the unknowns
a manager's guide to
open source

ILLINOIS GIS ASSOCIATION

So, as you can see,

Steve Coast

Open Street Map

I'm not Steve Coast,
and unfortunately I'm not here to talk about
<X> Open Street Map,
but I **am** here to talk about "open source"
software, which is very similar to "open street map"
not in the superficial sense, that they share the word

"Open"

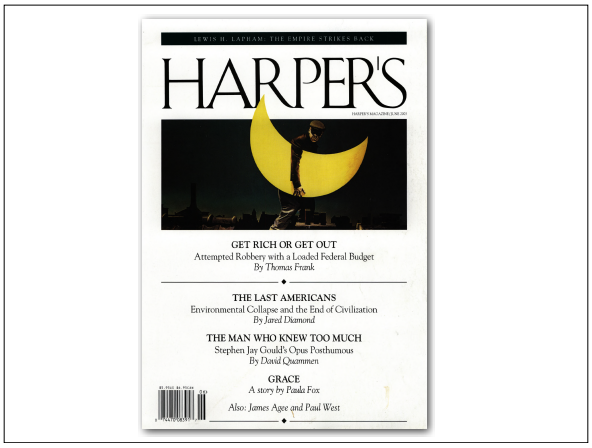
"open" in their name, but in the absolute beating core of their natures,
because open source
and open street map are activities that
only exist because

communities of people come together,
<X> over an global electronic network
<X> with a shared love for what they are doing
but before I get to that...

I'd like to start ...
with a digression.

One of my favourite pieces of poetry was delivered, not by a beat poet in Greenwich Village or by a 19th Century Romantic,

but by one Donald Rumsfeld, then Secretary of Defense, from the Pentagon press briefing room, on February 12, 2002.

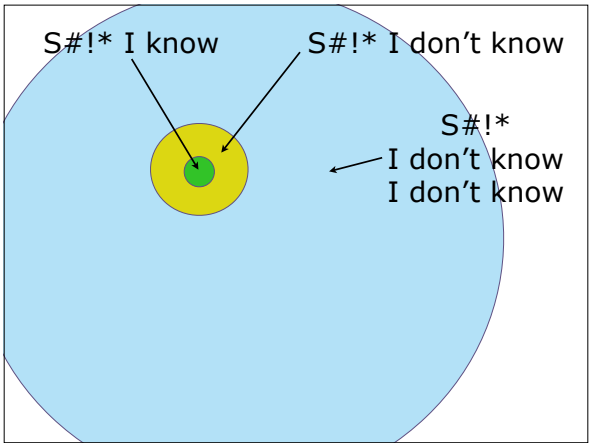


Hart Seeley later formed the Secretary's words into a poem which was published in Harper's Magazine in June 2003 as "The Unknown"

As we know,
There are known knowns.
There are things we know we know.
We also know
There are known unknowns.
That is to say
We know there are some things
We do not know.
But there are also unknown unknowns,
The ones we don't know
We don't know.

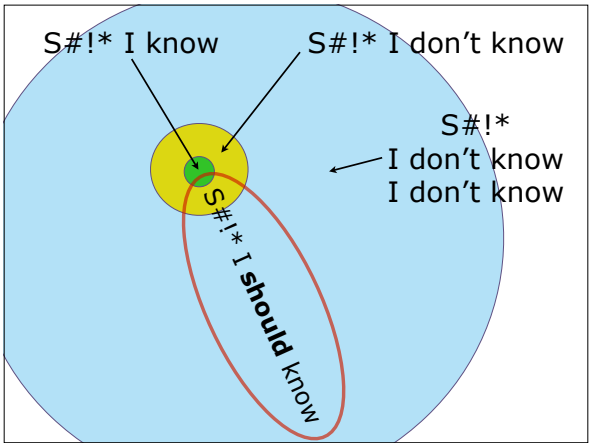
... read ...

I've also found the same sentiments
expressed less elegantly,
but more forcefully
in diagram form, showing



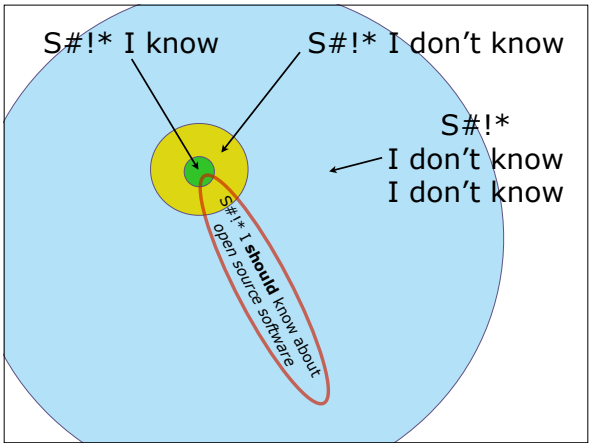
The stuff we know we know;
<X> The stuff we know we don't know;
<X> And the vast expanse of things we don't know we don't know.

It is scary that the largest category by far is one we definitionally cannot comprehend,
the stuff we don't know we don't know.



Of course, this is an epistemological diagram of *all* knowledge,
so we *can* constrain it, a bit, by noting that,
for practical purposes,
we are really only concerned with the
<X> **stuff we *should* know**.
Unfortunately the stuff we
should know still falls in all three categories.

And as IT managers, there is, amongst the stuff we should know,



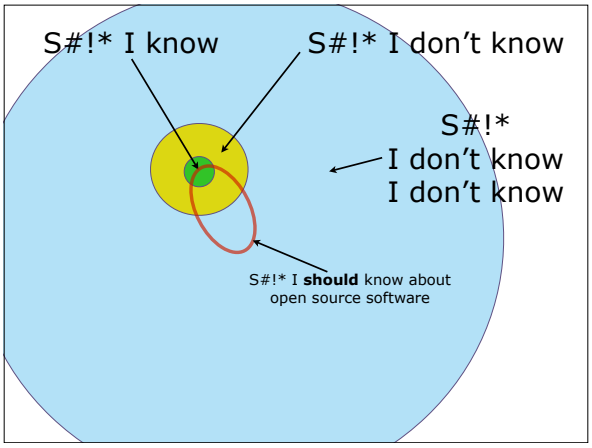
the stuff we should know about open source software

So, why do I think
I have something useful
to say on this topic?
My bona fides
to talk about open source
and management are

developer manager

Refractions RESEARCH

as a developer of open source software,
a hacker, a programmer,
in particular on the PostGIS spatial database,
which I have been involved in for 10 years
<X> and as a manager of a small consulting company,
Refractions Research, which I ran for 10 years.
My goal today
is to modify your internal
epistemological diagrams a little,



maybe to something more like this.

And not because I expect you
all to rush back home and
implement open source,
but because when you
know more about open source

open source is an
option

it becomes an OPTION.

To understand why open source
is an option, it helps to have some
background.

who
what
where
when
why
how

So I am going to
begin with a quick rundown
the journalistic
who, what, where, when and why.

And fortunately,
I can squeeze the

why
how

Who, What, Where and When
into a preliminary story,
and then we can deal
with Why and How at our leisure afterwards.

So, the story...

once upon a time...

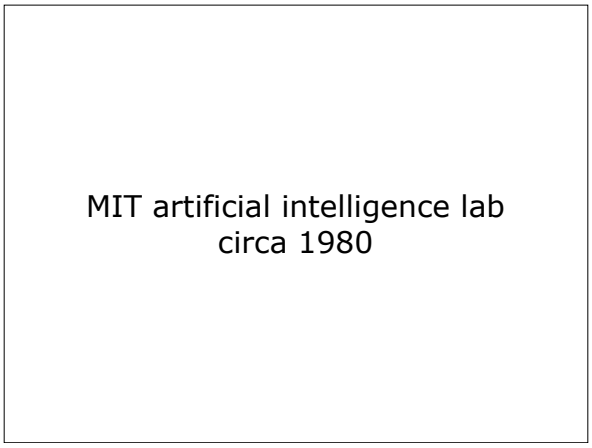
Once upon a time,
there was a young man with
wild ideas about freedom,

who took on
the established order of things,
appeared to lose,
but in the end changed the world forever
(though perhaps in ways
he might not approve of).

Actually, not that young man,

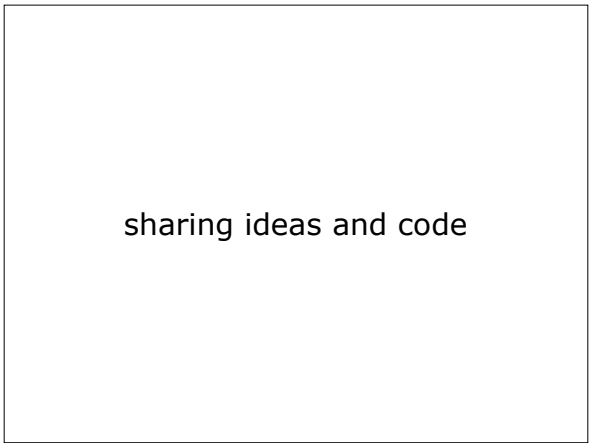
though there is a striking resemblance...

In 1980,
Richard Stallman was a programmer



at the MIT Artificial Intelligence lab.
Some of the best minds in the

artificial intelligence field worked together



and shared ideas and implementations of those ideas in code.

It was, to hear Stallman tell it,

a brief golden age of
collaboration and intellectual ferment.

Then one day,
and don't all horror stories start this way,
one day,

the lab got a new printer
(a xerox 9700).
Unlike the printer it was replacing,
the new printer came with a
binary-only printer driver;
the source code was not included.

Stallman had modified the
previous driver to
send a message to users

printer has jammed

when the printer jammed.
With the new binary
driver he couldn't do that.
The situation was *inconvenient*,
it was a pain.

why not just share
the code?

Why couldn't Xerox just share their code?
Everyone would be happier!

Most people might have shrugged.
But for Stallman it was a
galvanizing moment.
Over the past five years
working in the AI lab,
he had grown used to
sharing code and ideas
with other programmers.

But now the atmosphere in
computing was changing.

It wasn't just the printer driver.

A private corporation had
started recruiting
his colleagues in the lab.

symbolics

symbolics.com
registered in 1985

Once hired, they were no longer allowed to exchange code with him.
(Completely unrelated nerd trivia, but, the company doing the hiring, symbolics, was also the first company to
<**X**> register a .com domain name, in 1985.)
The old computers in the lab,
and the software that ran on it,
were becoming obsolete.

The new computers
being purchased by the lab
included operating systems
that were locked down:
you had to sign nondisclosures
just to use them.

It was the death of
the old collaborative community.
Stallman worried that

"the first step
in using a computer
was to promise
not to help
your neighbor"

"the first step in using a computer was to promise *not* to help your neighbour" by accepting a license agreement.

As a highly talented and idealistic computer programmer, Stallman wanted his work to serve a larger purpose.

The financial promise of working in the growing proprietary software industry was not enough,
nor was the sterile intellectual amusement of continuing his work alone in academia.

Facing the death of his old intellectual community, Stallman asked himself

"was there
a program or programs
that I could write,
so as to make
a **community possible**
once again?"

"was there a program or programs that I could write, so as to make a *community possible* once again?"

