Address Resolution



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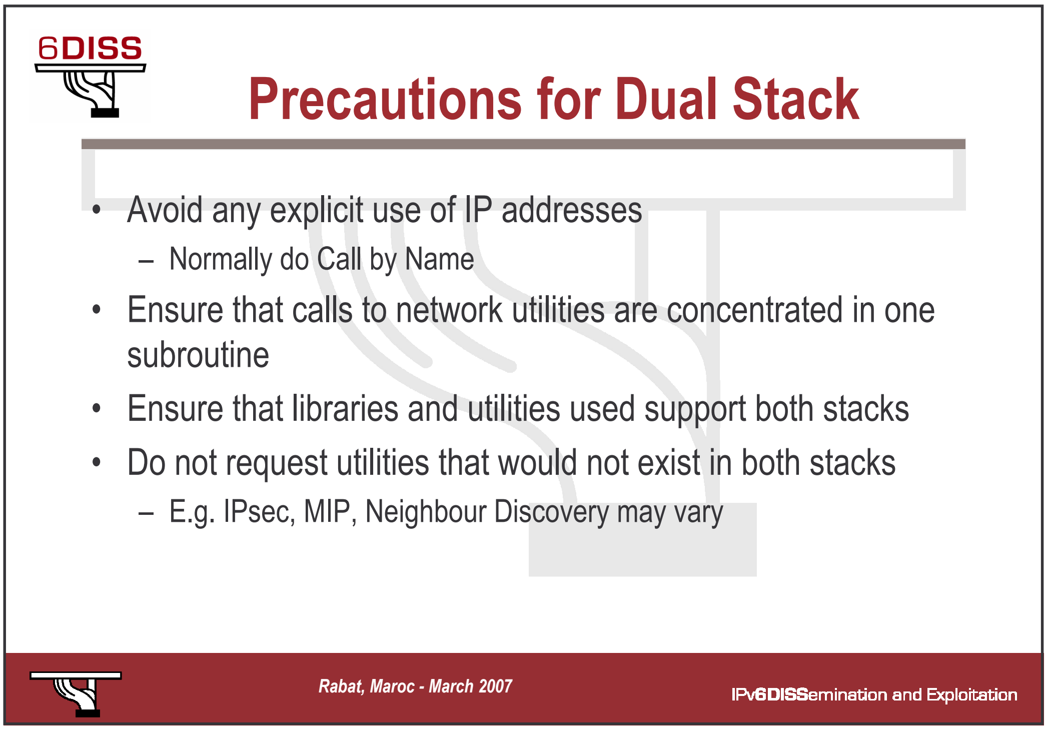
Heterogeneous Environments



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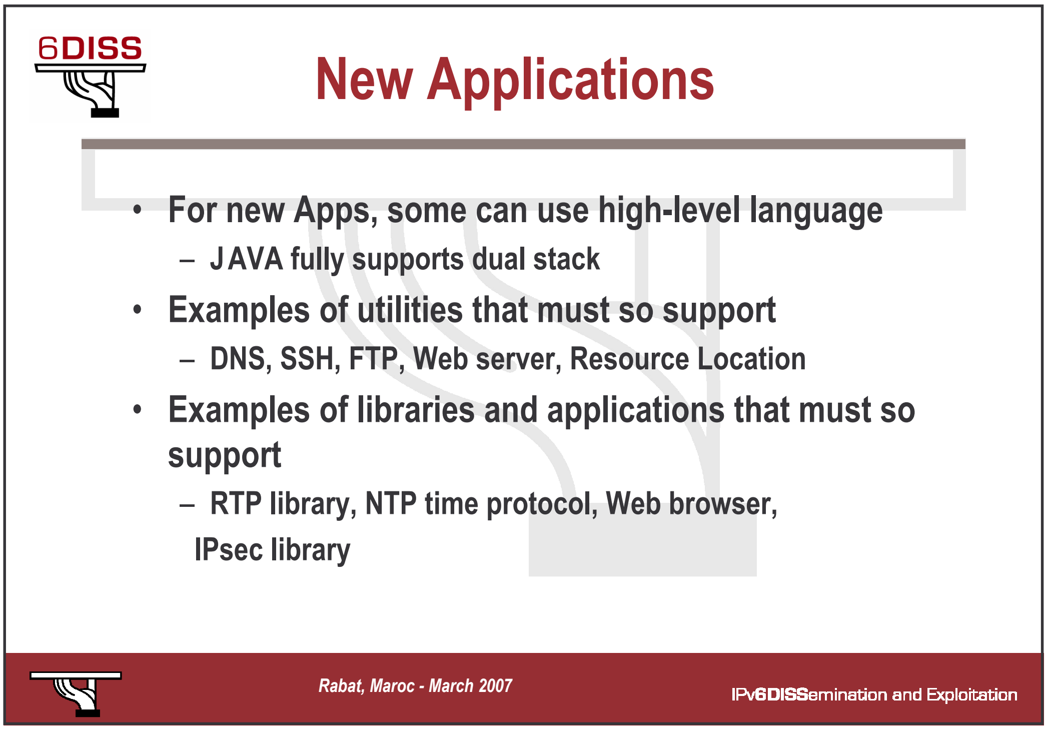
Precautions for Dual Stack

