Lessons Learned from Isis

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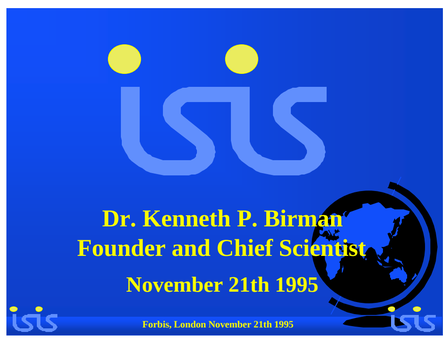
Outline

- History of Isis
- How we presented the system
- How did people really use it?
  - What worked? What didn't?
- What to take away



A quick summary

- Use process groups as a distributed systems programming construct
  - They "structure" your system
  - And create a new way to think about distributed state
- Fault-tolerance through "toolkit"
- And Isis will make money as a middleware player

Lesson #1: People like groups

- The Isis programming model was very popular
- People liked group communication primitives. Isis has an easily-used API
  - This lesson has been lost for subsequent systems: Spread, Ensemble, Horus were all far harder to use!
  - .... and Eternal, trying to be even simpler (in a CORBA setting) is too constraining

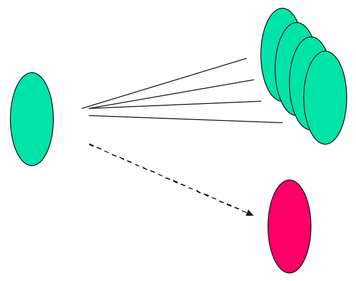
Lesson #2: It works

- Productivity was actually very high
- And fault-tolerance in the Isis model is quite good
  - Although we deliver many events in the same order....
  - ... there are enough differences to avoid correlated failures

Lesson #3: They don't follow advice

- Isis recommended:
  - Groups, but not "too many of them"
  - And not "too many members"
- People are people. They don't easily accept such advice

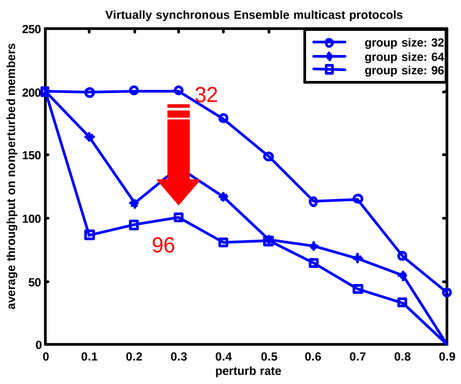
Swiss Stock Exchange Problem: Vsync. multicast is "fragile"



Most members are healthy….

… but one is slow

Performance degrades as the system scales up



SWX was forced to limit fanout to about 50 receivers.

Replicate for availability

All data filters through core system

One or a few repeaters at each bank or brokerage

Up to 50 users per "repeater"

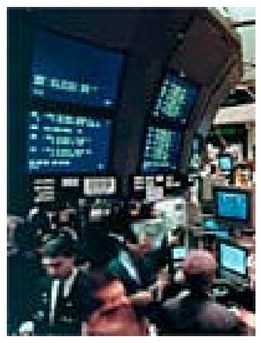
50x50 = 2500 users, maximum

New York Stock Exchange

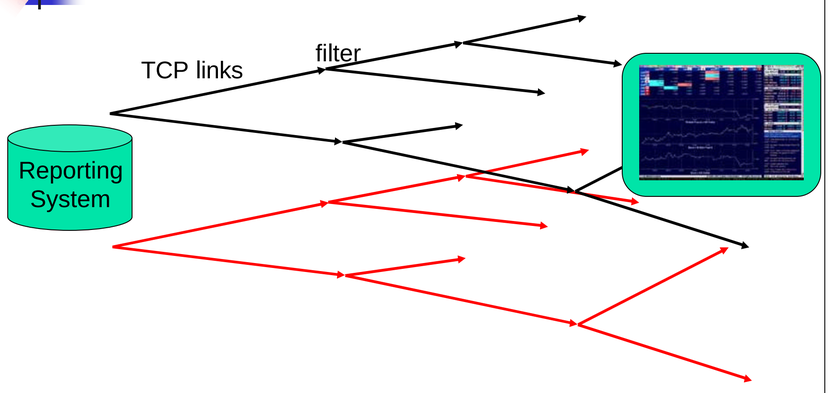
- A far more ambitious system!
- They have
  - Far higher loads
  - Much more demanding requirements
- But... they didn't want to replicate the entire exchange (whew!)
  - In fact, they backed into their use of Isis

NYSE goals?

