

<b>NOMACHINE</b>		Introduction to NX Technology	
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# Introduction to NX Technology

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## 1. Introduction to NX Technology

This document outlines the background and the design decisions that guided NX development. It explains why NX is different from similar technologies and states the goals the NX project is set to pursue.

### 1.1. Open Standards Drive the Success of the Internet

Network Computing is an old "buzzword" of the Internet. It is the idea of freeing users from reliance on their Personal Computer and Operating System and moving towards computing made of applications and servers. So far, the lack of a universally accepted protocol (like HTML and XML for the Web), has made it difficult to implement and support network computing on a large scale.

## 2. Why the X-Window System

NX Distributed Computing Architecture is a suite of technologies and commercial tools, designed to make network computing as easy and widespread as browsing the web. It consists of a thin layer of server software that enables any Unix computer to work as a terminal server. Clients are also available for a wide range of platforms and operating systems. NoMachine has chosen to build the foundations of its NX Distributed Computing Architecture on the well known and widely used X-Window System - the windowing system that's behind the Graphical User Interfaces of Linux and the Unix Operating System.

Most network computing solutions seem to be designed to work as surrogate tools. It appears that the architects behind their design did not intend them to be the primary means by which users access their desktops. This is the problem, for example, with VNC and RDP. Both these protocols are much simpler than X (and so very well suited for thin clients), but their simplicity does not compensate for their lack of efficiency and functions. These protocols, for example, draw the remote screen by transferring huge amounts of image data over the network. Even if RDP is of a much higher level and a much more efficient protocol than RFB, it has not been designed for everyday use of computing resources, but as an add-on to the underlying operating system.

X-Window is the graphical subsystem, and not an extension, of the host OS's subsystem. X applications communicate with X-Window using the X protocol, so that the operating system does not have to add a layer to translate screen updates into a network protocol.

## 3. X-Window System's Challenger

X-Window System is an open and extensible client-server protocol, designed to offer a layer of separation between the application logic (running on application servers) and the presentation (taking place at clients). In other words it has been designed for

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network computing. The native X protocol requires high bandwidth and low latency networks to work at its best. Over the years, though, evolution of Graphical User Interfaces has increased the demand for network and computing resources. Instead of layering X applications to adapt to available network resources, X client and X toolkit designers have relied on users giving up X-Window's networking capabilities to simply access applications running on their own computers. Over the last few years, the X-Window system has completely lost its original characteristics of network computing protocol, being perceived as a mere display driver even by the most informed and technological users.

The main goal of the NX project, since the beginning, has been to develop X compression technology that would enable any user to run unmodified versions of the most widespread X desktop environments on a standard X server, over any type of network connection. This is, according to us, what is first needed to allow X-Window system regain its function of networking protocol.

#### 4. NoMachine's X Protocol Compression Technology

NoMachine has developed exclusive X protocol compression techniques and an integrated set of proxy agents that make it possible to run complete remote desktop sessions, even at full screen, using narrowband Internet connections, at speeds as low as those offered by a 9600 band modem.

NX compression operates at three levels on the X protocol:

- It compresses the network traffic by a variety of means, including -per message-differential algorithms, advanced caching methods, lossless and lossy image compression.
- It reduces network round-trips nearly to zero, maximizing the throughput.
- Adapts bandwidth in real-time, according to the network conditions.

NX provides X protocol compression ratios ranging from 10:1 to 100:1 and over, depending on the application being displayed. This is obtained without penalizing performances on fast LANs, so that remote sessions can usually run at a speed that is indistinguishable by a local computer.

#### 5. Linux as a Server and Desktop Platform

NX Server products run on Linux Operating System. Linux is a Unix operating system and thus offers all the characteristics of reliability, scalability and performance required by today's corporate environments. At the same time, its flexibility make Linux a good candidate to power the distributed, peer-to-peer network of millions of connected computers providing services and applications, which will constitute the network computing of tomorrow.

Whilst being an established platform in the server operating system market, Linux is also

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emerging as a reality on the desktop. Desktop environments like KDE and GNOME, and the StarOffice award winning office productivity suite, use the X-Window protocol. NX support of such environments comes at zero cost and provides the best performances overall.

## 6. RDP and RFB Foreign Protocols

NX accessibility and remote computing capabilities are not limited to Linux desktops and servers. It is also available for numerous different operating systems. NX encapsulates into X protocol the Remote Desktop Protocol used by Microsoft Windows Terminal Server and Citrix Metaframe. It also encapsulates Remote Frame Buffer, the protocol used by VNC, an Open Source remote computing facility.

## 7. NX Distributed Computing Architecture

NX Distributed Computing Architecture is designed from scratch for distribution of workload between nodes in a Wide Area Network. The NX Servers are intended to perform high-level, manageability functions on the NX network. They are responsible, for example, for authentication and activation of user sessions, as well as for ensuring that nodes export their familiar computing environment to users (for example the same file systems and the same applications). Sessions run on NX Node computers in a virtual cluster. Hundreds of NX nodes can be connected to one or more controlling servers to support thousands of concurrent sessions.

NX Nodes are not intended to be dedicated computers (even if this is likely to be a common scenario in legacy contexts). Any computer on any desktop can be a node of a NX Distributed Network. An NX network is very similar to a peer-to-peer network where clients search for a song (in this case a single application or a desktop environment) and the search engine redirects the client to the appropriate server, providing, on behalf of the client, the authorization credential that will have to be submitted to let the node accept the connection.

## 8. Distribution of Load Between Nodes

Not only can servers balance the network load by distributing sessions among nodes, but nodes can distribute the applications running in a session between different application servers. This can happen either because a resource or an application is not available on the original node, or because a resource is "closer" to the user and so the shorter network path guarantees better performances.

A session can be identified with an agent running on a node. Agents run in proximity of application servers and accept connections from NX clients. Clients are the users' computers where X Server runs. Only one (socket) connection to the X server is needed by each agent. A node can connect any RDP and RFB sessions to a different Windows Terminal Server computer or a different VNC server, balancing the load of sessions

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among the available network resources.

Besides deploying a complete desktop session over the network, two operating modes are also possible to run a *single application* in its top-level window. When a user chooses to run a session in a new virtual desktop, the agent itself acts as an X server. It multiplexes X client connections into a single connection to the real X server. X applications can be run on different nodes, acting as application servers. Communication between X applications is resolved locally, on the side of the agent. As this communication can be very verbose, the overall performances are greatly improved. X applications run in X agent appear to be "nested" inside the agent's window.

When a user chooses to run applications in *rootless mode*, nxagent lets the top-level windows to be children of the real root, so they appear undistinguishable from the local windows present on the same display. In *rootless mode* nxagent is still able to remove the round trips, enable the applications to be migrated to a different X server, let applications to be suspended and resumed, images to be streamed etc.

## 9. Designed for Simplicity

In spite of the apparent complexity, the built-in networking capability of Unix and the inner characteristics of scalability of X-Window and Unix network services make it straightforward. NX uses SSH remote execution facilities to gain access to a node's functions. All the communication takes place encrypted through SSH, a network protocol that allows data to be exchanged over a secure channel between two computers. No new network servers need to be installed on nodes, except the SSH daemon, a server that comes standard in any modern Unix distribution.