You can't use a computer
without an operating system.
So Stallman decided that, first
he needed to write an

operating system

portable / multi-platform

UNIX compatible

free

operating system.
It had to be
<X> portable to many computer platforms, it should be
<X> compatible with the popular new UNIX operating system to make it easy for people to run their existing programs on it,
and most importantly it
<X> should be **free**.

to run it
to modify it
to share it
to share your modifications

free

By "free", Stallman meant
you should be <X> free to run it,
you should be <X> free to modify it,
you should be <X> free to share it,
you should be <X> free to share your modifications

"free" as in "freedom"

- logiciel libre
- software libre
- il software libero

liberty

In a latinate language like
French, Spanish or Italian
it's more obvious that,
Stallman isn't talking about price,
not "logiciel gratuis",
he's talking about <X>
[fr] logiciel libre,
[sp] software libre,
[it] il software libero.

He's talking about
<X> liberated software,
the key addition is liberty.

open source definition

These core freedoms, to modify and share software,
also make up the "open source definition",
which was popularized in 2000 by the non-profit open source initiative

GNU's
Not
UNIX

GNU's
Not
UNIX

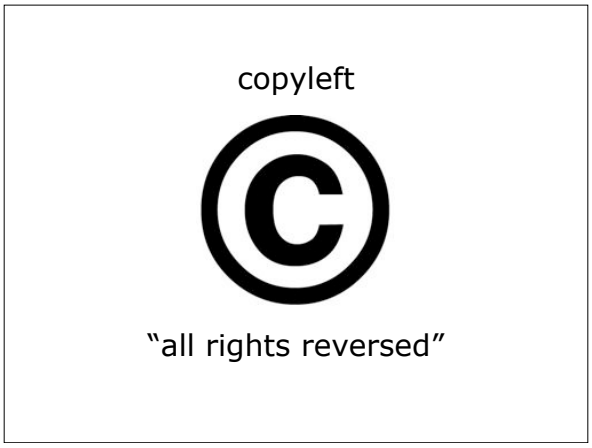
So, rather than join a computing industry that he considered morally bankrupt, Stallman decided to basically start a new one from scratch.
It was an audacious plan.

Stallman called his new system
<X> GNU, which stands (recursively) for
<X> "GNU's Not UNIX?"
(See the recursion?)

GNU's
Not
UNIX

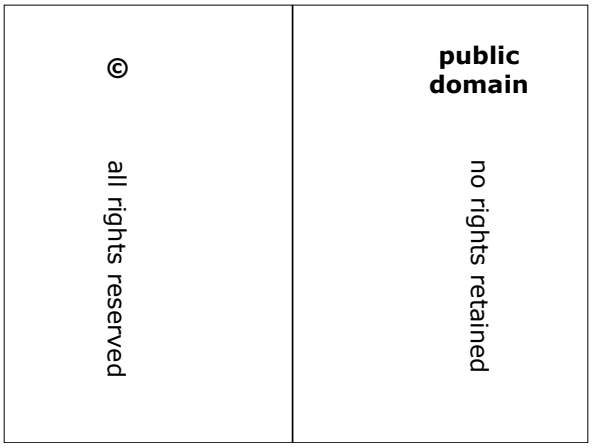
GNU's
Not
UNIX

Let me just take a very minor diversion here to add some extra flavor.



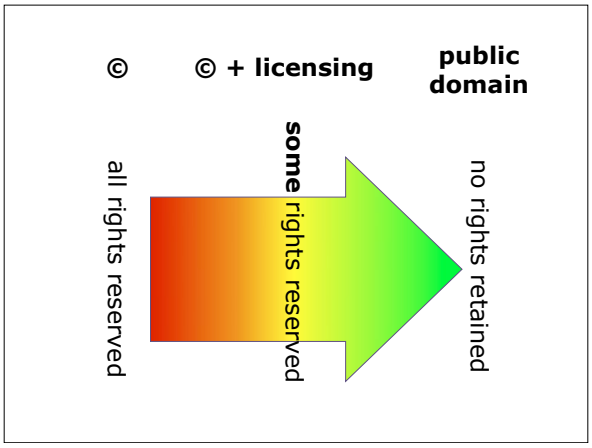
In order to ensure GNU remained free, and did not get subsumed into a proprietary system in the future, Stallman released his work using a scheme he called "copyleft".

Generally speaking,
intellectual works
(books, movies, songs, computer programs)
are either under



copyright or public domain.
The author either retains
full control over the work,
"all rights are reserved",
or no control,
"no rights are retained".

Copyleft,
and open source licenses in general,



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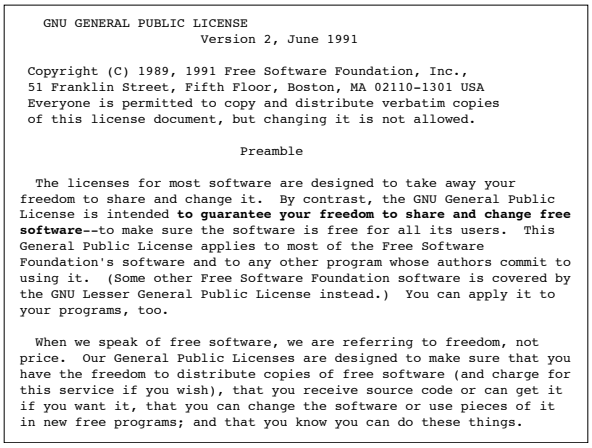

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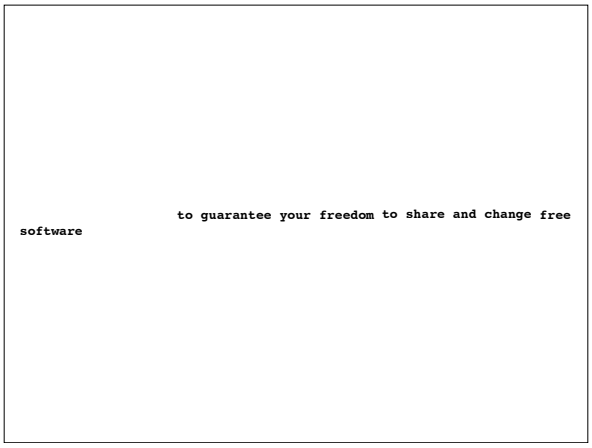
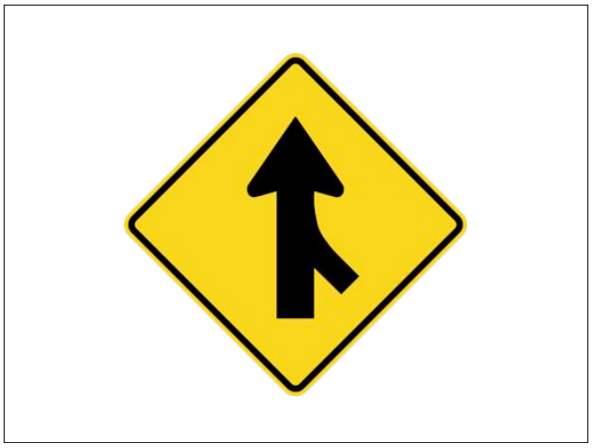
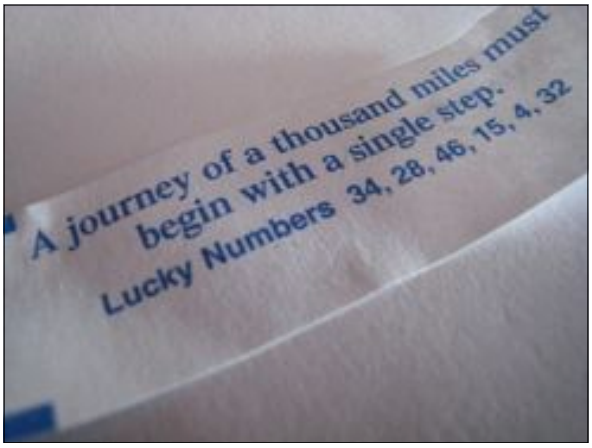


The legal language can get complex,
but the principles are hardly foreign.
Share and share alike.
Do unto others
as you would have them do unto you.



OK, back on the highway.

So, in 1984 Stallman quits his job at MIT
and starts working on GNU full time.
No visible means of support,
this is a labor of love.

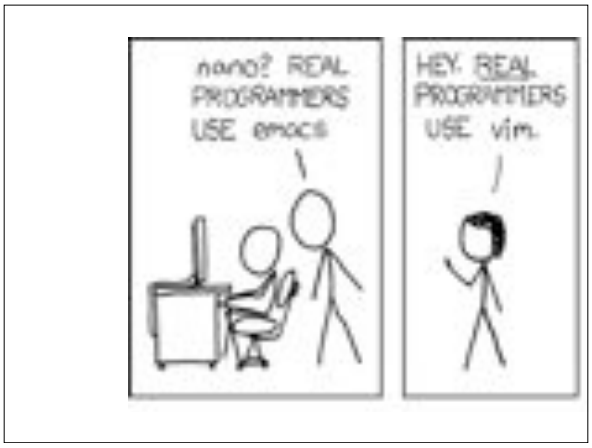


But where to start?
From a blank canvas, you want a
completely free software ecosystem,
what do you do first?

If you wanted to build a
100% all hand crafted house,

you would start by hand crafting your tools.
Stallman did the
same thing,
with GNU versions of
software development tools.

He starts by writing a text editor



(GNU Emacs),
so he can write his
free system using only free tools.

The Emacs editor proves so popular
(and internet access is still so rare)
that he is able to earn a
small living selling tape copies of the code
(distributed under copyleft of course).

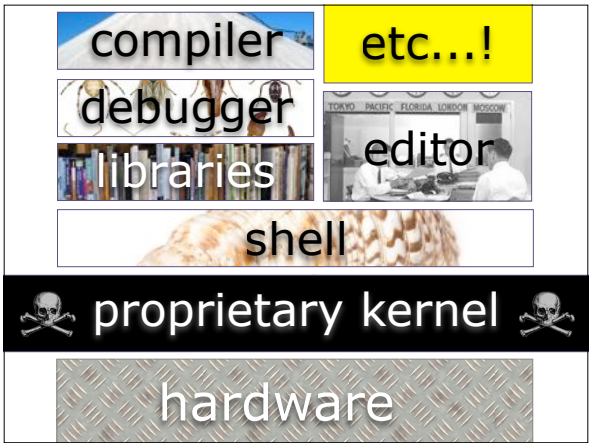
Then he writes a compiler, GCC,
You can still find GCC
in every Linux distribution
and also in Mac OSX.

Stallman lives like a monk,
works like a demon,
attracts some followers and helpers,

who formalize the project
in a foundation.

By 1990 they have
most of the components
of an operating system.

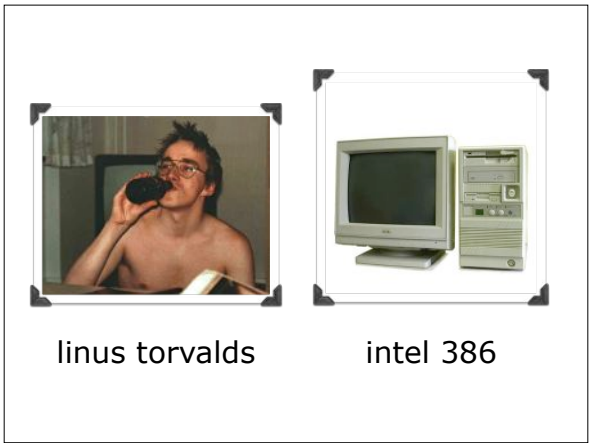
Most importantly, they have a full programming
tool-chain:
<X> shells,
<X> compilers,
<X> debuggers,
<X> editors,
<X> core libraries,
<X> and so on.
All the things you need to write complex software.
<X> What they don't have, is a UNIX kernel, the
piece of software that talks directly to the hardware.



