TANGO Interactive Training Session

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Agenda

- TANGO functionality - What it does?
- TANGO architecture - How is it built?
- Installation of TANGO software distributions
  - Client software
  - Collaboratory server software
  - Full installation of TANGO application server
- Installation of TANGO “local applications”
- Using core TANGO
- Using TANGO applications
- TANGO API and programming examples

TANGO Interactive - What it Does?

- **It lets applications controlled by your browser to talk to Web application run by other people**
  - **With few mouse clicks, TANGO Interactive builds for you a conference room, or a classroom, using tools from a long list of collaboratory modules**
  - **When you have your tools, with another mouse click you send them to your partners' machines**
  - **Anybody can join any of the application sessions, grab control, leave, open a private channel, create another chat room, send a private or public message, play a video other people can see, or start and share any "legacy" application….**

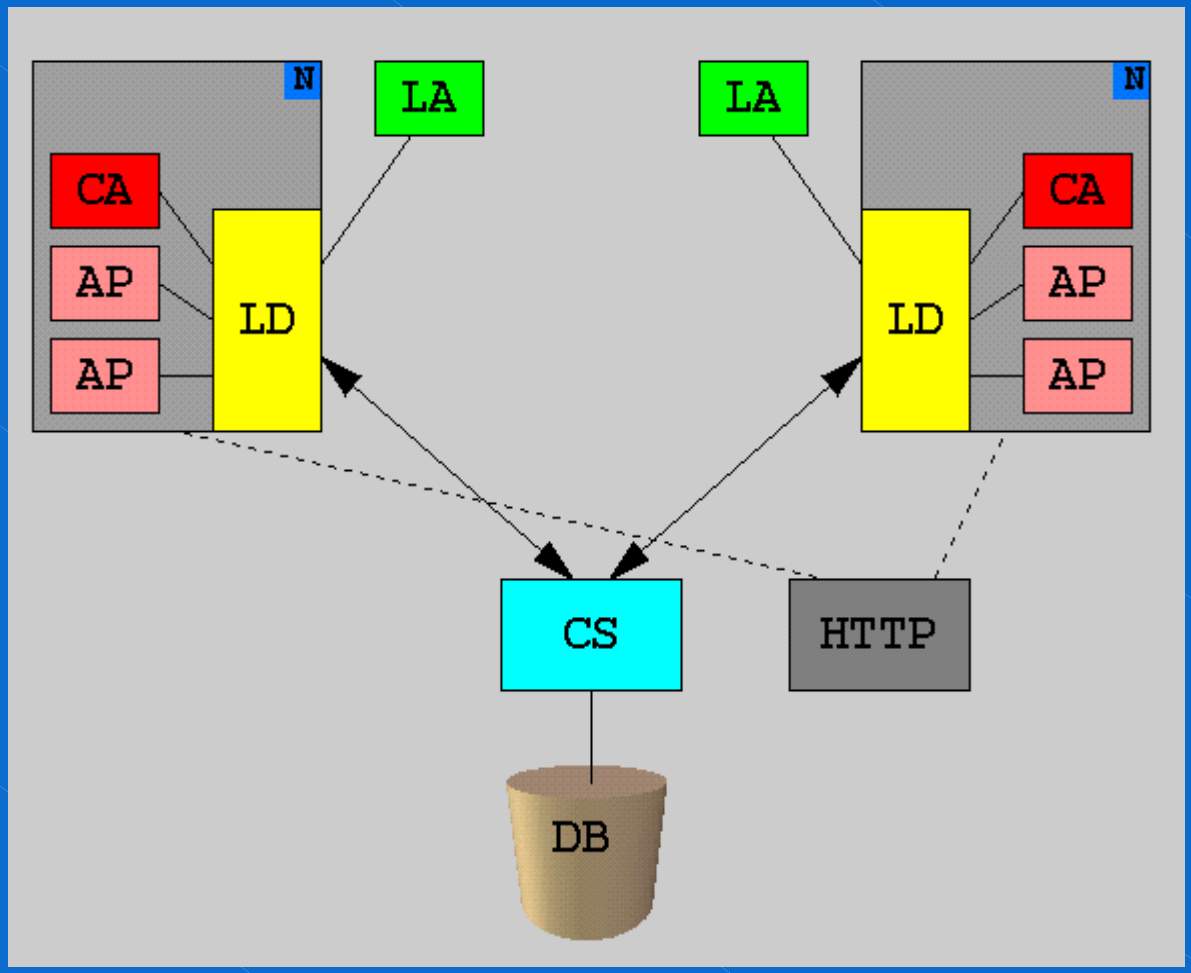
TANGO Interactive - What it Does?

- **TANGO turns a web browser into a communication program**
  - **does not limit is any way current browser functionality**
  - **seamlessly merges communication and database access**
  - **provides means for sending not only data but also tools for their display and manipulation**
  - **provides complete collaboratory run-time with powerful session and floor control**
  - **provides open integration platform for collaboratory applications**

TANGO Interactive - What Is It?

