# Why Linux rules Chicago

- Christoph Lameter, August 20, 2014. Chicago

Linux has become a dominant operating system not only in high performance computing and on handhelds. It also runs the world of finance these days. And Chicago is one of the prime locations for businesses using Linux. In the financial area we have use of Linux by the Stock Exchanges, Investment banks as well as by "Quants" that use Linux to implement complex trading strategies.
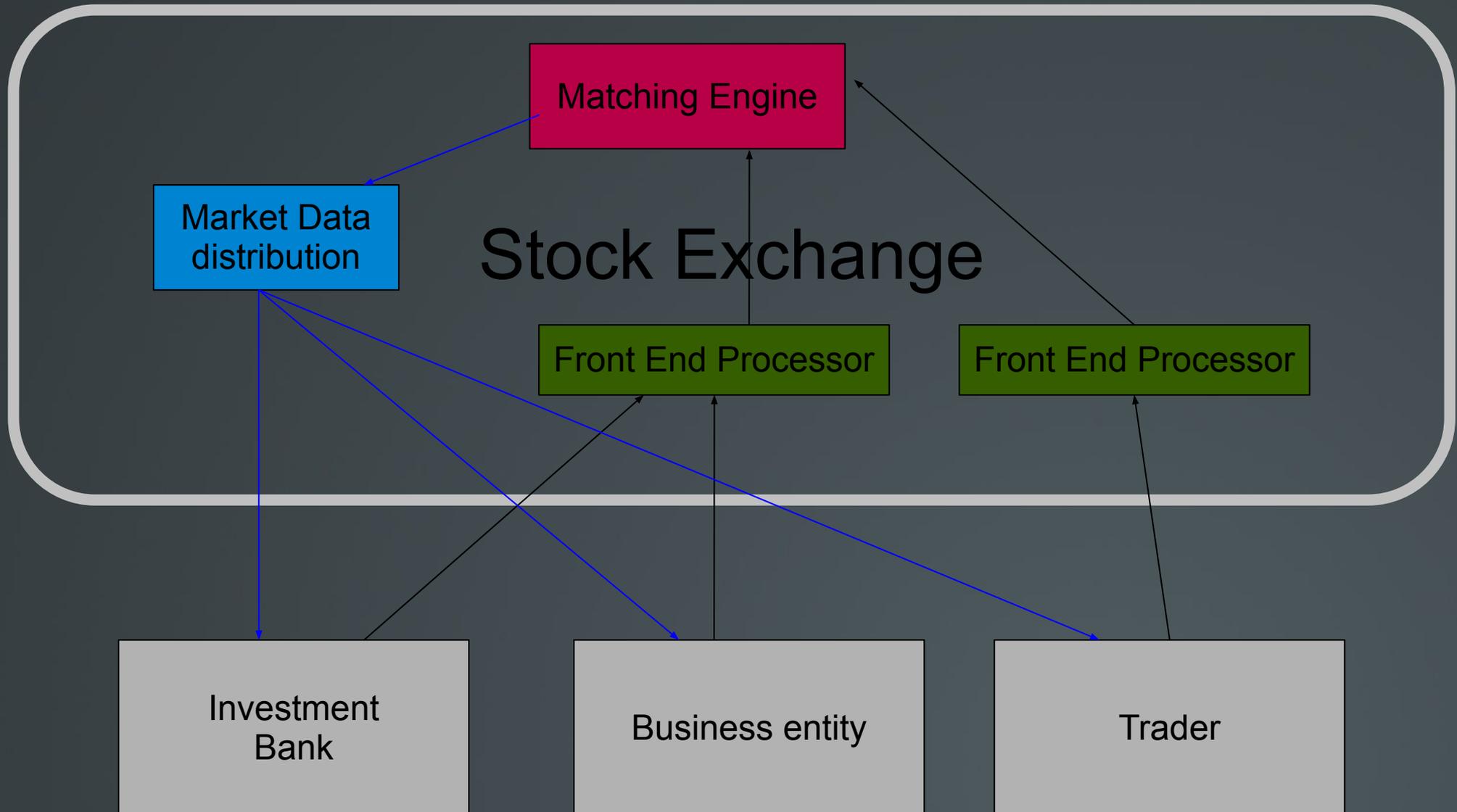
# World of Finance from a Tech perspective

- Stock Exchanges

- Banks (Investment banks)

- Big companies

- Small investors with software on their machines at home (wannabe Quants)

- Professional Quants

- Where?