At this point,
<X> all their free tools are
still being run on proprietary UNIX!

OK...

In 1991, a Finnish
computer science student



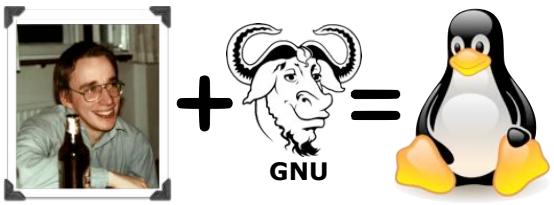
named Linus Torvalds
buys a new computer,
<X> an Intel 386.

As a student at the university,
he has access to UNIX systems,
and he wants to run UNIX
on his 386 at home.

This is not possible.

The good implementations
for the 386 cost more
than the computer itself.
<X> The cheap implementation,
Minix, is quite limited.

So Linus writes his own kernel.



He uses Stallman's GNU tools
to write and compile it.
And in August of 1991
he posts the following
on an internet discussion list.

Hello everybody out there using minix -

I'm doing a (free) operating system
(just a hobby, won't be big and
professional like gnu) for 386(486)
AT clones. This has been brewing
since april, and is starting to get ready.
I'd like any feedback on things people
like/dislike in minix, as my OS resembles
it somewhat (same physical layout of the
file-system (due to practical reasons)
among other things).

I've currently ported bash(1.08) and

... read ...

Underneath the technical language,
note the subtextual bits:
the humility (just a hobby...),
the interest in
other people's ideas
(what do you like/dislike in minix...).

does anyone want to play?

The posting is an invitation.
Does anyone else
want to come out and play?
Does anyone?
They do.

Within 15 minutes, he has a reply.

"Tell us more!
Does it need a MMU?
How much of it is in C?"

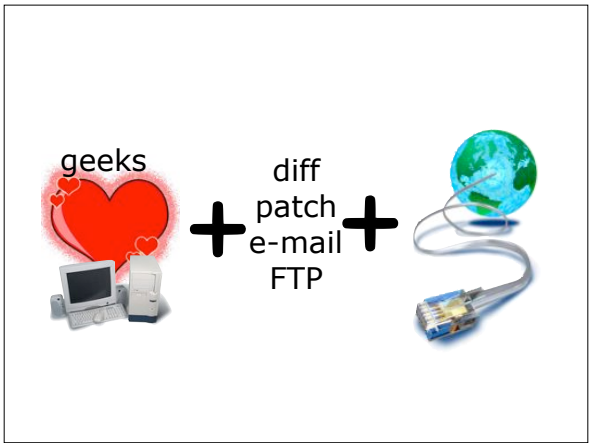
Tell us more! Does it need a MMU?
(memory management unit)
How much of it is in C?"

Within 24 hours,

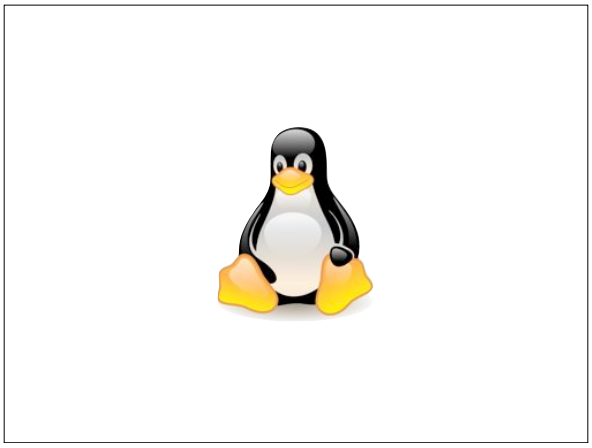
he has replies from Finland, Austria, Maryland, and England.

In a month the code is on a public FTP server. Within four months, it is so popular that an F.A.Q. document has been written to handle the common questions.

Linus Torvalds tapped a seam of enthusiasm just dying to express itself.

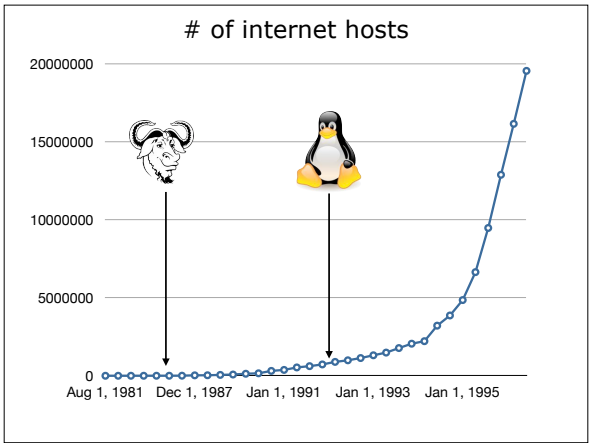


People who loved computers and computing and just wanted to play together. And through the medium of the internet, using only the simplest computing tools (diff, patch, ftp, e-mail), he built a community of thousands of contributors, and



together they built a usable operating system.

Something important changed between the time Stallman started the GNU project and when Torvalds released Linux.



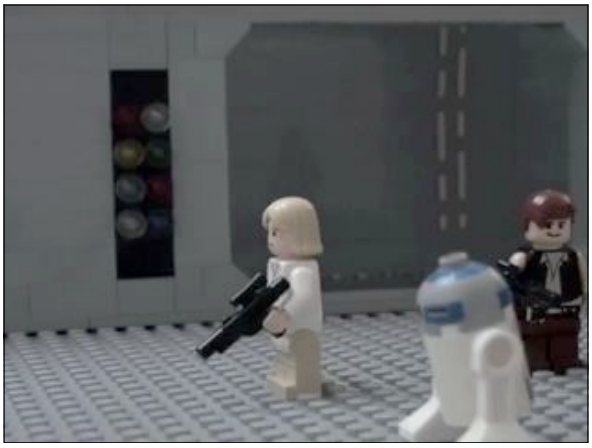
The values of collaboration were the same, but the opportunity to exercise those values was greater, via the internet.

<X> When Stallman started GNU in 1984, there were 1000 hosts on the internet.
<X> When Torvalds started Linux in 1991, there were over 400,000.
And the pool of potential collaborators was in the middle of a huge expansion.

Let's take a quick detour

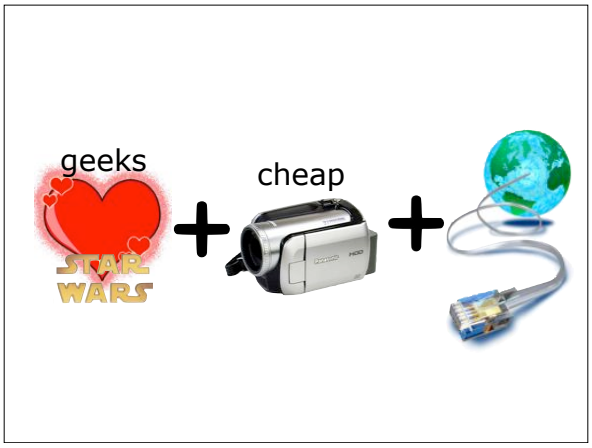
and talk about Star Wars.
In particular, let's look at
<X> a web site called Star Wars uncut.

Star Wars Uncut has
taken the original movie
and chopped
it into 473 fifteen second scenes.

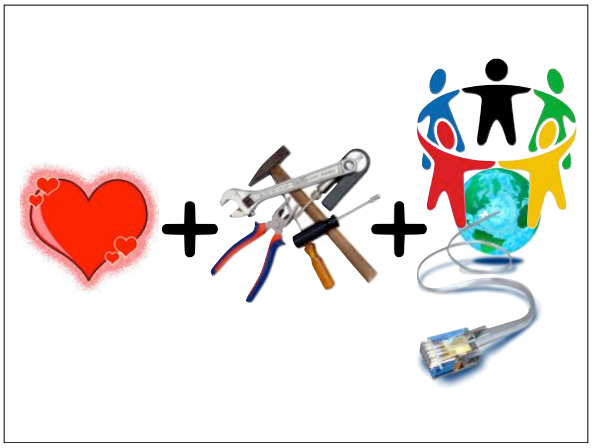


Each scene is then
separately claimed
and re-enacted by site members,
and uploaded.
The result looks like this.

Seems pretty frivolous, right,
but break it down.
How is this (frivolous)
collaboration possible?
And, why is it only happening now,
<X> not 10 years ago?
There were just as many
Star Wars nerds
10 years ago as there are now.

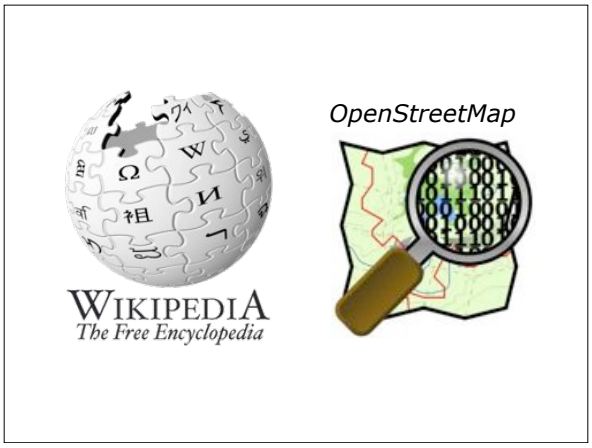


First, this activity requires
easy access to video recording
and editing tools,
and until recently cameras and
video editors were very expensive.
<X> And it requires enough bandwidth
to download and upload video,
and until recently people
didn't have that kind of
bandwidth in their homes.
<X> And finally it requires Star Wars geeks.
Generalizing, then...



To build a large collaborative product, you need
<X> tools freely (or very cheaply) available and
you need
<X> sufficient connectivity between participants.
Combine that basic infrastructure,
with community, collaboration
and <X> love for the subject matter,
and magic happens.

There are many, many more examples of this kind
of
group collaboration,



Wikipedia and
<X> Open Street Map are two others you've heard
of

"commons-based
peer production"

the academics call these collaborations
"commons-based peer production".
If you are interested
in the topic

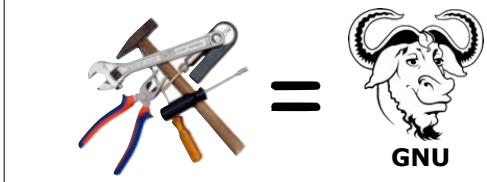
I strongly suggest reading
“Cognitive Surplus” or “Here Comes Everybody”
by Clay Shirky.

So this is
less of a detour
than it seemed at the start,
Because,

open source is
commons-based
peer production

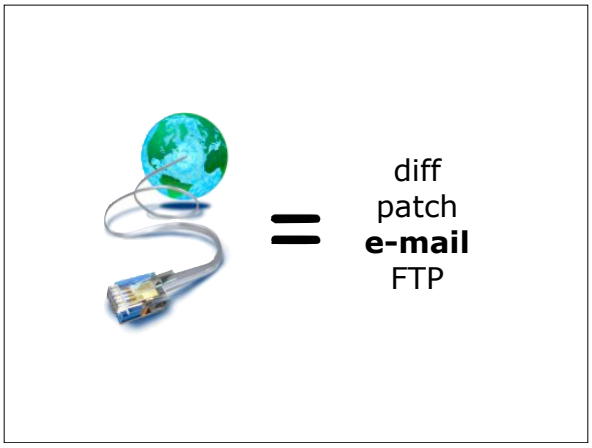
Open source software in general
and the Linux project in particular
are some of the
earliest examples of
internet-mediated
commons-based peer production.