- Technically, it is a multiparty, multi-session, multiplatform, multimedia collaboratory system
- It is also a software integration framework
  - It supports any kind of CSCW, but it is particularly well suited for distance learning applications
  - It is fused with Web infrastructure
  - It provides dozens of multimedia collaboratory tools
  - It does not require any expensive infrastructure beyond a standard PC or Unix workstation and a browser

System Architecture



- N: Netscape Browser
- LD: Local Daemon
- CA: Control Application
- AP: Applet
- LA: Local Application
- CS: Central Server
- DB: Back-end Database
- HTTP: Web server

Status of TANGO System

- It must be competitive with best available collaborative tools and so it's multi-language interface allows us to interface to other systems with TANGO supplying Integrated Session Control
  - e.g. interfaces to Microsoft NetMeeting
- Basic model is that of a room which is a group of people getting together for a class
  - Next version will support a very powerful persistent multi-room paradigm
- Each room supports a collection of shared objects chosen by teacher/students/administrator

Current capabilities of TANGO

- TANGO supports enough (over 40) applications. Most of them went through iterative evaluation, improvement and robustification cycle
- Core Collaboration Capabilities
  - Audio-Video Conferencing between room participants
  - Text chat rooms with various tradeoffs between "coolness", ease of use etc.
  - Shared Browser (Synchronized view of Web Pages)
  - White Boards, including multi-layer, scriptable, object-oriented drawing/presentation module
  - Shared Web Search (becomes shared database query)

Current capabilities of TANGO

- **Office and Authoring Tools**
  - **PowerPoint via shared display or shared Java viewer (collaboration with Net-Scene)**
  - **Microsoft Excel and Word**
  - **Shared visual C++ etc.**
  - **Shared XEmacs editor and GNU debugger**
  - **Shared telnet**
  - **Shared access to relational courseware backend with integrated PowerPoint**

Current capabilities of TANGO

- General Virtual University Applications
  - Current WebWisdom hierarchical systems navigating through 20,000 foils and 500 foil sets
  - "Raise Hands" Applet to help teacher-student synchronous interaction
  - Shared media players (audio/video, also RealMedia)
- Special Virtual University Applications
  - Shared Java applets to teach physics
  - Shared Java Applets used to teach Java!
  - Shared SmartDesk system aimed at activities useful in special education with built in assessment

Current capabilities of TANGO

- Have some fun with multi-player games
  - VRML2 Chess
  - Kids' games such as Chutes and Ladders
  - Othello (Java)
  - Rubik's Cube (Java)
- "Other" Applications
  - TANGOsim command and control system with shared tools (e.g. mapping, weather) to use in crisis management and C2; scriptable and interactive
  - 3D high-end immersive, collaborative visualization system with special support for terrain rendering and GIS

Versions of the TANGO system

- **Current system version: 1.02**
  - **Training material refers to this version unless otherwise noted**
- **Slated for end of Jan 1. '99: version 1.03**
  - **multiframe GUI, more robust JavaScript interface**
  - **new set of APIs, including TANGOBean API**
  - **new Control Application/Session Manager**
  - **non-browser version**
- **Slated for March 1 '98: version 1.1**
  - **will integrate personal identities, session recording, security/encryption, directory services both client and server side, possibly support for IE 4**
- **TANGO server: version 1.0 available now**

TANGO Interactive version 1.02

- TANGO 1.x requires browser plug-in
- Compatible with Netscape Communicator 4.0x and 4.5
  - not compatible with earlier versions (3.0+) not compatible with MS Internet Explorer
    - TANGO 1 uses LiveConnect and plug-in architecture. Both these technologies are available for Internet Explorer, but MS implementation of LiveConnect is not fully compatible. IE version of TI exists but is currently not available for public use
  - supported platforms: Windows'95/NT, IRIX, Solaris, Linux
- This version has been tested for 9 months

TANGO vs. browsers

- Integration with browsers provided critical functionality (information resource access)
- On the other hand, browser is a terrible platform to develop for
  - undocumented behavior
  - poor stability and robustness
  - mediocre performance
  - incompatibility between Netscape and IE
- Can we retain all current advantages but get out of the browser?