- Avoid any explicit use of IP addresses
  - Normally do Call by Name
- Ensure that calls to network utilities are concentrated in one subroutine
- Ensure that libraries and utilities used support both stacks
- Do not request utilities that would not exist in both stacks
  - E.g. IPsec, MIP, Neighbour Discovery may vary



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New Applications

- For new Apps, some can use high-level language
  - JAVA fully supports dual stack
- Examples of utilities that must so support
  - DNS, SSH, FTP, Web server, Resource Location
- Examples of libraries and applications that must so support
  - RTP library, NTP time protocol, Web browser, IPsec library

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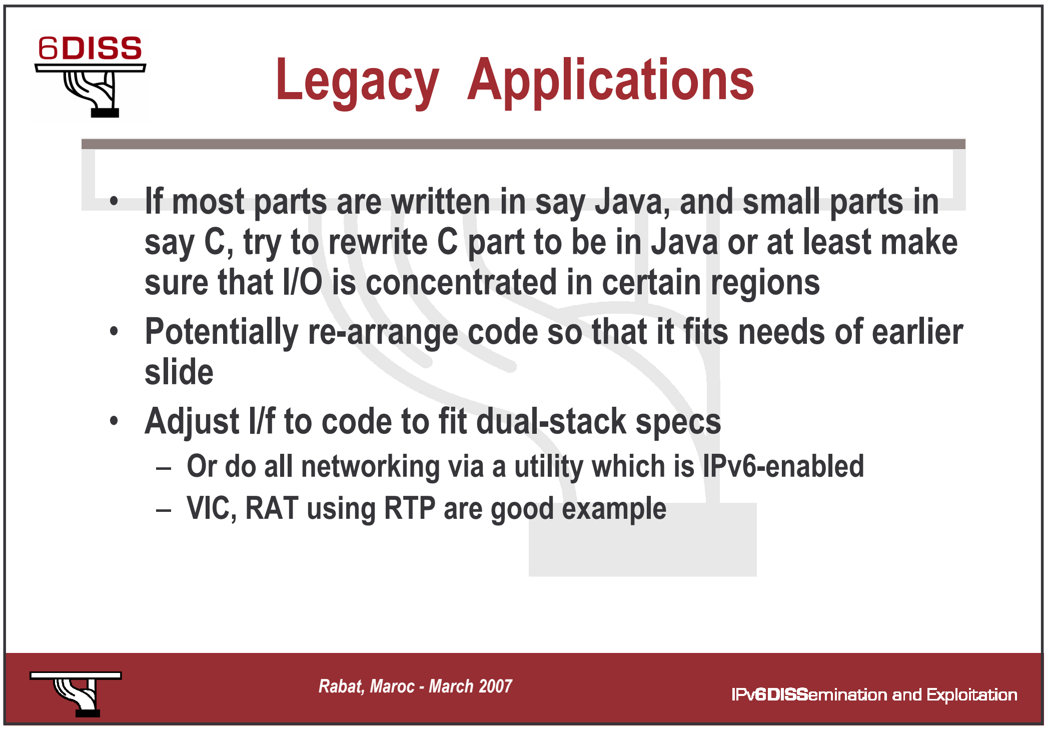
IPv6DISSemination and Exploitation



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Legacy Applications

- If most parts are written in say Java, and small parts in say C, try to rewrite C part to be in Java or at least make sure that I/O is concentrated in certain regions
- Potentially re-arrange code so that it fits needs of earlier slide
- Adjust I/f to code to fit dual-stack specs
  - Or do all networking via a utility which is IPv6-enabled
  - VIC, RAT using RTP are good example