The universal access to tools
was provided by the original



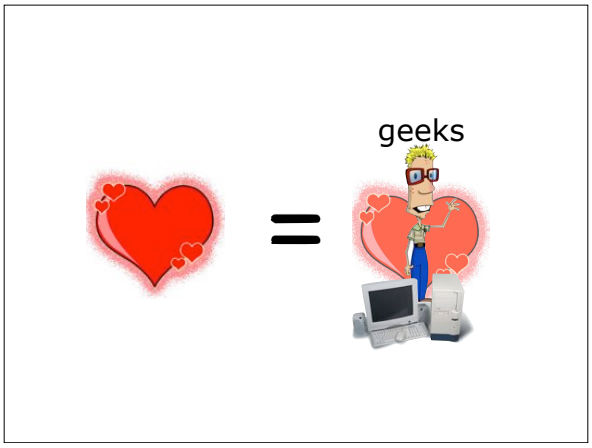
GNU project components.
Editor, compiler, lexer, libraries,
were all available equally to
all participants.

The medium of communication was just e-mail.



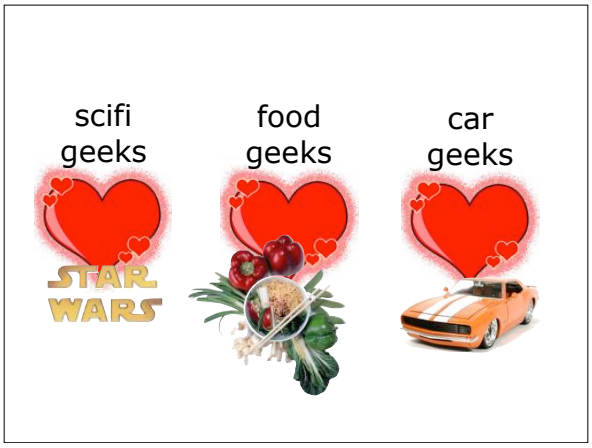
the work they were sending around was source code,
snippets of text, no problem
even for the dial-up
internet connections of the
early 1990s.

And why do open source programmers do it?
What is the core motivation.
It isn't money.



Fundamentally they
code because they love it.

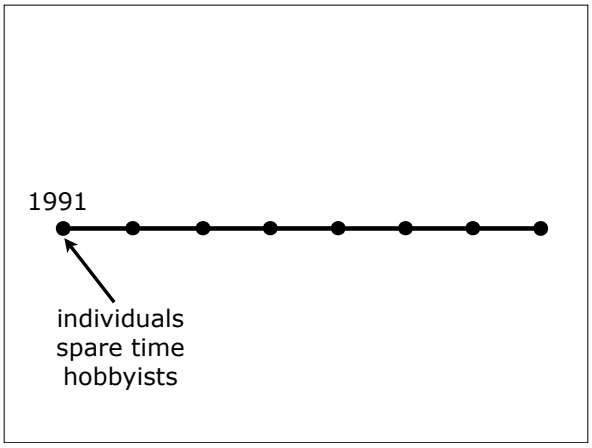
It's the same reason



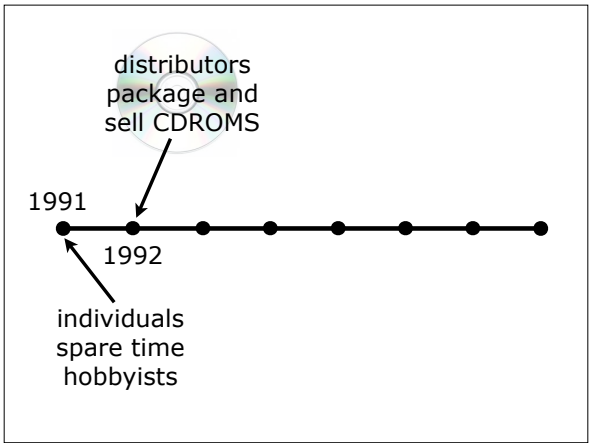
Star Wars geeks re-shoot 35 year old films,
<X> why food geeks post restaurant reviews,
<X> why car geeks re-build '68 Cameros.
It's an avocation.

At least, it starts that way.

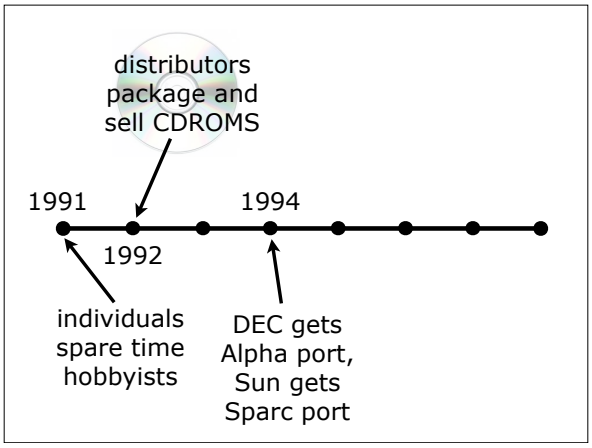
But open source software has a
wider utility than restaurant reviews and vintage muscle cars.
So as projects have expanded, they have at each stage become
more and more integrated into the wider economy.



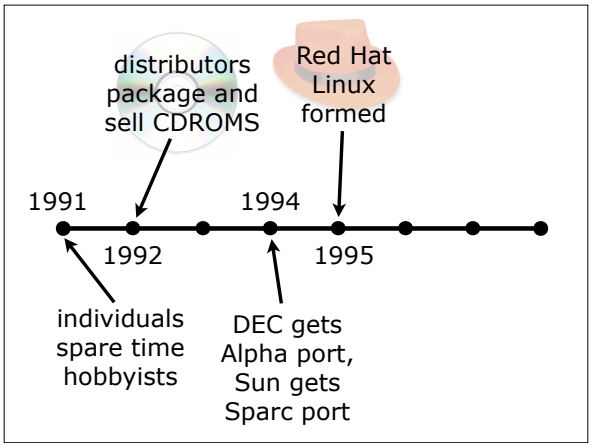
Linux is a good example.
Start with Linus and the early group of enthusiasts in 1991.
These are individuals working in their spare time.
They are doing it for love.



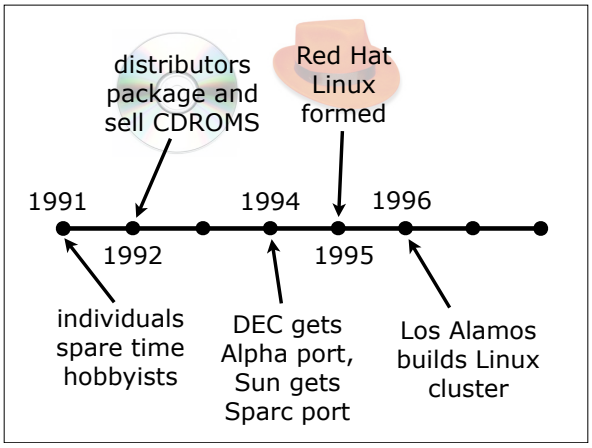
By 1992, you get "distributors", packaging up the Linux kernel
with collections of GNU and other tools to form full working operating systems.
First they do it for love, helping other Linux lovers,
but soon they are covering their cost and time, selling CDROMs for $50.
So programmers are earning livings with small Linux businesses within a couple years of the project start.



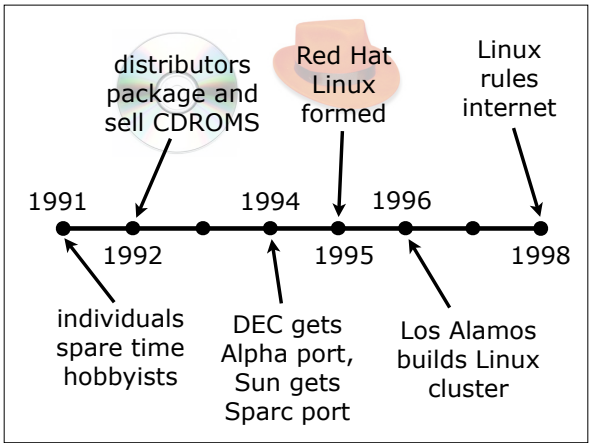
In 1994, DEC sends Linus a "free" Alpha workstation in the hopes he will port Linux to the Alpha chip.
He does.
Simultaneously David Miller ports Linux to the Sun Sparc processor.
Linux is now competing with "real" UNIX on corporate "big iron".
Over the next couple years, the makers of these machines start to hire Linux programmers of their own.



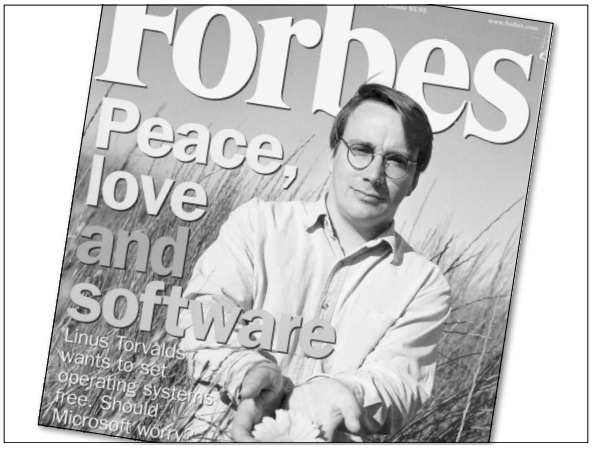
In 1995, Red Hat Linux is formed, a company which will eventually grow to an $8B Linux support enterprise.



In 1996, Los Alamos National Laboratory builds the first Linux cluster for
simulating atomic shock waves.
It costs 10% of a comparable supercomputer, and on start-up becomes
the 315th most powerful supercomputer in the world.



By 1998, the explosion of the internet into general public use is underpinned by thousands of commodity servers running Linux as their operating system.



Microsoft is drafting strategy memos about how to counter Linux, and Linus Torvalds is featured on the front page of Forbes magazine.

Linux is no longer a hobbyist activity.
It is deeply embedded in the economy at multiple levels.
This is in 1998, just **seven years** after that first newsgroup post.

Fast forward to the present.
<X> The NSA employs Linux programmers to make their systems secure.
<X> NASA employs Linux programmers to run it on their space mission hardware.
<X> Google employs Linux programmers to optimize their massive compute clusters.
<X> Oracle employs Linux programmers to support their Oracle-optimized Linux.
<X> IBM employs Linux programers to ensure it runs on their SystemZ mainframes.
<X> Microsoft employs Linux programmers to add kernel support for Windows virtualization.
<X> And so on, and so on, and so on,

So, here's a question I get asked a lot:

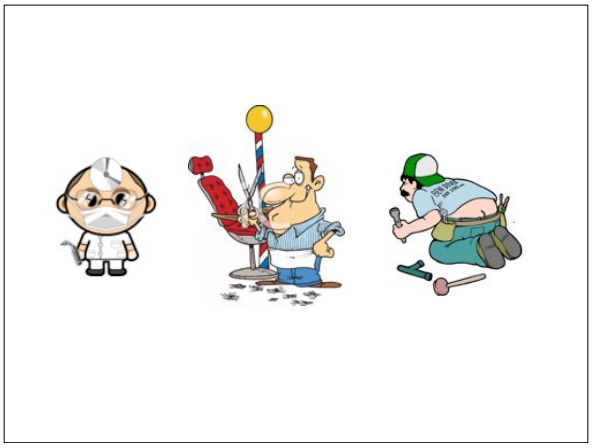
"how do you make a living writing free software?"

um, how do you make a living writing free software?

Referring back to the previous slide...

Hopefully it would be
obvious.