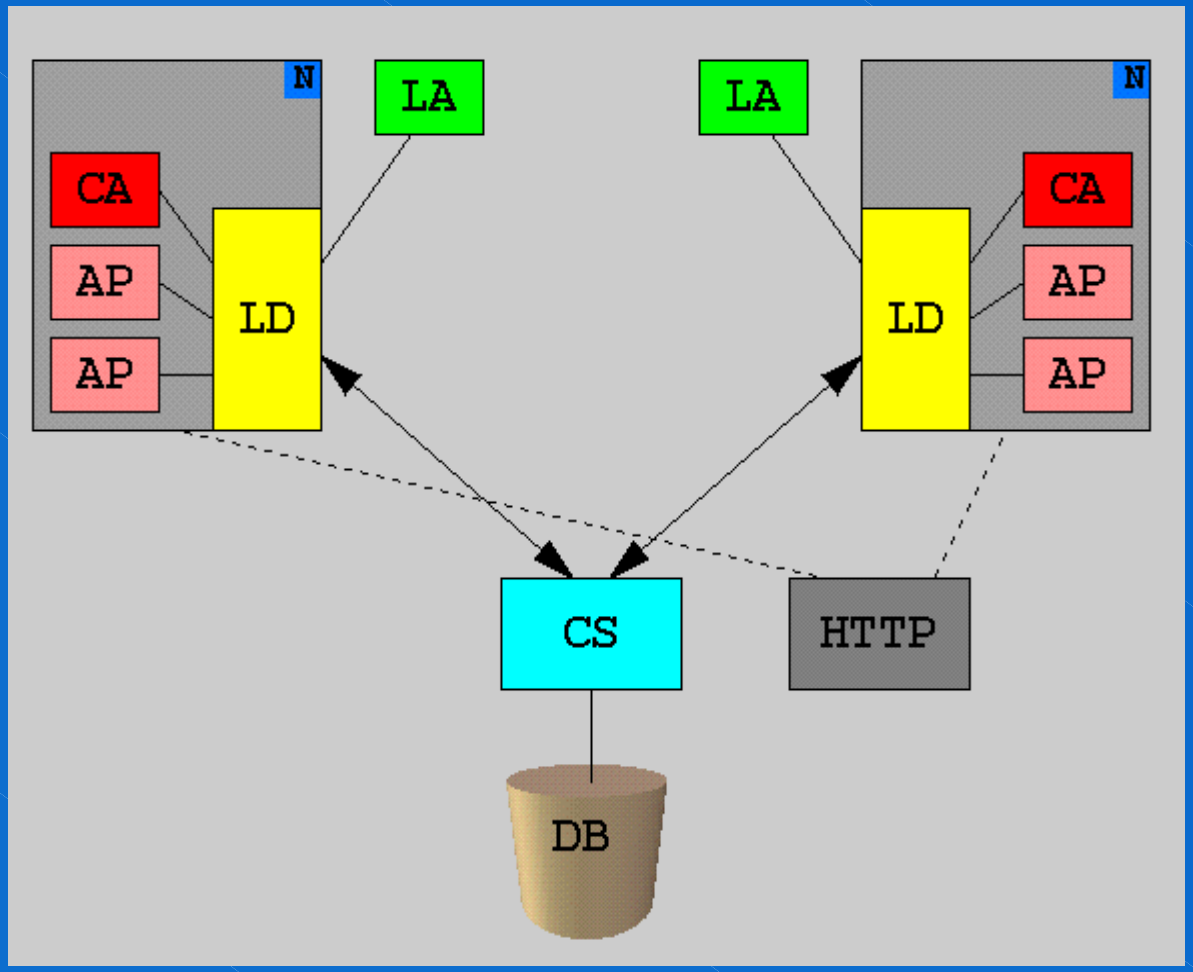
Yes, we can: Browser-less TANGO

- We enhance JDK's appletviewer to support multi-applet frameworks
  - communication between applets
  - enhanced multi-threading
  - interaction with native applications
  - TANGO plug-in folded into new appletviewer
- Browser treated as a native application
- LiveConnect emulator enables communication between HTML/Javascript pages and externally running TANGO Interactive
- Benefit: 10-fold performance increase on UNIX platforms

TANGO Interactive version 1.02

- **Supported browsers: all Netscape versions up to Communicator 4.5**
  - **supports Netscape 4 security model**
    - **digitally signed plug-in Java classes**
    - **Communicator version explicitly requires access to privileged operations**
      - **user's consent necessary for TANGO to run**
      - **consent needed only once per session**
- **Protocol incompatible with earlier beta versions and with beta TANGO server**

System Architecture



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TANGO Architecture: Components

- **Local Daemon's main tasks:**
  - **maintaining two-way communication between user applications, applets and central server**
  - **launching local applications**
  - **passing messages between applications running on the same node**
  - **providing certain system level functionality not normally available to Java applets, such as file access or printing**
- **The daemon is implemented as a plug-in to Web browsers.**
  - **The daemon is the only operating system dependent core part of TANGO.**