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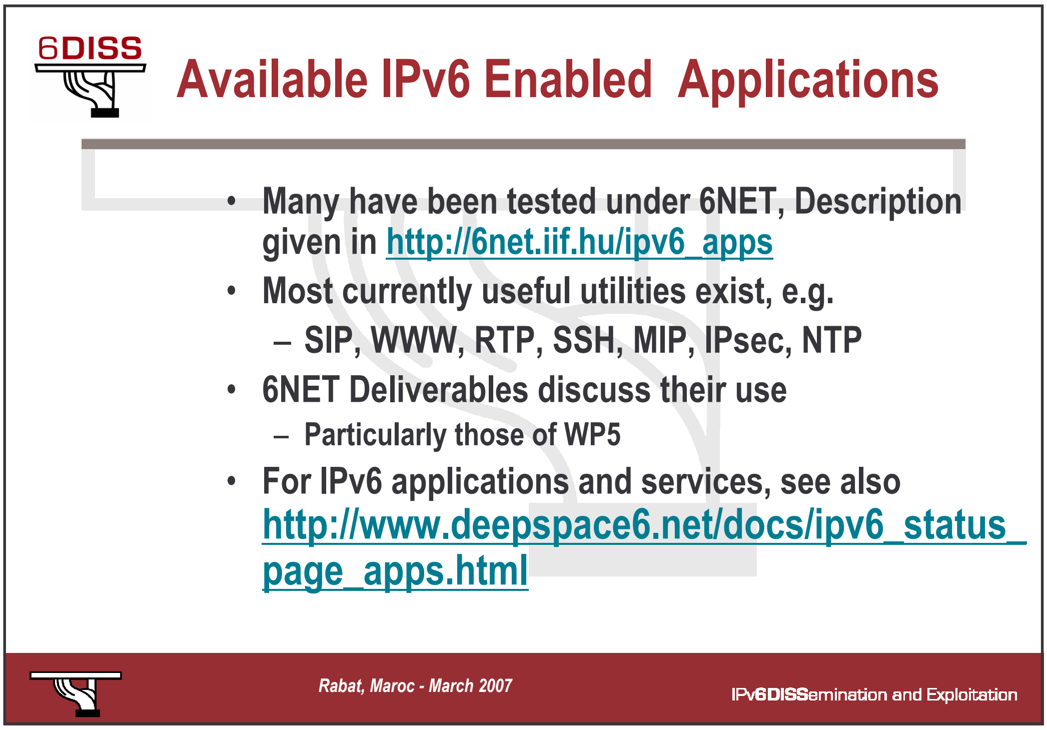
IPv6DISSemination and Exploitation

Heterogeneous IPv4/IPv6 Environments

- May require dual-stack client/server, accessible by both stacks
  - Often used, for example, with Web services and with SIP signalling
- May require transition gateway
  - As for example with IPv4 telephones accessing other IPv6 ones
- May be very difficult, as when encrypted IPv4 messages are passed into the IPv6 networks with packet header encrypted, or certificate cryptographically bound to IP4 address