I make my living the same way



my dentist, my barber and my plumber
make their livings.
I sell my very specialized expert services
in open source spatial database programming
to people who need those services.
And in a globalized, internet connected world,
there are plenty of people who need them.

I could talk for another half hour about the
different ways open source projects are
deriving support from the general economy,
but unfortunately, then,

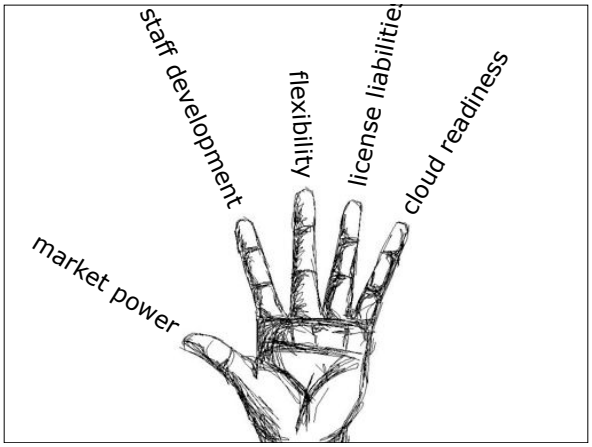
open source is an
option

I wouldn't have time
to talk about why you,
as managers,
should be
looking at open source as an **option**.

who ✓
what ✓
where ✓
when ✓
why
how

We have covered the
Who (Richard Stallman, Linus Torvalds and thousands of others)
<X> What (Freedom to redistribute and modify)
<X> Where (Mostly on the internet) and
<X> When (From 1985 initially, but really starting from the early 1990s, growing rapidly right up to the present)
of open source.

<X> Now let's take a look at the "Why".
And not the "why" of Stallman
(the moral imperative to share),
but the "why" of an information technology manager.



Here are five good reasons to
consider open source in your enterprise

<X> Cloud Readiness also known as Scaling also known as Rapid Deployment
<X> License Liability or actually the Lack Of same
<X> Flexibility and its kissing-cousin Heterogeneity
<X> Staff Development and Recruitment
and most importantly
<X> Market Power

So, first of all

#0: technical superiority

<<Technical Superiority>>

Did I forget to mention this one?

There are open source advocates
who will claim,
straight up, no hedging,
that open source software is
just technically superior to
proprietary software.
They will say that the
open development model
results in code with

- fewer bugs
- more modularity
- better security
- faster release cycles
- better performance

fewer bugs per 1000 lines,
<X> higher levels of modularity,
<X> better security due to wider peer review
<X> faster release cycles, and
<X> better performance.
I am not one of those advocates.

not me

At least not for most projects.
For a project like Linux, perhaps.

more developers and testers
than any one company
could possibly field

Linux has concentrated an
incredibly large number of very high quality
technical contributors
into one code base,
more people than any one company could ever
employ.

But most open source projects,
and certainly those in the geospatial realm,
operate with at most a
few dozen contributors,
they aren't out of the league of corporate
development teams.

PostGIS
Spatial PostgreSQL

>

Microsoft SQL Server 2008
Spatial

(Although a little birdie tells me there are
more people working on PostGIS
right now than are working on
SQL Server Spatial.)

weird

Which is weird.

If you are interested in the
topic of technical superiority,

David
Wheeler

dwheeler.com/
oss_fs_why.html

David Wheeler has a 2007 paper
"Why Open Source Software:
Look at the Numbers!"
that brings together all the
research in one,
very, very long page,
which is well worth reading.

Moving on,

#1: cloud readiness
scaling
rapid deployment

Reason #1, cloud readiness,
<X> also known as scaling,
<X> also known as rapid deployment.
It looks like I'm squeezing
three topics into one,
but I'm not.
These three benefits are
all aspects of the same
open source attribute:

$0 capital cost

the zero-dollar
capital cost of deployment.

Always on the trailing edge
of the leading edge,
Microsoft has recently been
advertising "to the cloud!"

More and more computing tasks will be
delegated to "clouds" of computers
hosted in huge data centers
"somewhere" on the internet.
More users will expect
direct access to data through
web services.

More mobile devices will consume those services
with every passing year.
All that new user demand adds up to
potentially unconstrained load on services,
and growth curves that transition
very quickly from horizontal to vertical,
as services move into the mainstream.

Scaling services is **important**.
It's getting even more important.

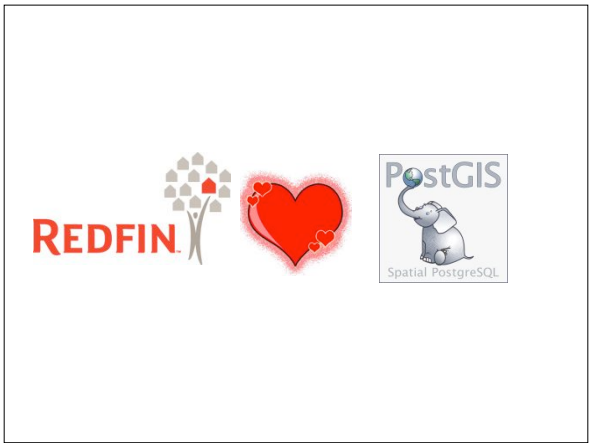
So....

start-ups  open source

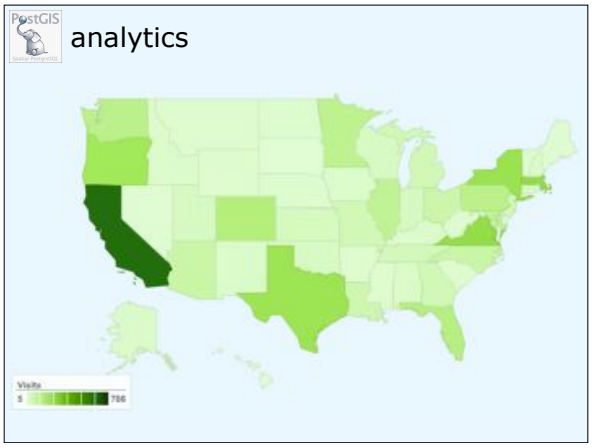
I'm a principal developer of the PostGIS open source spatial database, and one of the things I have noticed about users of PostGIS over the past years, is that the most enthusiastic adopters have been start-up companies.

GlobeXplorer based their satellite image service on the PostGIS open source database, choosing it over Oracle and Informix.

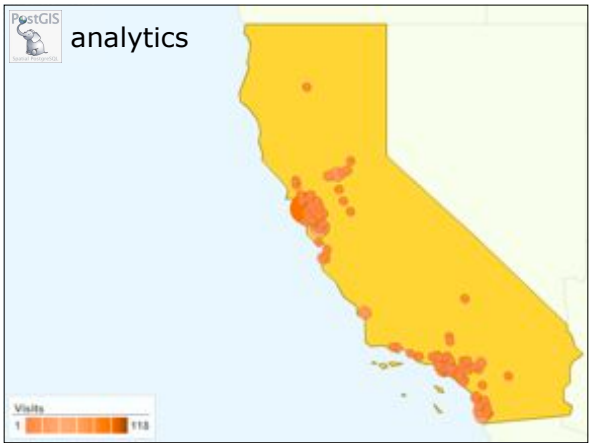
Zonar Systems developed a fleet tracking system on top of PostGIS and the MapServer web mapping software.



RedFin started their
real estate information site on
MySQL and moved it to PostGIS for
performance reasons.



The Google Analytics for the
PostGIS web site show that
California is the state with highest
interest and



inside California it is
San Francisco and Silicon Valley
that have the highest interest.

The reason start-ups love open source

start-ups cannot
afford artificial
limits on growth

is because it removes a
critical constraint to their growth.

While the cost of computing hardware
falls dramatically year after year.
The cost of proprietary software
does not follow the same curve.

If you are using software

$N per core

- X cores

ouch!

licensed per CPU or core,
that means that
the primary driver of **scaling cost**.
is **software cost**.

The math can be brutal
even **before** you start
scaling horizontally.

Dell T710

2x quad-core Xeon
36 GB RAM
2 TB RAID 10

$6,953

This Dell T710 with
dual quad-core CPUs,
36Gb of memory and
2TB of RAID 10 storage
will set you back
$6,953.

OK, now

ORACLE

8	cores
0.5	"processor core factor"
$47,500	Oracle Enterprise
$17,500	Oracle Spatial

$260,000

let's put Oracle Enterprise
on our fancy new server.

<X> We have 8 cores, multiply that by
<X> a 0.5 "processor core factor", times the
<X> per processor price of Oracle Enterprise,
<X> add in Spatial because we are
GIS folks (and remember, you need
Enterprise to run Spatial)
and the grand total is,
<X> a cool $260,000.
Or as Larry Ellison calls it,

a quarter.
(of a million dollars)

$6,953

ORACLE

$260,000

Just contemplate the numbers
for moment. Hmm.

The exact same
unpleasant math applies to
GIS map serving,
and it gets worse and worse
the more you scale up.

Let's compare scaling

	proprietary	open source
server	CA$5,000	CA$5,000
software	CA$30,000	CA$0
training	CA$0	CA$30,000
total	**CA$35,000**	**CA$35,000**

an open source and a
proprietary map service.

At initial roll-out, the load is small, so we buy
<X> one server for $5,000, and
<X> one copy of the software for $30,000.
To be fair (or perhaps unfair)
<X> let's assume the staff is
already fully trained in the proprietary software,
but requires an immense amount of expensive training
or
learning time to adopt the open source.
So there's our sub-total for the first server,
$35,000.

	proprietary	open source
server	CA$5,000	CA$5,000
software	CA$30,000	CA$0
training	CA$0	CA$30,000
total	**CA$35,000**	**CA$35,000**

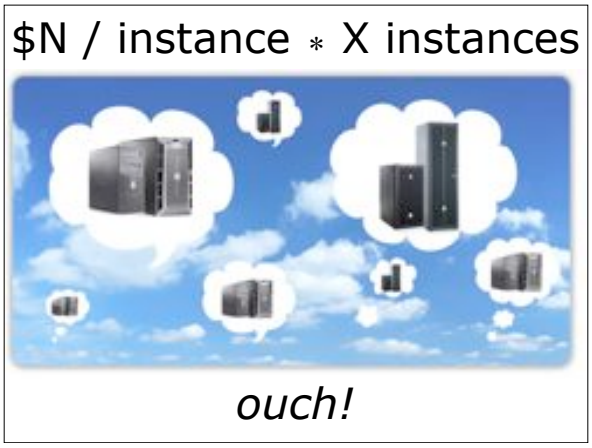
Now great news,
the citizens love the map service,
maybe someone built a cool iPhone app around it,
and
suddenly the load on the machine quadruples.
What does it cost?

	proprietary	open source
server	CA$5,000	CA$5,000
software	CA$30,000	CA$0
training	CA$0	CA$30,000
3x server	CA$15,000	CA$15,000
3x software	CA$90,000	CA$0
training	CA$0	CA$0
total	**CA$140,000**	**CA$50,000**

Add three more servers.
<X> Add three more licenses.
<X> We don't need more training,
the software is the same.
<X> And he more you scale, the worse
the totals on the left
become.