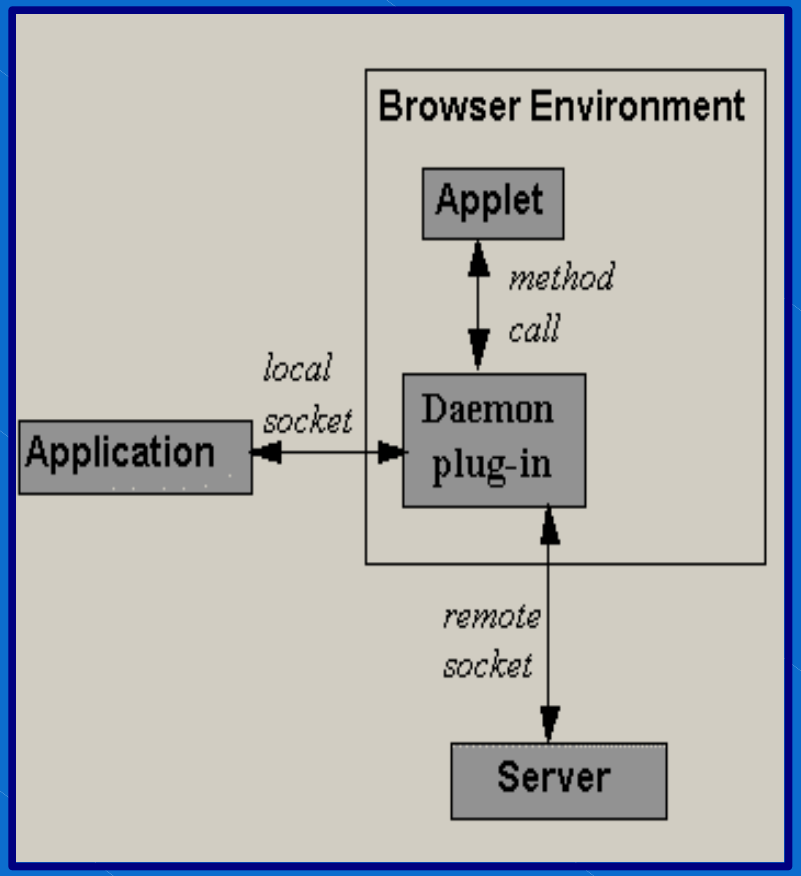
TANGO Architecture: Components

- **Central Server** is the main communication element.
  - **Local daemons** communicate with the **central server**
  - Server maintains the **system state data**
  - Server **routes messages** between applications participating in each session
  - All **application protocols** are **opaque** to the server
  - Currently, TANGO users are restricted to only one collaboratory server at any given time
    - Server switch somewhat clumsy
  - TANGO server is **extremely stable** and **maintenance-free**
    - No administrative interface

TANGO Architecture: Components

- **Java applets**
  - **User applications written in Java, downloaded from an HTTP server, and executed in browser environment**
    - **Communication between Java applets and central server is also maintained by the local daemons. Java applets communicate with local daemon by calling its method functions**
- **Local Applications:**
  - **User applications which run as standalone programs are called local applications. Local application may be written in any programming language**
    - **Communicate with the local daemon using sockets. The daemon is responsible for starting these applications and routing messages to and from applications**

Implementation Details



- **Daemon provides a mechanism for TANGO components such as Java applets, central server, JavaScript scripts etc. to talk to each other.**
- **TANGO daemon has been implemented as a plug-in.**
- **Using LiveConnect mechanisms, each applet residing in the same page with the plug-in may obtain its handle.**
- **Message passing between plug-in and an applet is achieved by calling appropriate methods of each other**

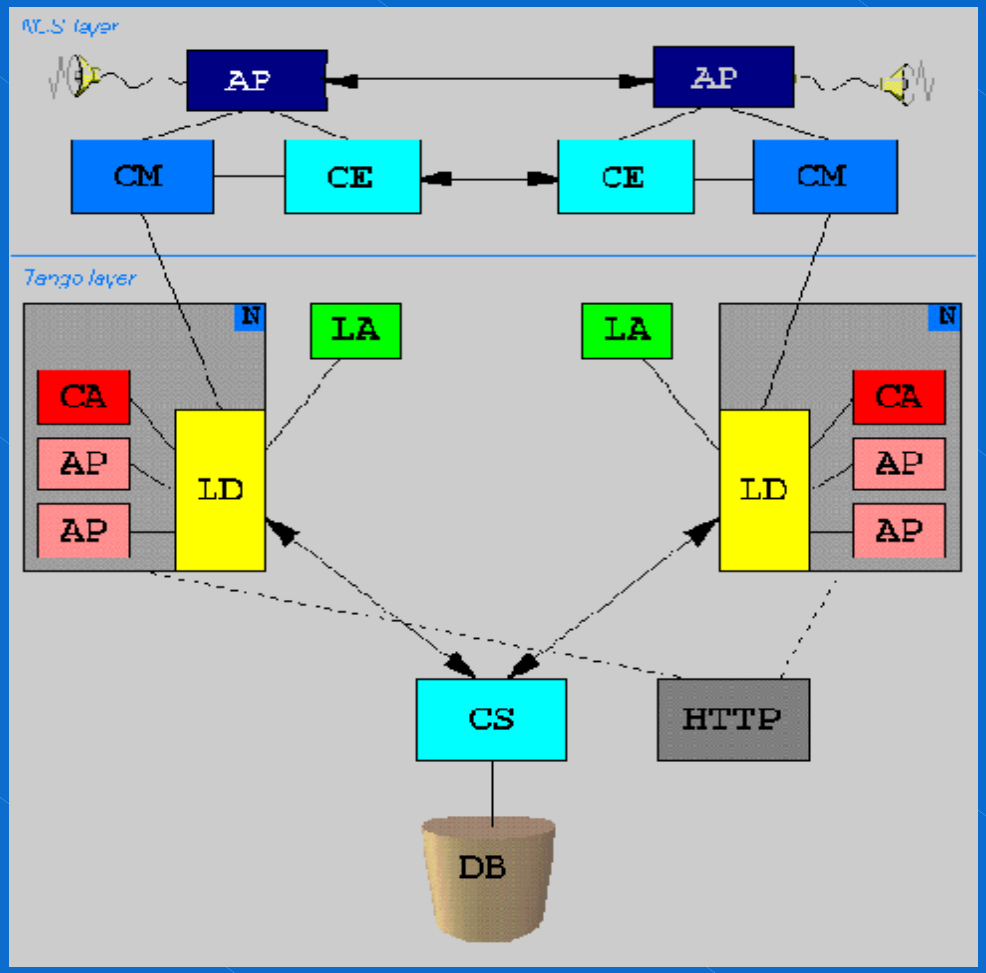
TANGO Architecture: Components

- **Control Application provides TANGO GUI**
  - **Provides uniform application session and floor control for all TANGO applications**
    - **Launches applications locally or remotely, creates and connects to existing sessions, exits applications, logs into the system, etc.**
    - **Routes messages between applications on the same node**
    - **Monitors integrity of the distributed system**
    - **User interface to the control application auto-adjusts to the operating system**
  - **CA communicates with the system via LD**
    - **The communication between control application and local daemon is different than in the case of standard Java applets since control application can also generate system messages**