Available Applications



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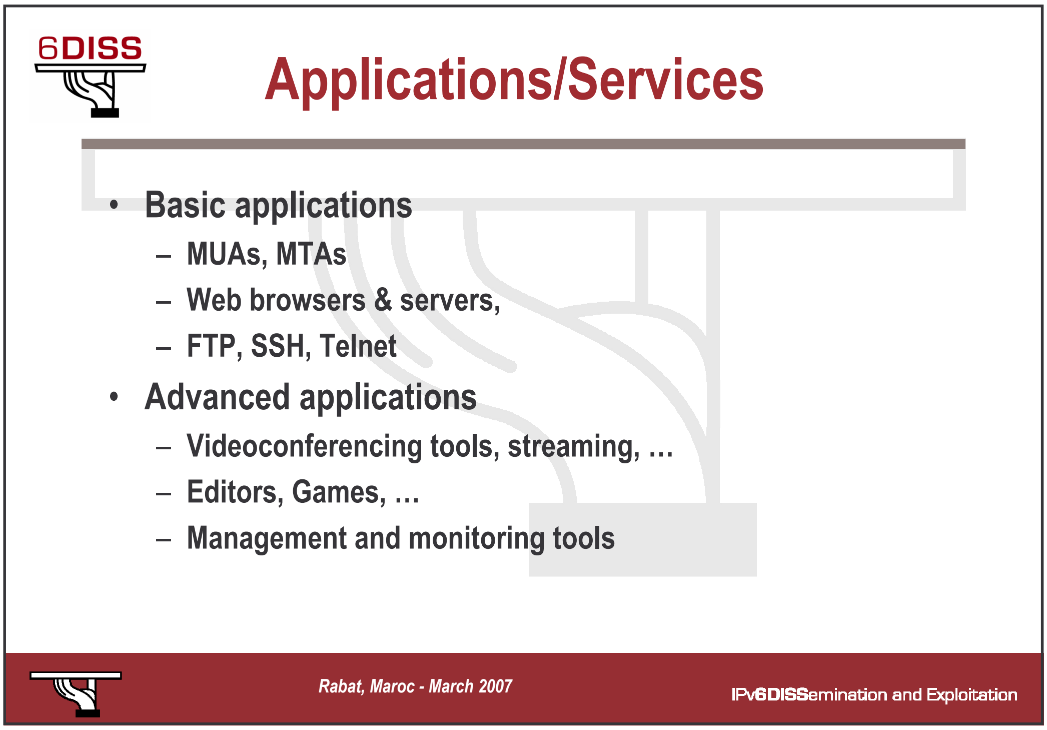
Available IPv6 Enabled Applications

- Many have been tested under 6NET, Description given in http://6net.iif.hu/ipv6_apps
- Most currently useful utilities exist, e.g.
  - SIP, WWW, RTP, SSH, MIP, IPsec, NTP
- 6NET Deliverables discuss their use
  - Particularly those of WP5
- For IPv6 applications and services, see also http://www.deepspace6.net/docs/ipv6_status_page_apps.html



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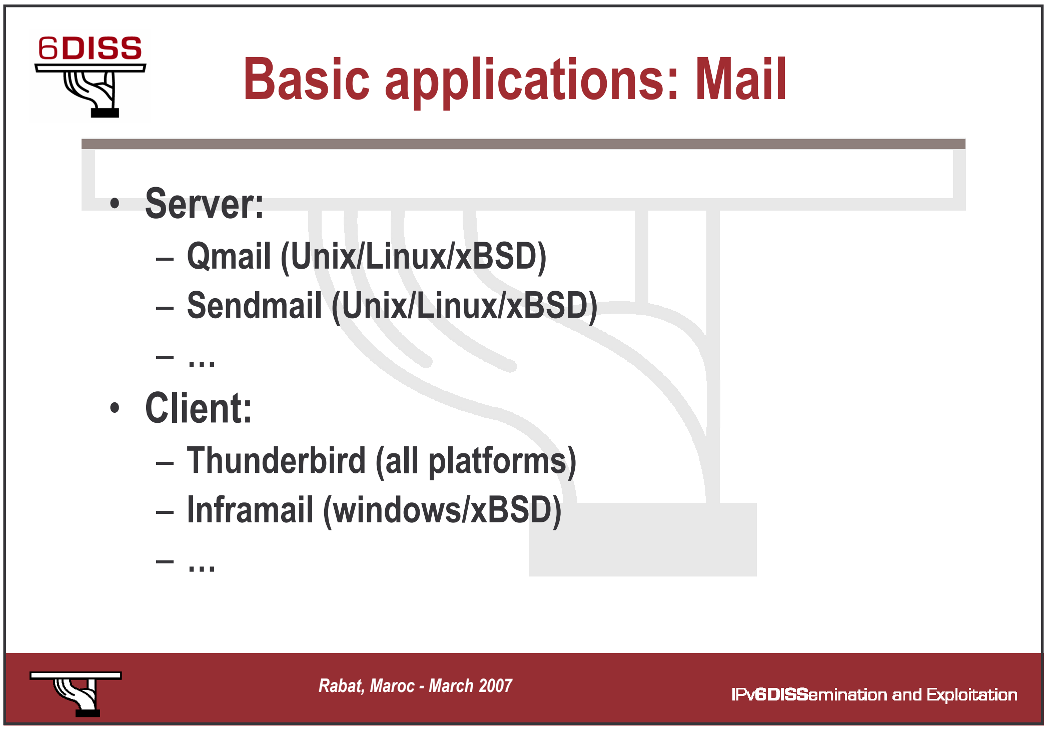
Applications/Services