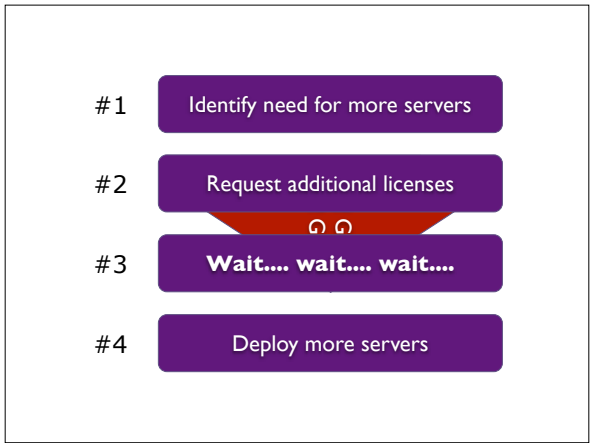
Now, it is possible you are
already so highly evolved

that you run your public services
in the cloud.
So there are no capital costs for "servers".
But the math in the cloud remains
just as unpleasant:

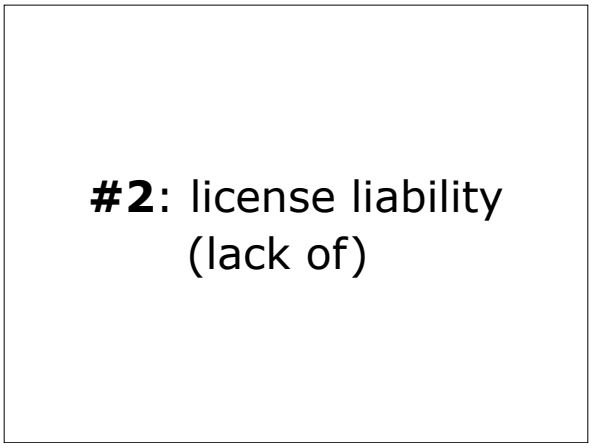


per-instance proprietary
software licensing
dwarfs the per-instance
hardware cost.
The only difference
is that the hardware costs are
spread out more evenly over time
instead of being concentrated in
big capital-intensive bursts.

The final reason start-ups

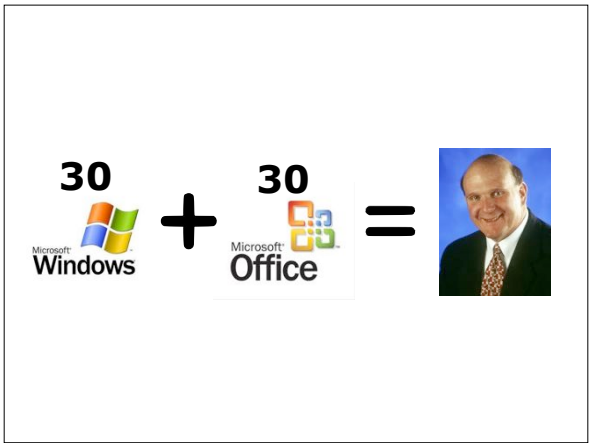


love open source is that they
don't have to ask permission to fire up those new servers,
so they can respond to crises and new opportunities
very very quickly.
Any software that requires a license or a license manager can
potentially slow a deployment by days.
If you are suddenly enjoying
<X> a surge in traffic,
the last thing you want to offer your new customers is a slow customer experience because
you haven't been able to deploy enough servers.



#2. License Liability (Lack Of)

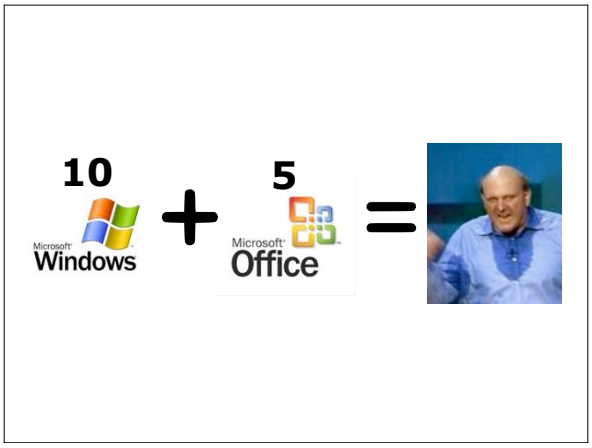
So, before I was a programmer,
I was a manager,
(figure out THAT career arc)
I used to run a consulting company,
and at our peak we had 30 staff.
A small company.
But that still meant



30 workstations under 30 desks,
running 30 licensed copies of Windows and
30 licensed copies of Microsoft Office.

At least, that was the theory.

In practice the company had grown very quickly over two years and software,
particularly application software,
had been installed wherever it was needed whenever it was needed.
So when we finally got around to counting up the difference
between what we were using and what we owned,
it was a bit shocking.

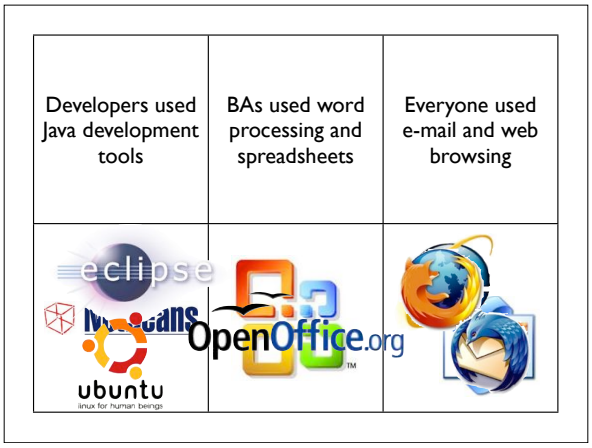


We had 10 licenses for Windows and
5 for Office.

Coming into compliance would cost almost $20,000.
Not coming into compliance would risk
hundreds of thousands of dollars in fines.

We were one disgruntled employee away
from a big cash crunch.

So we examined what we wanted our software to do.

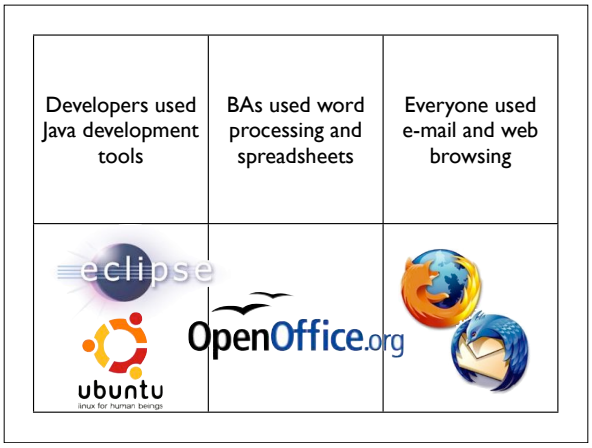


Our developers needed Java development environments,
our BAs needed document processing,
our managers needed some word processing,
everyone needed e-mail.

So we switched to open source.

<X> Everyone got OpenOffice for word processing.
E-mail and web browsing was with <X> Firefox and Thunderbird.
Some developers switched to <X> Linux as their operating system.
And we bought a few extra Windows licenses to come into compliance.

It was all, surprisingly, easy. Two things to keep in mind



First, if we had been more disciplined about using open source in the first place,
we wouldn't have built up the liability problem we did.
On the server side we had always been a pure Linux and open source shop,
so we never built up a problem.

<X> Second, once we *got* the open source discipline,
our potential *future* liability problems were reduced.
There were just a *lot fewer licenses*
remaining to keep track of.

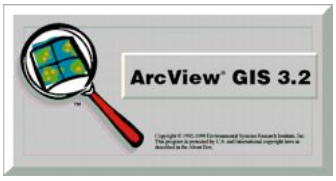
ok, smart guy,
what about GIS software?

So we replaced our office automation side without much trouble, what about the GIS side?

Some tools were too specialized and ingrained in our workflow to be replaced.
So we simply worked to manage our license load.

We put our FME licenses on a shared system with remote desktop, for example.

Other things ...
had just gotten out of hand.



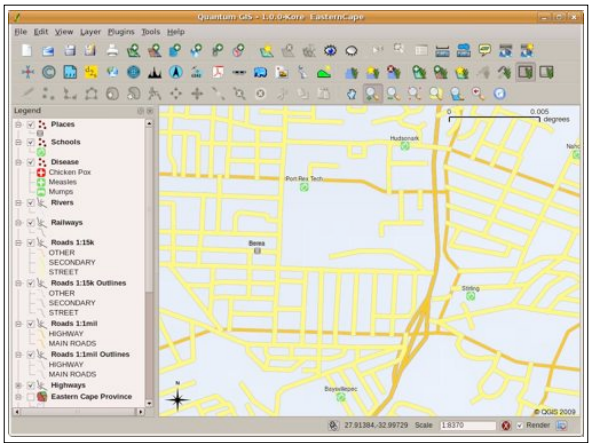
ArcView 3 is just really, really, easy, to copy. Isn't it?

How many of you still have illegal copies of ArcView 3, floating around your offices or...
sssshhh, your homes?

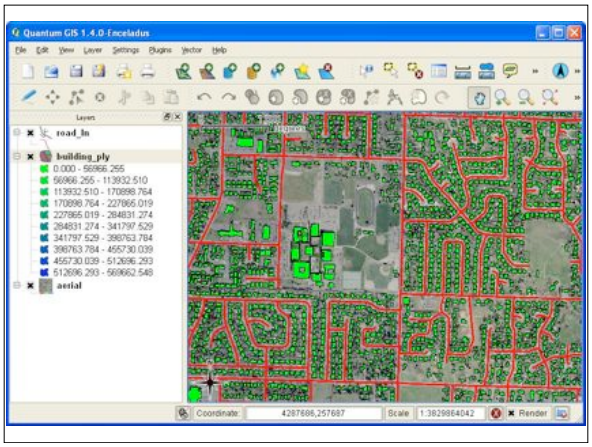
If I listen very carefully, I can hear a license compliance managers teeth grinding somewhere in the back.

It's OK... Jack's already rich.

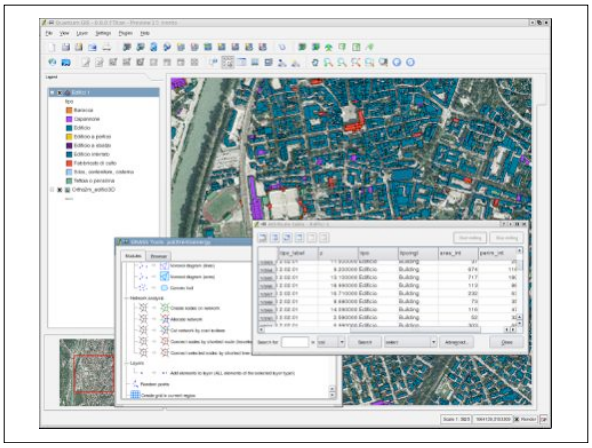
Our story ended with
removing all the unlicensed
ArcView copies and using
QGIS instead.



Here's a few screenshots of QGIS,
it looks eerily familiar doesn't it?



Simple UI,
basic scripting language,



simple printing capability.

It fills a need.

But the core point here is
not that proprietary software
is replaceable
(though it often is),

proprietary software licenses
are a legal liability
that **must be managed**

it is that proprietary software adds a
layer of
legal
liability
that needs to be managed.
And that takes
time and effort.

Because software gets copied. A lot.

Why wouldn't it,
you can make a perfect copy with two keystrokes

Ctrl-C. Ctrl-V.

And if that software is proprietary,
each of those keystrokes
digs a compliance hole for the
organization.
Click, click, click,
deeper and deeper and deeper.
And you don't realize how deep
that compliance hole is,
until you fall into it.