Events and Data

- **Since TANGO uses central server architecture, there are system scalability concerns.**
  - **System makes careful distinction between event and data distribution pathways**
    - **events are always distributed via collaboratory server**
    - **data may be distributed via collaboratory server for thin data streams**
    - **voluminous data are either distributed directly between application instances or delivered from HTTP or other servers**
    - **peer-to-peer application data exchange may use multicast if necessary**
    - **certain TANGO applications are therefore implemented as Web browsers for specialized data types (e.g., GIS Open Inventor Web browser)**

TANGO Architecture: Media Streams



- For scaleability reasons, the real time multimedia streams are not sent via central server.
  - Instead, we use a distributed architecture akin to the Insoft's OpenDVE
  - The architecture supports multicast.
  - Session control remains with the TANGO session manager.
  - TANGO VTC supports stream recording, storage, and retrieval

Application Protocols

- **A blueprint for a truly successful collaboratory system does not exist. Hence:**
  - **Need an extensible system with very few limitations.**
  - **System must not define application specific protocols, application programming language, or limit in whatever way functionality of collaboratory applications**
- **The essence of each collaboratory function must be defined by application and by application only**
- **TANGO does not define any application protocols**

Application Protocols

- Current system requires application developer to implement application protocol conversion to byte streams
- There is no explicit system support for application state sharing
  - "latecomers" problem must be handled by application
- TANGO 2 system addresses this by providing shared data support on the server
  - this project will be resumed early '99
- Current solution: powerful object oriented API on top of message passing

Session Management

- A **session** is a group of application instances currently working together in the collaborative mode.
  - All (and only) applications belonging to the same session exchange information and may share behavior.
  - How particular application operates in collaborative mode depends on this application characteristics.
  - In all sessions there is one master user.
    - Master of the session has special privileges of controlling access of other users to this session and/or controlling the application behavior. The privileges depend on the application type.

Session Management

- Master status is dynamically transferable. Floor control allows for both master-master and master-slave relationship
- TANGO does not restrict the number of concurrent sessions. There may be multiple independent sessions of applications of the same type.
- Messages from one application compatible with application of another type will be distributed transparently.
- NOTE: current model confuses floor control and session ownership. It will be replaced by two distinct mechanisms in version 1.1

Session Management

- Currently supported operations:
  - Local open
  - Remote open (opens an instance on remote machine)
  - Global and limited remote open (open an instance on a group of machines)
  - Session join
  - Local close/leave
  - Remote close, including global remote close
  - Acquire and grant session master status
- CA implements “intelligent interface”
- CA supports different “privacy” models

Floor control issues

- Diversity of application behaviors
  - symmetric “no floor control needed” apps (chats, VTC)
  - symmetric apps with mandatory arbitration (shared web browser)
  - asymmetric apps (different data views), either transferable or non-transferable
  - more than two categories of users (observed multi-player games)
  - multiple users with full control
- Need for better system support for floor control

TANGO Client Installation: UNIX

- **Download URL:**

`http://trurl.npac.syr.edu/tango/Use_it_/Download/download.html`

Packaging: gzipped tar file

- **May download to any location, no root password necessary**
- **After unzipping, run tar:**

```
tar -xpvf webwisdom102.irix63.tar
```

  - **Please, note the "p" option. If you don't use it,you file permissions will be determined by your umask**

TANGO Client Installation: UNIX

- Un-tar creates the following directory structure

```
trurl:/usr/people/mp/webwisdom% ls
BuenaVista/    Copyright    README.html    exec/
   tango_plugin102/
```

- Change directory to `exec/` and run the command `source tangorc`
  - `tangorc` script sets environment variables
  - you have to source the script from the `exec` directory!
  - to make envvariables setup permanent, you must embed call to `tangorc` in your `.cshrc` file
- All this is needed since UNIX has no global registry

TANGO Client Installation: UNIX

- **The relevant envvariables after sourcing `tangorc` should be as follows:**

```
CLASSPATH=/usr/people/mp/webwisdom/tango_plugin102:
/usr/local/lib/netscape/CosmoPlayer/classes

NPX_PLUGIN_PATH=/usr/people/mp/webwisdom/tango_plugin102/bin/:
/usr/local/lib/netscape/plugins

TANGO_APP_ROOT=/usr/people/mp/webwisdom/

NCS_PATH=/usr/people/mp/webwisdom/BuenaVista
```