- At first, goal was to link clearing systems (completed trades and certain quoted prices) to SEC monitoring
- Later: used Isis to operate the overhead display systems



A multicast mesh



Use of multicast

- In this architecture, the role of multicast is to keep the states of the forwarding nodes synchronized
  - Both trees should look the same
  - So inner nodes need to use same filtering policy
- There is also a need to replicate the overall “shape” of the tree
- And multicast is employed, internally, to report failures so that tree can be healed in a clean, consistent manner

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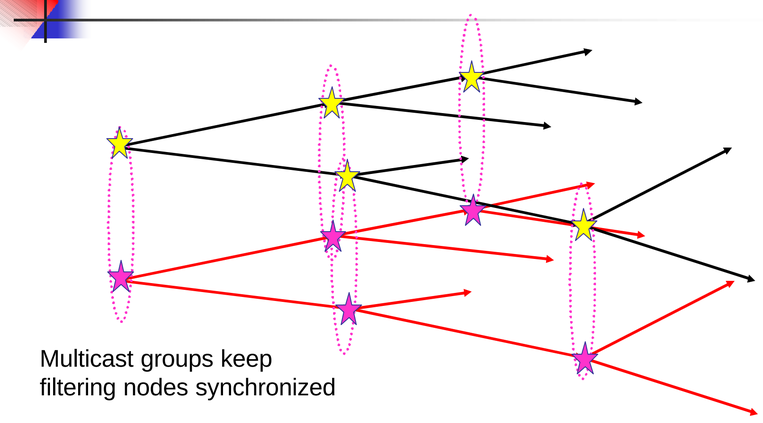

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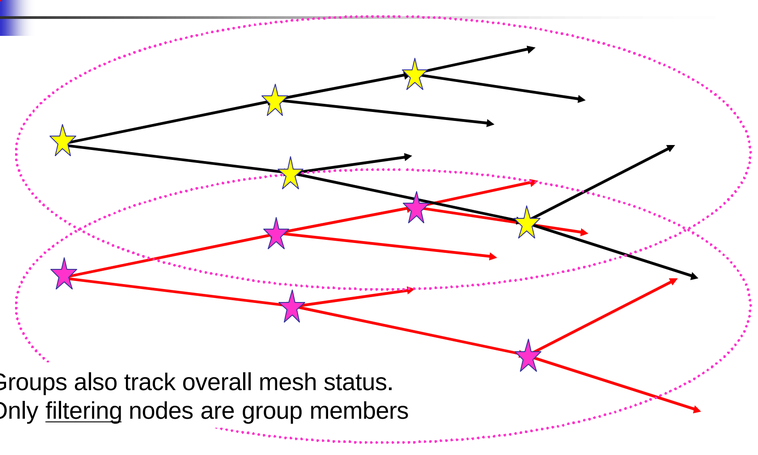
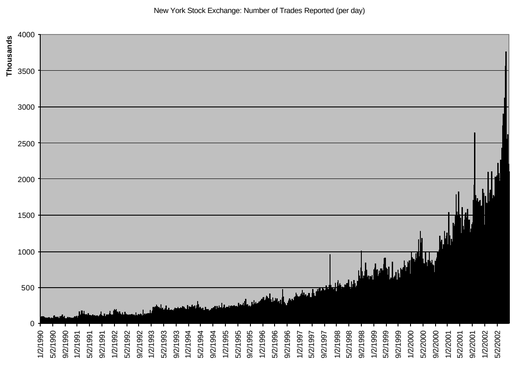