#3: flexibility heterogeneity

#3, flexibility and heterogeneity,
This is a bit of a geeky argument, but bear with me

- "**flexibility**" is an attribute of components
  - flexible components are easy to connect and adapt

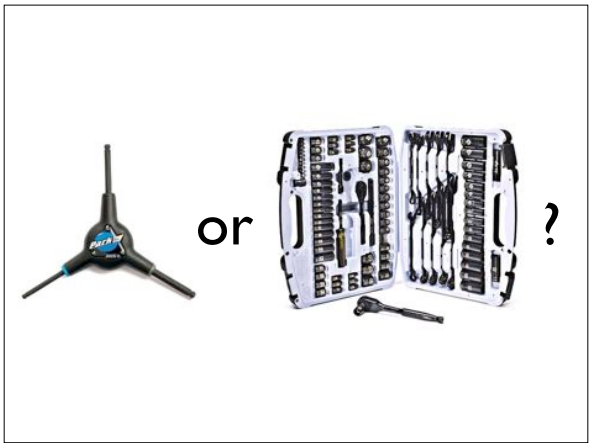
First, flexible components are easy to connect to each other and to adapt.
You can use flexible components from multiple vendors to build a heterogeneous system.

- "**heterogeneity**" is an attribute of the system
  - heterogeneous systems use parts from many sources

A heterogeneous system incorporates components from multiple sources.

Now,
Flexibility is great,
but usually you have to trade some ease-of-use to get get it.

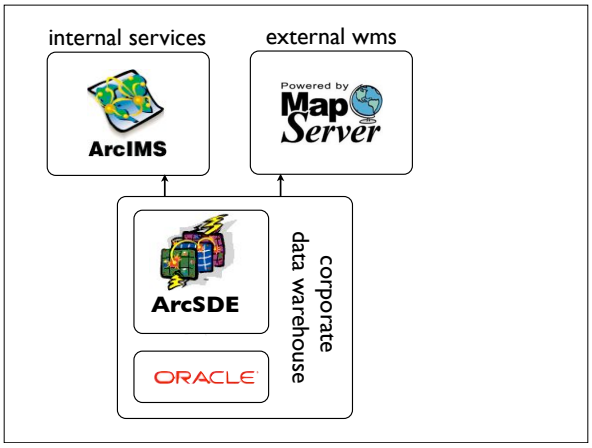
Which toolbox would
you rather work with?



The hex-tool: convenient, easy,
fits in the palm of your hand,
three sizes.
Or
<X> The socket set: modular, extendable,
64 sizes, metric and imperial.

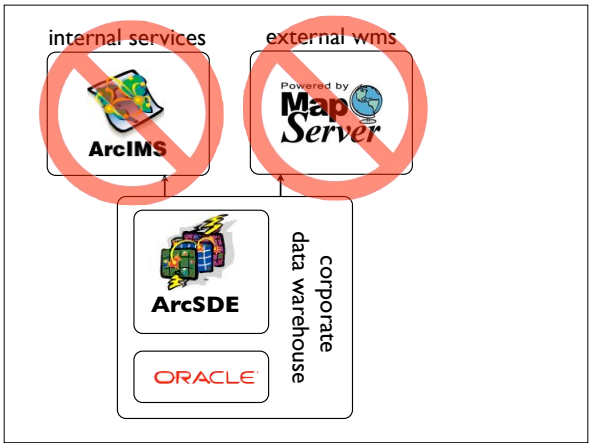
One's easy, one's flexible.

Here is a practical example of the
value of flexibility and heterogeneity.



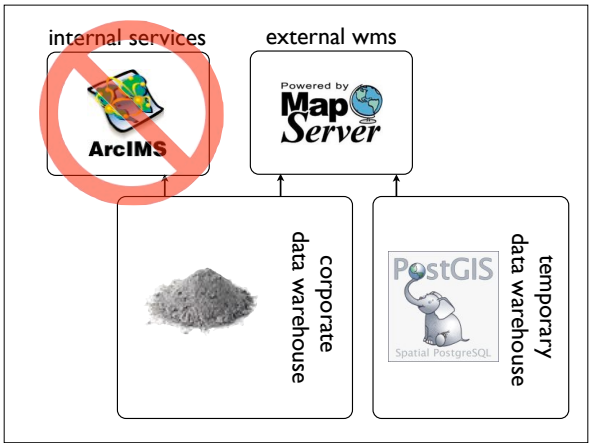
The British Columbia government built their web mapping infrastructure
using ArcIMS for their internal web servers and web applications,
and using MapServer for their external WMS services.

Both web mapping servers pull their data from a central ArcSDE instance.
So they have a flexible tool (in MapServer) and a heterogeneous infrastructure (using both ArcIMS and MapServer).



A few years ago,
the infrastructure team applied a
minor, minor, teeny weeeny, sliver of a
service patch to the Oracle database that hosted ArcSDE.
To their surprise,
<X> the minor patch locked up SDE and they couldn't restart.
Which meant their web services <X> (that depended on SDE) were also down.

The WMS services were brought back up in three days,
after a long process of loading the raw data into a temporary PostGIS database.



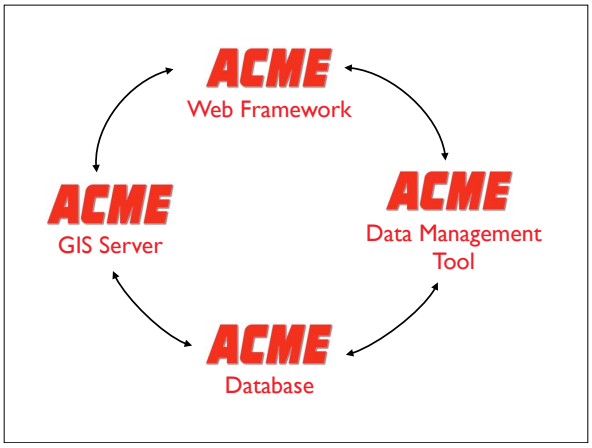
Because MapServer could read from
PostGIS just as easily as ArcSDE,
this was no problem.

The ArcIMS services remained
offline for the duration of the outage,

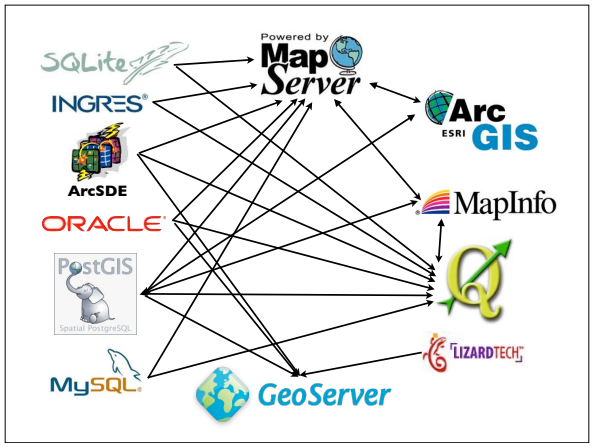
corporate warehouse
offline for 28 days

which was 28 long days
until a patch to ArcSDE was made available.

As a general proposition,



proprietary product lines talk well to other systems
from the same vendor, and
less well to systems from other vendors.
Competitive advantage dictates this arrangement,
but, it puts the interests of the
customer in interoperability
below the interests of the
vendor in promoting lock-in.

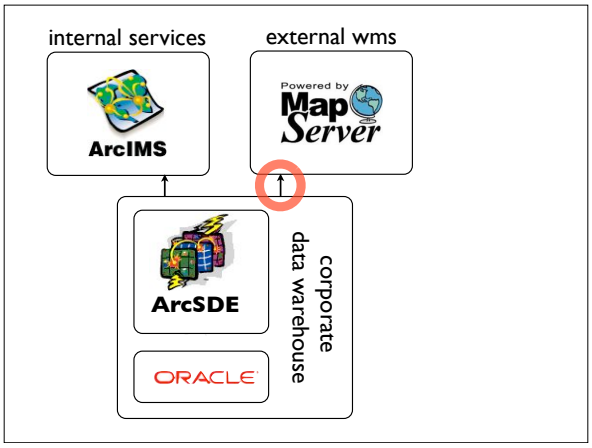


As a general proposition,
open source products talk
well to all other systems.

The reason why is less obvious,
but it has to do with the
practical motivations of the developers.

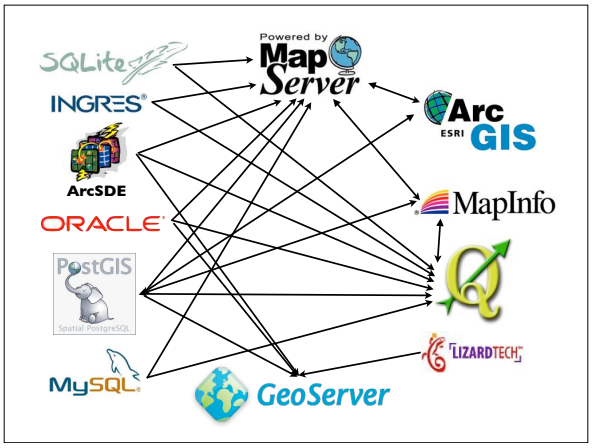
open source is a tool
that needs to be made useful
within the context
of **existing systems**

Once a project moves past the "for fun" stage,
the developers are working on it
because it is a workplace tool,
they need it to "do something".
And the "something" they need it to do,
is usually in the context of other software.



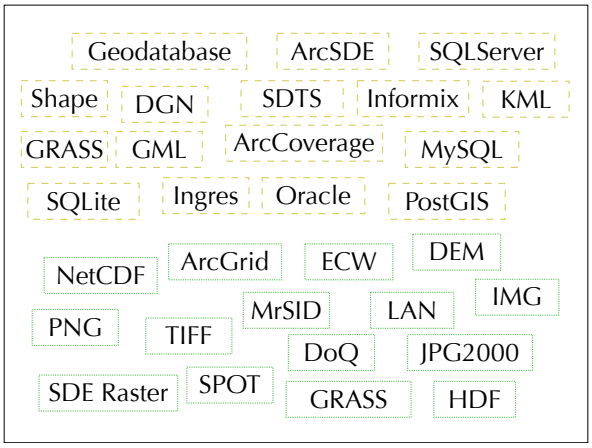
So, as a developer,
if you like MapServer's GML support,
but you work in an environment
where most of the data resides in ArcSDE,
a reasonable thing to do is
write code to connect the two.

Each of these practical interconnections
increases the overall
value of the project,



bringing in more developers in,
who bring in their own
unique interconnection requirements.

An example of the end
state of this process



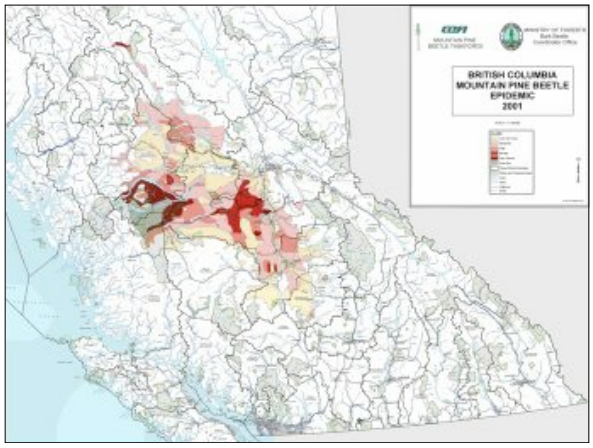
is the Minnesota MapServer
supported format list,
which is one of the most
extensive in the industry.
MapServer started out in
2000 with just one format: shape files.

Indulge me in a short digression...