    - Chicago (CME)

    - New York (multiple Exchanges)

# Electronic Data Flow

# Technologies

- Intelligence and Speed
    - Powerful and fast processors
    - High capacity and fast LAN
    - High capacity and fast WAN
    - Powerful but stripped down code
- Need for tuning
    - Therefore a lot of Linux hotrodding

# How did it happen?

- 70s: Paper trading

- 80s, 90s: MS-DOS, Novell, Sun, proprietary Unixes

- Tandem Systems from the 90s are still in use!!

- 90s Microsoft develops kernel extensions for messaging layers needed for trading.

- ~2000 a lot of Sun systems and other proprietary Unixes. Linux at the fringes. Fierce discussions if Windows is better or Linux.

- 2007-9 Widespread adoption of Linux as the trading OS of choice.

- > 2010 Linux is the standard OS for trading systems. Windows on the desktop and for specialized services.
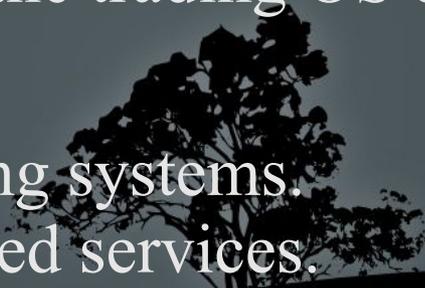
# Players in the Game

- Exchanges (NYSE, NASDAQ, CME, LSE etc)

- Banks (Investment banks like Goldman Sachs)

- Funds (Various investment funds)

- Individual Traders (via specialized brokerage companies)

- Brokers focusing on electronic trading.

# Linux Technology

- Kernel optimizations
- Fast RDMA APIs
- Realtime kernels
- Optimization of binaries
- Fast C++ code
- Networking enhancements
- Tendency to do bare metal coding

# The Speed of Light Problem

- Machines are extremely fast these days.

- However it takes hundred of milliseconds to send a signal around the world or to a satellite.

- Relativity sets limits on signaling speed (and therefore in the world of finance one constantly runs against the limitation of physics).

- Things must be close together. One person in Los Angeles will have a tremendous disadvantage against the person in New York if they are trading at the NYSE.

# Transition from Manual to Automated Trading

- Hours to arrange

- Human reviews data

- Human decides

- 30-60 trades per min max

- Mostly a backup mechanism

- Dying out

- Milliseconds

- Computer analyses

- Trading algo decides

- Thousands of traders per sec

- Fast reactions

- Taking over the world

# The case for Linux

- Speed dependency. Whoever gets there first wins. You must be able to control your tech.

- Differentiation: How can you beat the other guy? Hot rodding Linux

- Problems with high latencies of windows network stack.

- Linux is highly customizable

- Most internet servers use linux. Logical choice to also use that for financial markets.

- Major stock exchanges are all on Linux these days.

- Commercial solutions vendors focus on Linux. Products for Windows are rare in this market.

- Solaris was present for the longest time but gradually diminished after the acquisition by Oracle in 2009. Trend was there before but it accellerated when Sun was bought.

- Some minor use of AIX and some of BSD.

# Distributions in use

- Predominantly Redhat Enterprise Linux (mostly older releases)

- SUSE Novell (mostly in Europe and Germany)

- Realtime versions of the above

- Gentoo (extremely customizable)

- Ubuntu / Debian

# Challenges for Linux in Finance

- Open source contributors are rare

- Trading companies want to keep competitive advantage and therefore involvement in upstream development is limited.

- Constant unnerving regressions in kernel components that cause high latencies. People stick to old kernels.

- Operating system is in the way

    - Direct Hardware interaction (OS bypass) are seen as a path to better performance.

    - OS overhead impinging in uncontrollable ways on the applications which can cause unforeseen delays at unfortunate points in time.

# Final comments

- Linux dominates for the foreseeable future

- We need to find a way to encourage contributions from the financial world.