- Basic applications
  - MUAs, MTAs
  - Web browsers & servers,
  - FTP, SSH, Telnet
- Advanced applications
  - Videoconferencing tools, streaming, …
  - Editors, Games, …
  - Management and monitoring tools



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Basic applications: Mail

- Server:
  - Qmail (Unix/Linux/xBSD)
  - Sendmail (Unix/Linux/xBSD)
  - …
- Client:
  - Thunderbird (all platforms)
  - Inframail (windows/xBSD)
  - …

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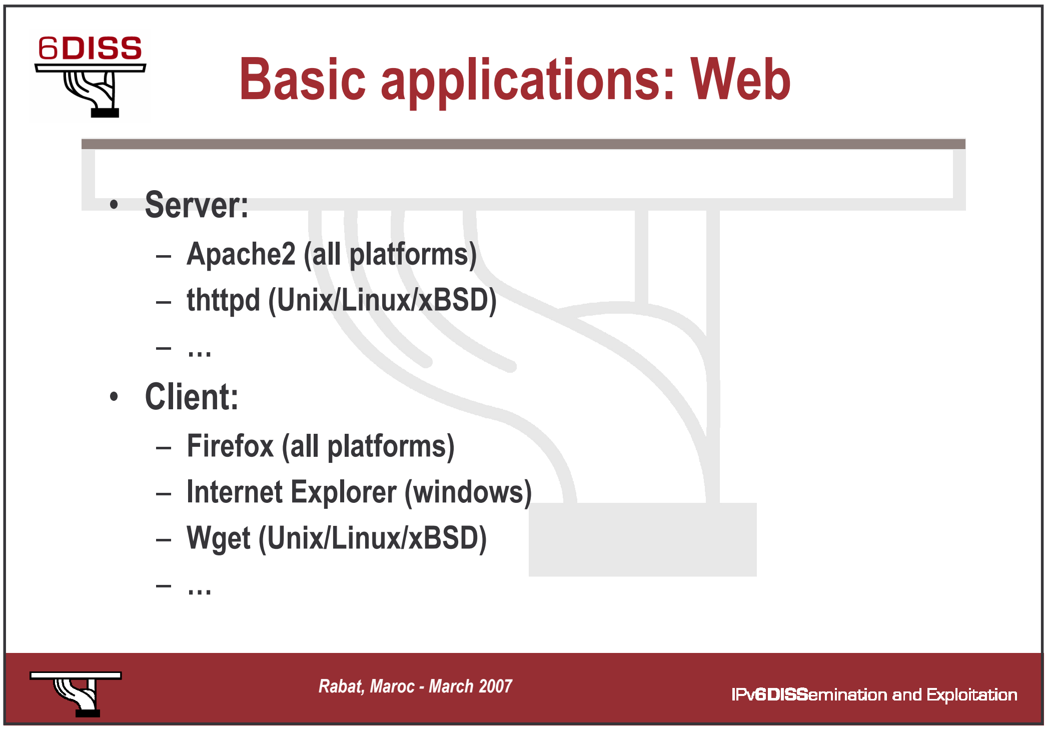

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Basic applications: Web

- Server:
  - Apache2 (all platforms)
  - thttpd (Unix/Linux/xBSD)
  - …
- Client:
  - Firefox (all platforms)
  - Internet Explorer (windows)
  - Wget (Unix/Linux/xBSD)
  - …