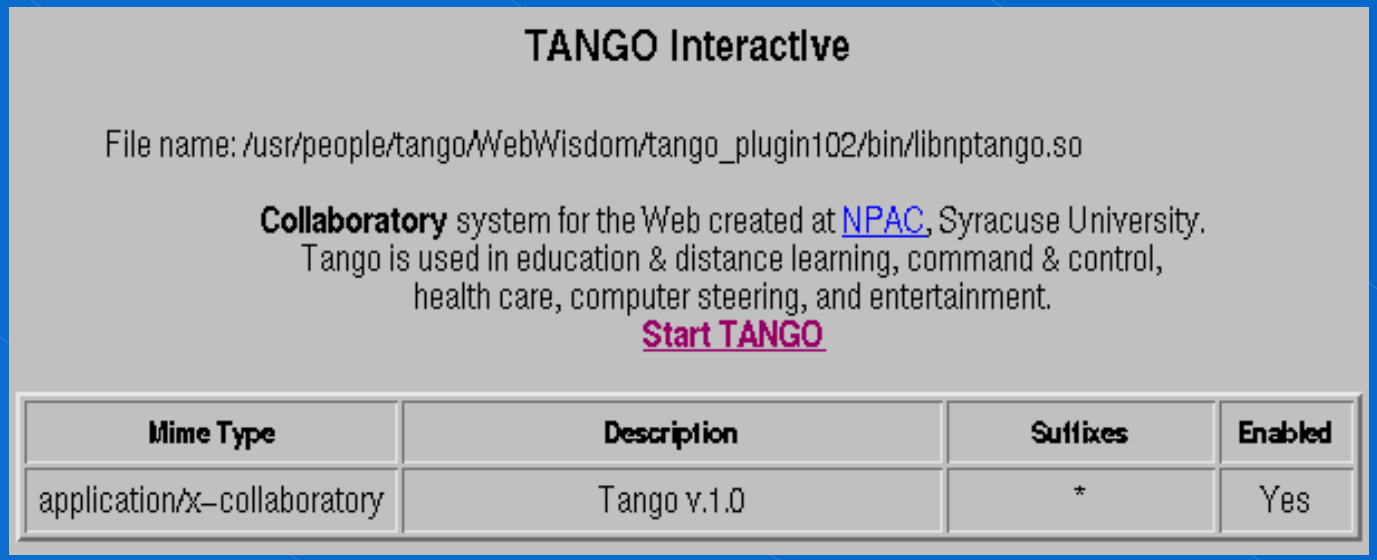
(assumes installation in `/usr/people/mp` directory)

TANGO Client Installation: UNIX

- `TANGO_APP_CONF` variable points to TANGO installation directory.
  - Combined with entries in `.tca` files (to be discussed later) this variable tells TANGO client where to look for "local applications" executables
  - The user does not need to configure individual applications (as it was necessary in earlier versions)
- `NCS_PATH` variable is used by BuenaVista to find its own media modules. Without this variable BV won't be able to start audio and video agents.
- There may be additional variables for other applications

TANGO Client Installation: UNIX

- **Restart your Netscape browser from the window you used to set environment (not from the desktop!)**
- **Check plug-in installation (Help/About Plug-ins)**



- **If plug-in OK, start the system**

Troubleshooting: Configuration

- **Common pitfalls:**
  - **Java not enabled in browser (on SGIs, browser will coredump!)**
  - **Envvariables incorrectly set (browser started from wrong window or not restarted, `.cshrc` wrong)**
  - **Plug-in installed for the wrong browser**
  - **Wrong permissions on configuration files**
  - **Faulty browser installation (missing Java classes)**
  - **Corrupted classes in browser cache (flush the cache!)**
  - **Duplicate, incompatible Java classes (CLASSPATH!!!)**
  - **Missing application Java classes (e.g., CosmoPlayer)**
  - **Re-link without re-hash**

Troubleshooting: Networking

- TANGO server not running
  - no error message if server restarted
- Client behind firewall
  - need access to port 11000
  - firewall incompatible with Java security model!
- DNS problems
  - TANGO generally does not care, but current BV needs proper DNS setup for all parties)
- HTTP server slow or not running
- TANGO on the HTTP server misconfigured

Diagnostics: Java console

index.html: browser ok: 'Netscape’
index.html: major version numberok: 4
index.html: minor version numberok: 4
index.html: mime ok: 'application/x-collaboratory’
index.html: plugin ok: 'TANGO Interactive’
index.html: loading CA …
CA.html: loadTango(ohio.npac.syr.edu:11000,320x700)
LocalBase.LocalBase(): server=ohio.npac.syr.edu:11000 localPort=8000
LoaderApplet.init(): CA registered with code=52
[
CentralServer.initSocket(): unable to contact server:
java.net.ConnectException: Connection refused
]
AppDef.readConfFile(): contentLength=3372
AppDef.readConfFile(): reading again
AppDef.readConfFile(): completed
…..