Non-use of multicast

- Multicast does not carry high data volumes – the TCP connections handle that
- This works (in large part) because NYSE has a private, clean network
  - Even so, need to support “dual IP addressing” was very tough
  - Today would probably use a hardware solution (an off-the-shelf CISCO router...)
- On the WAN Internet, same architecture would have tough problems overcoming network congestion... but this gets to a topic we’ll visit later in the lecture

PS: Trading Volumes are rising



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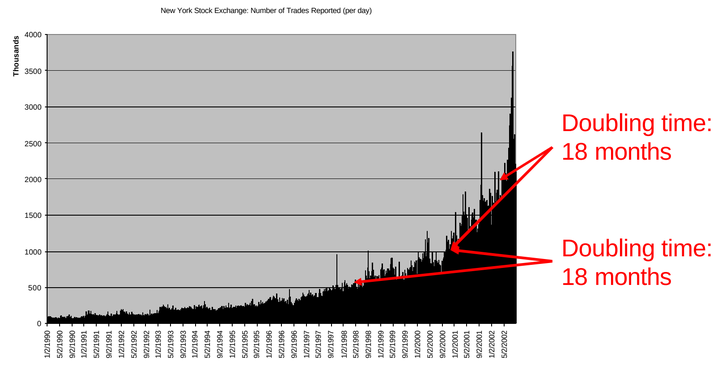

Other similar “problems”

- With too many groups, Isis gets slow
  - Often they overlap heavily
  - But each runs its own version of the membership protocol… redundantly
  - And Isis tries to preserve properties, like causal order, over group boundaries
- Is the Isis model “scalable”?

French ATC problem

- They wanted to use Isis for
  - Fault-tolerant console clusters
    - Radar data comes in separately. Display as a sort of “background” image
    - Use Isis to replicate data for state of planes in the air – tracks, flight id, “owner”, etc
  - System management
    - Track state of all the workstations in Toulouse
  - Inter-airport flight plan updates

Observations

- One center might have
  - 150-250 machines, in
  - 50 clusters of perhaps 3-5 each
- Flight plan updates relevant to 3-5 control centers at most

“Fear of Isis”

- Without Isis, those 200 workstations are very loosely coupled
  - Isis couples groups of 3-5 at a time…
  - .. But the management application also links them into massive groups
- And data rates
  - Are low for the small groups
  - But would be high for the management app.

Solution?

- Run Isis in a partitioned mode
  - Each group of 3-5 systems is a separate Isis instance
  - Loads light... membership small... an easy Isis application
- Don't use Isis for the system-wide membership mechanism!

Isis success stories

- The two French ATC systems (console cluster or "Phidias" and the inter-airport flight plan system – I don't know name)
- New York and Swiss Stock Exchanges
- Florida Electric and Gas
- US Naval AEGIS warship, various black applications in military

Lesson #4: You don't get rich

- Sadly "Middleware doesn't sell"
- And because of this, economic forces conspire ferociously against Isis and similar technologies!
- Ultimately, any middleware company
  - Either grows into a services company
  - Or dies

Terminology

- A company can sell
  - Iron. Like Dell: Priced by the pound
  - Platforms. Like Microsoft, Red Hat
  - Applications. They do stuff. Like Adobe
  - Solutions. Integrated applications with the "whole story" for some customer category
  - Itself. Some companies exist primarily to be acquired by other companies.

Middleware?

- A term used for a company that is neither selling platforms nor applications
- Often, they sell bandages! We'll fix defects in your Linux and Windows platforms...
  - And you might even pay for this.... a fraction of what you spent on Windows!

Services

- Companies like IBM, HP... and in fact, Isis, make much of their money on services
  - At IBM, roughly six to one relative to licenses for middleware
  - "Our crack team of hackers, using our superior middleware, can solve your problems better."

When Stratus bought Isis...

- They wanted to greatly increase the flat license revenue with less services revenue
  - And this was a disaster.
  - In fact, it can't be done.
- Middleware gets sold to the wrong kind of customer. Not a scalable revenue stream.

Summary of lessons?

- Groups are way cool
  - But in fact, building a really scalable group mechanism remains a tough challenge even today!
  - And even if you pull it off... nobody will want to pay enough to make a profit on it
  - This is just not a good business to go into!
- But the underlying technology was deep and that was fun