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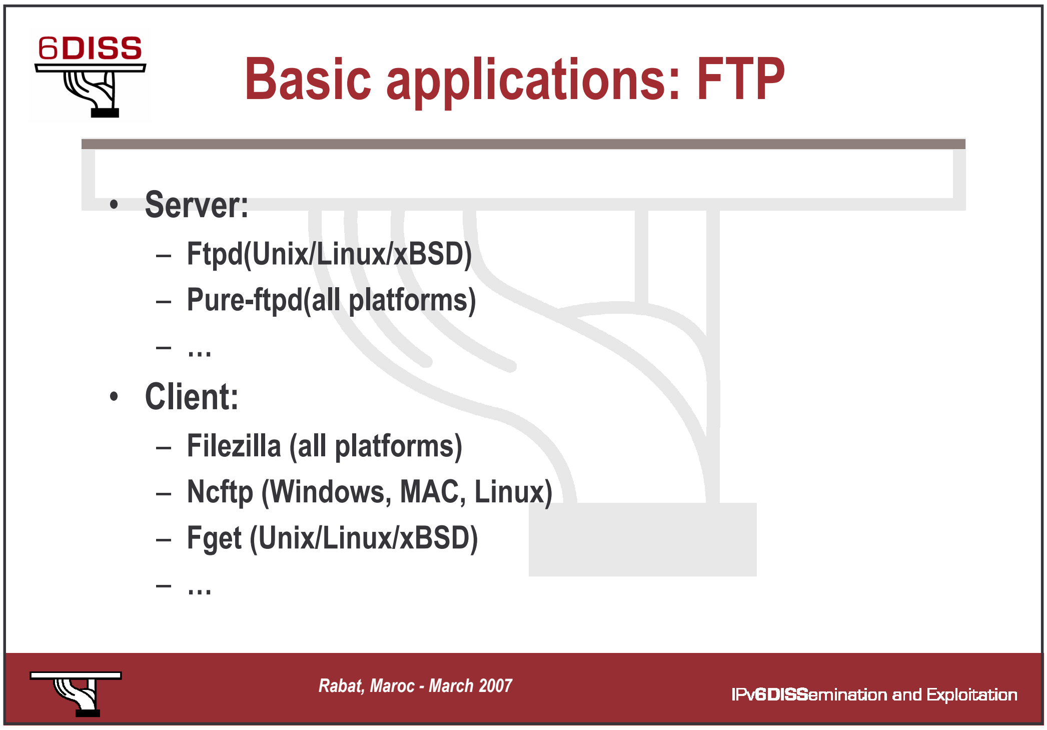

Basic applications: FTP

- Server:
  - Ftpd(Unix/Linux/xBSD)
  - Pure-ftpd(all platforms)
  - …
- Client:
  - Filezilla (all platforms)
  - Ncftp (Windows, MAC, Linux)
  - Fget (Unix/Linux/xBSD)
  - …

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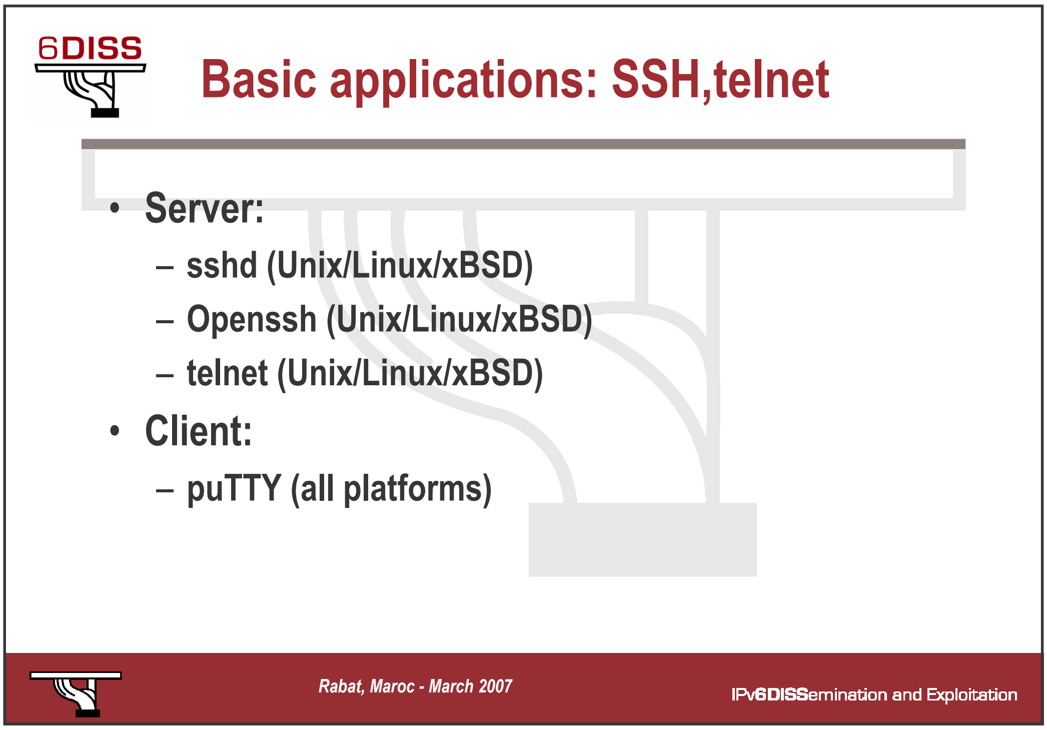