TANGO Client Installation: Win32

- **Download URL:**

  http://trurl.npac.syr.edu/tango
- **Packaging: .exe file. The same for NT/95/98**
- **May download to any location**
- **After downloading, run exec file:**

  `tango_pluginNT102.exe`
  - **This will launch the Install Shield which will guide you through the installation process**
- **Don't install as administrator on NT!**
  - **InstallShield sets registry variables on a *per user* basis**

TANGO Client Installation: Win32

- Installation puts the files in the following directory

```
X:\Program files\WebWisdom
```

- Some of the files go to Netscape plugin directory:

```
X:\Program files\Netscape\Communicator\Program\plugins
NPTangoV10.dll
```

- and to the Netscape Java\Class directory:

```
….\Communicator\Program\Java\classes\tango10.jar
```

- The .jar file is digitally signed
- Most recent versions of TANGO also installs items such as Swing class libraries
  - as well as entire code of the application modules

TANGO Client Installation: Win32

- The function of environment variables under UNIX is replac3ed by registry entries.
  - No system reboot necessary, but browser must be restarted!
- Win32 installation comes with Buena Vista
  - automatic installation
  - both stand-alone and TANGO versions of BV
  - using BV is somewhat tricky and will be covered by a separate training
    - users have problems with properly using audio peripherals
    - non MFC-compliant video capture card drivers

TANGO Client Installation: Win32

- Troubleshooting
  - the most frequent problem we see: damaged installation of Netscape browser
    - users usually adamant; say browser OK
    - most of the time they are wrong
    - most frequent reason: corrupted or manually deleted files
- If TANGO "does not work", you likely have a system problem
- Which browser version is best?
  - Large Java performance differences: need v. 4.06 at least (Java 1.1.5 with AWT 1.1 support)
  - AWT 1.1+ needed for some application modules

TANGO Server

- Java application
  - requires JDK 1.1.2 or higher
- 100% maintenance free
- Industry-strength stability
- Platform-independent
  - tested on IRIX 5/6, Solaris, Linux, Windows NT
  - will also run on Widows'95 (not recommended)
- Available for download from
  http://trurl.npac.syr.edu/tango

TANGO Server Installation: Unix

- The server can run with any UID, but...
- Recommended procedure: create new local UID "tango" with home directory in `/usr/people/tango`
  - create `/usr/people/tango`
  - download, unzip, and un-tar distribution file in this directory
  - make sure you have JDK 1.1 installed
  - cd to `tango_server/exec` directory
  - run `tango_start` script to manually start the server
    - the server will be listed in `ps` output as

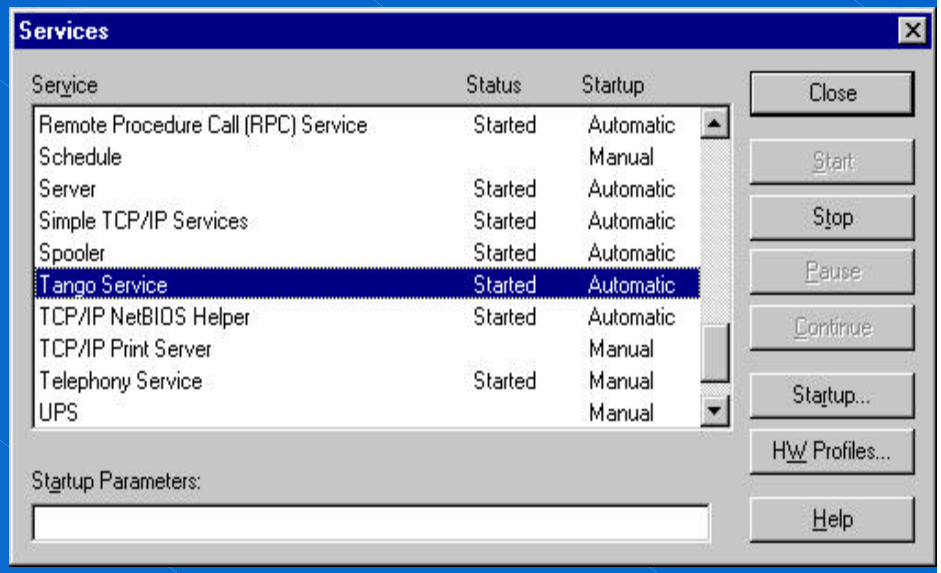
```
java -jit main.TangoServer 11000
```

TANGO Server Installation: IRIX

- For IRIX, we have a procedure for automatic server restart after machine reboot. To install, follow this steps:
  - Go to the `tango_server/etc` directory and, as root, run the "`run_as_root`" script.
  - The script assumes that the server is installed in `/usr/people/tango` which is the home directory of user "tango" (UID 10856).
  - The script installs user “tango” in `/etc/passwd`, and adds TANGO startup script to `/etc/init.d`
  - It also installs TANGO control via `chkconfig`