Basic applications: SSH,telnet

- Server:
  - sshd (Unix/Linux/xBSD)
  - Openssh (Unix/Linux/xBSD)
  - telnet (Unix/Linux/xBSD)
- Client:
  - puTTY (all platforms)

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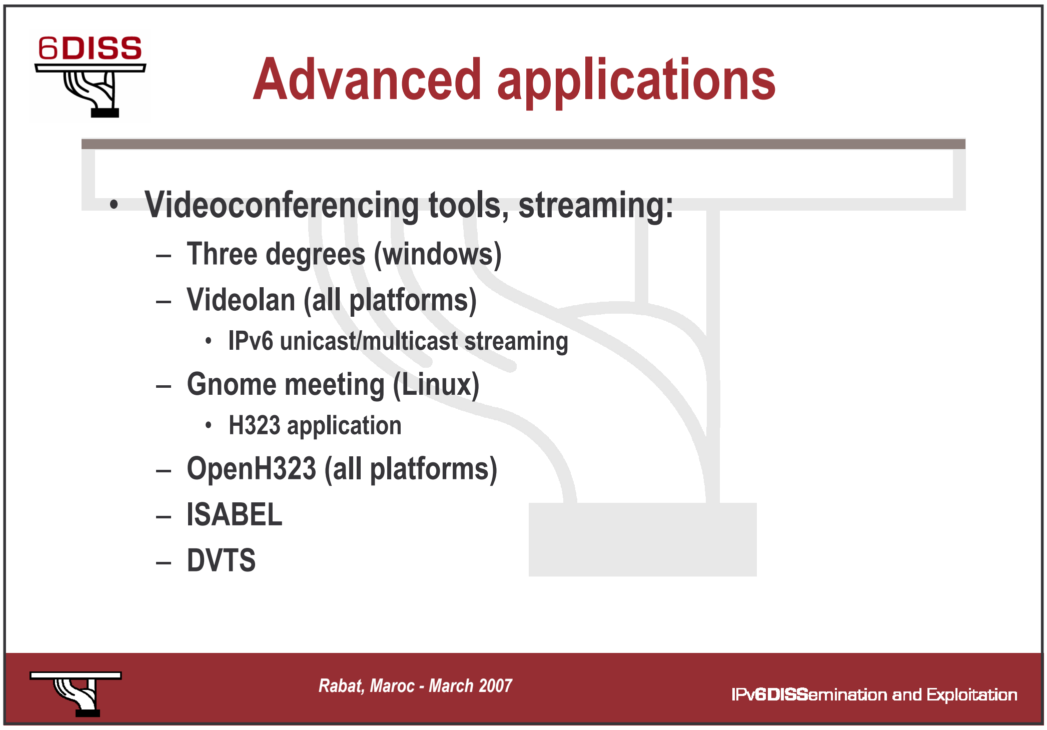

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Advanced applications

- Videoconferencing tools, streaming:
  - Three degrees (windows)
  - Videolan (all platforms)
    - IPv6 unicast/multicast streaming
  - Gnome meeting (Linux)
    - H323 application
  - OpenH323 (all platforms)
  - ISABEL
  - DVTS