Server installation - Win NT

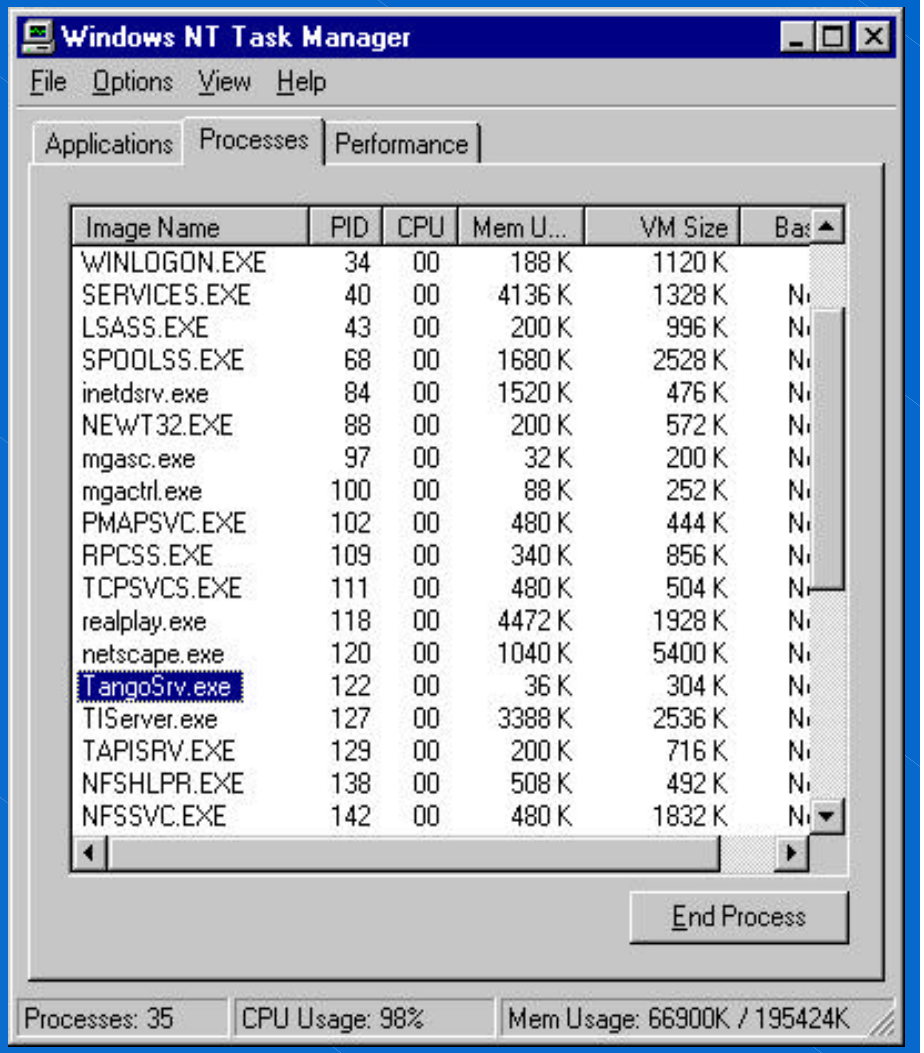
- Download server (in exe file) from
  - http://trurl.npac.syr.edu/tango
- Run `.exe` file
  - this will launch Install Shield which will guide you through the installation process



  - the server installs as Windows NT service
    Don't try to start it from command line!
    The server needs MS Java VM (included, needs separate install, normally comes with IE 4)
  - server should start automatically
    if it does not, use "Services" CP applet to start it

Server installation - Win NT

- Does it run???
  - in Services applet, you have `Tango Service` marked as started and automatic
  - in Task Manager, there are two processes:
    - `TIServer.exe`
    - `TangoSrv.exe`
  - you are able to connect to the server
- It doesn't?
  - Java VM not properly installed



TANGO: Complete distribution

- **TANGO applets may be loaded from arbitrary http server. For scalability reasons, one may decide to distribute applets to multiple servers or even local disks on client machines**
- **Distribution directory tree:**
  - **applets:** `tango/applets/appletdirectories`
  - **control application:** `tango/ca/……..`
  - **CA configuration file:** `tango/ca/conf/GUIname.tca`
- **Graphical interface for .tca configuration:**
  - `http://trurl.npac.syr.edu/tango/admin/client` **(work in progress)**

.tca Configuration Files

- APPLICATION_TYPE / AT / SYSTEM CONSTRAINTS / NAME / SHORT NAME / FOLDER - may be multiple / NUMBER OF SESSIONS ALLOWED /[URL] / [WINDOW_HEIGHT]/ [WINDOW_WIDTH] /
- NUMBER OF SESSIONS ALLOWED:
  0 - any number; 1 - one session; >1 - exact number
- Application type:
  0 - APPLET; 1 - APPLICATION; 2 - APPLET & APPLICATION;
- SYSTEM CONSTRAINTS:
  0 - all systems; 1 - only Windows; 2 - only Unix
- AT: unique application identifier, administered by TANGO Team

.tca Configuration Files

Example:

```
#0#142#0#SharedBrowser#Browser#1#2#http://ohio.npac.syr.edu/tango10
   1/applets/sb/index.html#60#80#

#0#145#0#WebWisdom#WebWisdom#1#1#http://www.npac.syr.edu/wisdom/use
   rs/gcf/wisdom/tangowisdom1.html#20#570#

#0#311#0#VideoPlayer#Video#2#1#http://trurl.npac.syr.edu/tango101/a
   pplets/video/index.html#50#300#

#1#37#0#Buena Vista#BuenaVista#1#1#BuenaVista#BVtango#

#1#331#2#3D GIS#GIS#2#1#GIS#terrain_viewer#
```

Upcoming change: relative URL addresses for easier migration

Product Support

- General questions
  - Marek Podgorny, marek@npac.syr.edu
- Architecture, client setup
  - Konrad Olszewski, konrad@npac
- Server
  - Luk Beca, beca@npac.syr.edu
- Applications
  - Tom Major (whiteboards), toma@npac, Tom Stachowiak (BV), stach@npac, Remek Trzaska (GIS), remek@npac, Bart Winnowicz (VoD, MS apps), bartw@npac, Greg Lewandowski (media players), grzes@npac

FOR MORE INFO...

http://trurl.npac.syr.edu/tango