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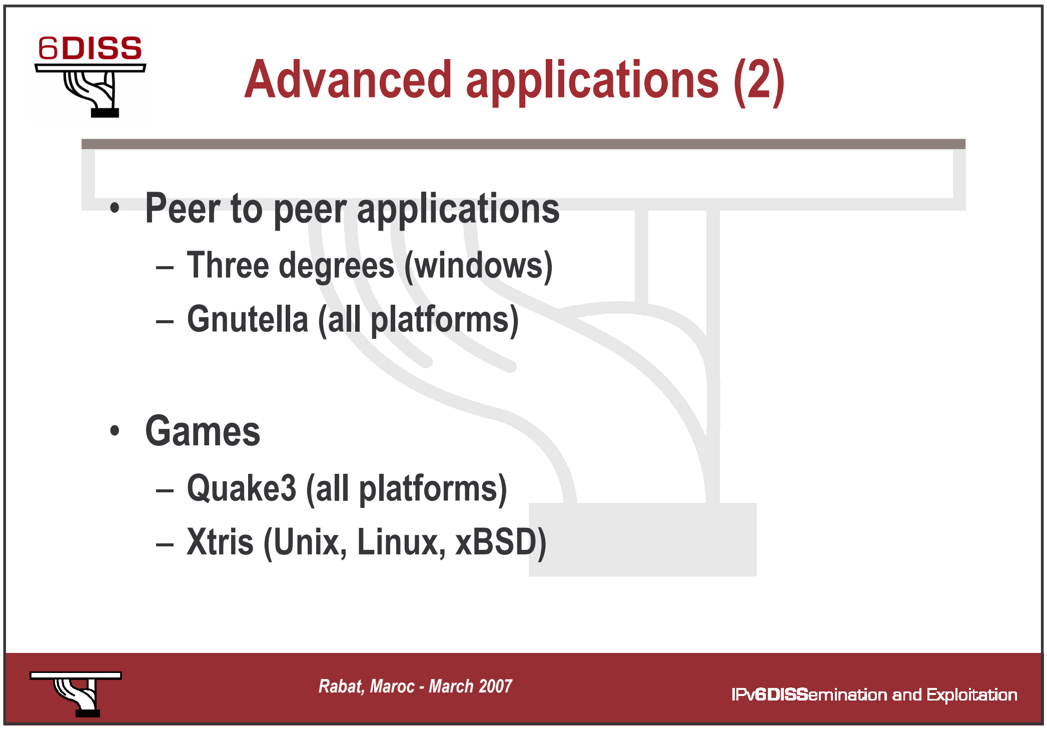

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Advanced applications (2)

- Peer to peer applications
  - Three degrees (windows)
  - Gnutella (all platforms)
- Games
  - Quake3 (all platforms)
  - Xtris (Unix, Linux, xBSD)

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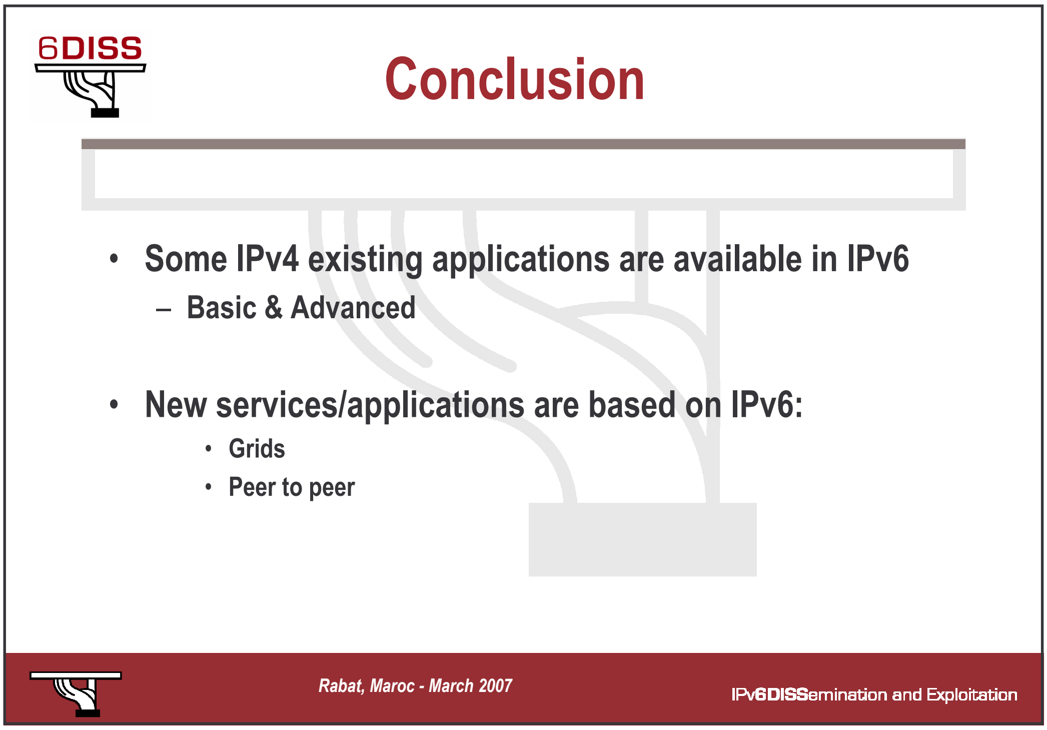

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Conclusion

- Some IPv4 existing applications are available in IPv6
  - Basic & Advanced
- New services/applications are based on IPv6:
  - Grids
  - Peer to peer