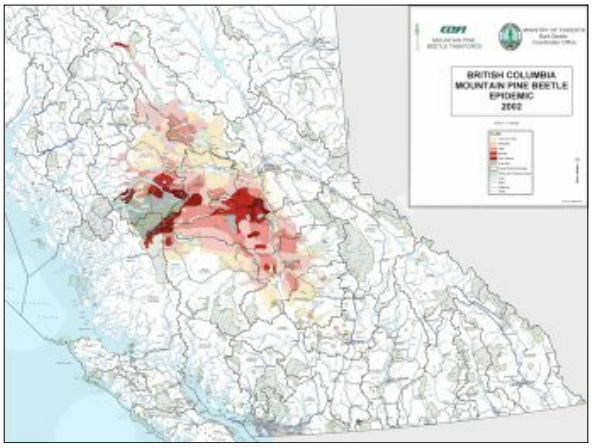
This is the boreal forest
around Prince George, British Columbia,
where I grew up.
In the mature forest,
out of the creek valleys,
over 80% of the trees are
pine and spruce.

In the late 1990s

an infestation of the
mountain pine beetle began in
Wells Grey Park in north western
British Columbia.



The local infestation turned
into an epidemic over the
next few years.
The epidemic has been "uncontrolled"
for a decade now and is
only forecast to abate by the
middle of this decade,
when the population of
mature lodgepole pine
has been completely digested.



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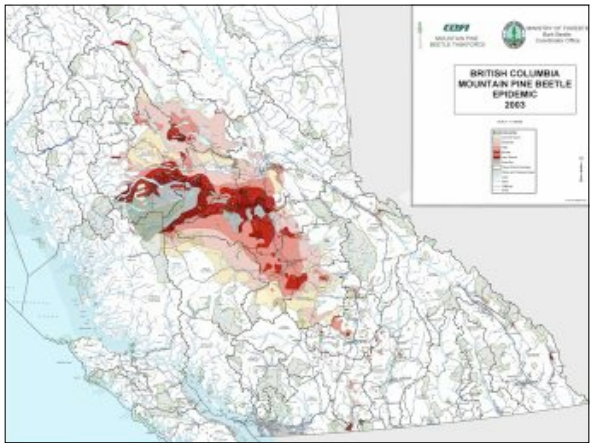

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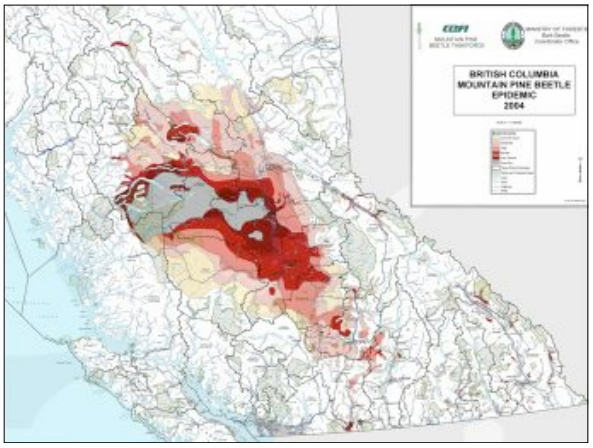

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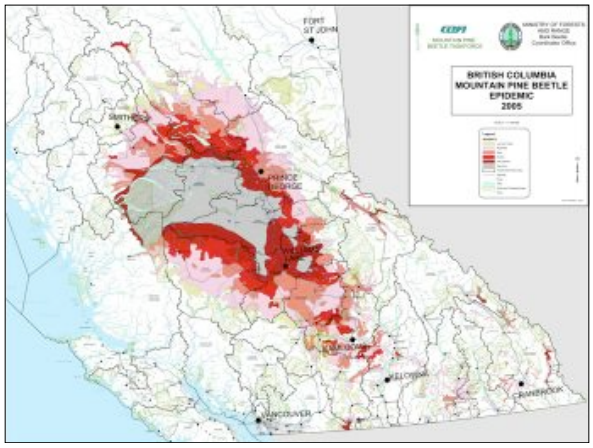

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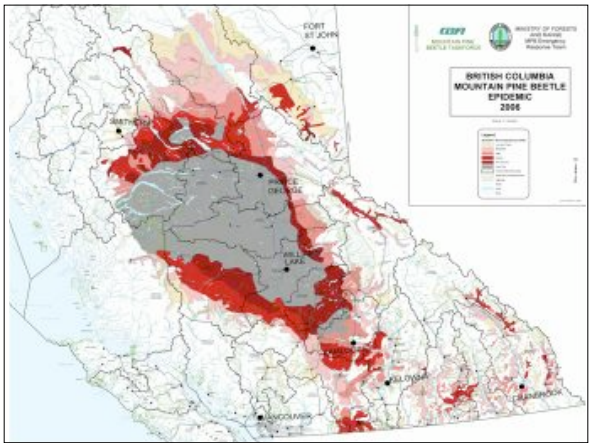

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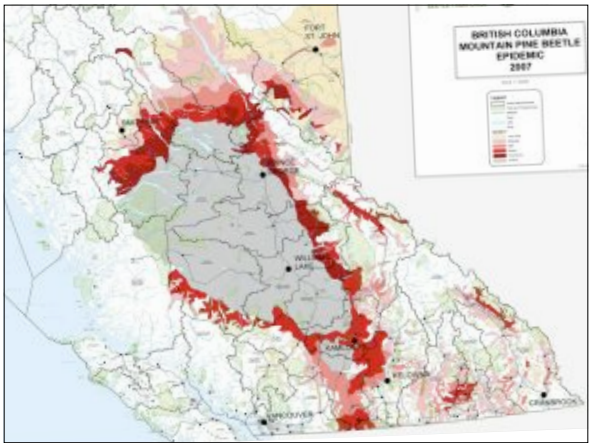

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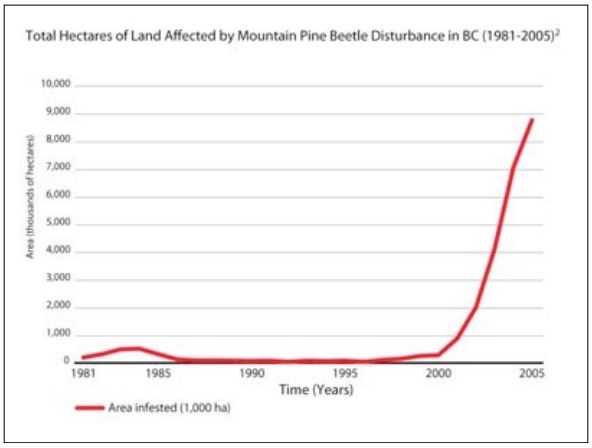
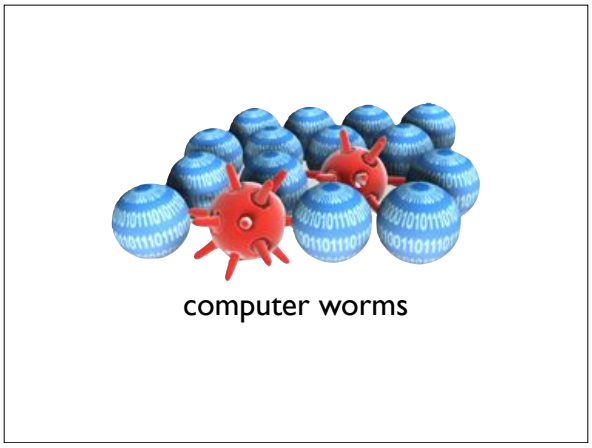


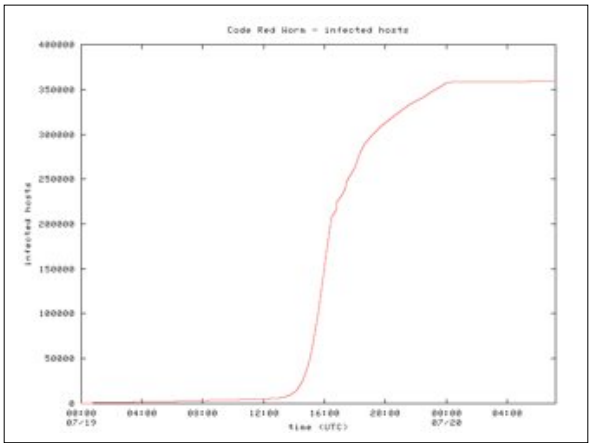
Here's a graph of the number of hectares affected
over time.
The pine beetle has been so ...
"successful" for lack of a better word,

not just because climate change has
reduced the number of cold winters that
kill beetle populations,
but also because of the good luck in finding a
huge homogeneous area of mature boreal forest
ready to consume,
the product of 50 years of successful forest fire
fighting.

Just a little digression on the digression...



Computer worms are
pieces of code that
self replicate,
kind of like beetles.
They start from a host,
scan for other vulnerable hosts,
then copy their
children to the new host,
where the process continues.



This is the infection timeline
for the Code Red worm,
which in 2001 spread through a
vulnerability in the
Microsoft IIS web server.
Familiar, yes?

```
GET /default.ida?
NNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNN
NNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNN
NNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNN
NNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNN
NNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNN
NNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNN
NNNNNNNNNNNNNNNu9090%u6858%ucbd3%u78
01%u9090%u6858%ucbd3%u7801%u9090%u6
858%ucbd3%u7801%u9090%u9090%u8190%u
00c3%u0003%u8b00%u531b%u53f
%u0078%u0000%u00=a HTTP/1.0
```

If you're a
network administrator,
you might recognize this log entry,
the signature of an
attempted Code Red infection:
You can actually
still see them in logs
from time to time,
very rarely now,
like marooned Japanese soldiers
who don't know the war is over.

OK, let's get back on the road.

homogeneous systems
and single-vendor strategies
can be convenient

Homogenous systems, and single-vendor strategies, are usually convenient.
But there is a trade-off.

but,
lack flexibility
for fast adaptation

They lack flexibility, which can make it hard to adapt them to
unexpected purposes.

and,
homogeneous systems
can be susceptible to
“population catastrophes”

And, they present
reliability risk, an increased vulnerability to population catastrophes,
issues that are capable of shutting down your whole infrastructure in one go.

#4: staff development and recruiting

#4 Staff Development and Recruitment

One of the most gratifying things I have heard over my career of teaching about open source GIS software is this:

“that talk you gave last year totally changed my life”

"that talk you gave last year totally changed my life".

i'm not kidding

Saying this about a software talk.

It is a
totally absurd thing to
hear about a software talk.

"that talk you gave last year
totally changed my life"

And yet, I have actually been told this
several times.

The people saying it are
technology staff in GIS departments,
and the reason they say it is because
adopting open source gave them a
whole new toolbox to solve problems.

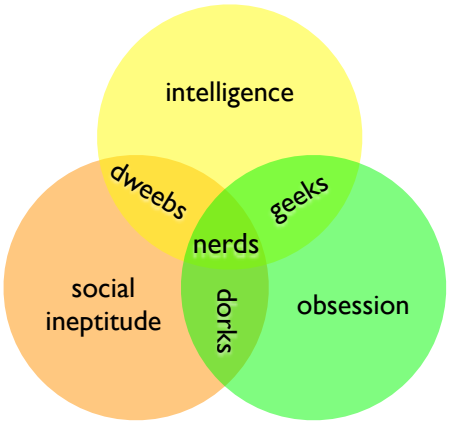
some people think
learning new things
making new things
without constraint
is really cool

hire these people!

The exhilaration
of learning what was in that box, and the
freedom to use that knowledge to
make cool things,
without external constraints (like licenses)
on what they could make, was
deeply empowering for them.

These are very special people,
<X> they are the kind of people you want to hire.

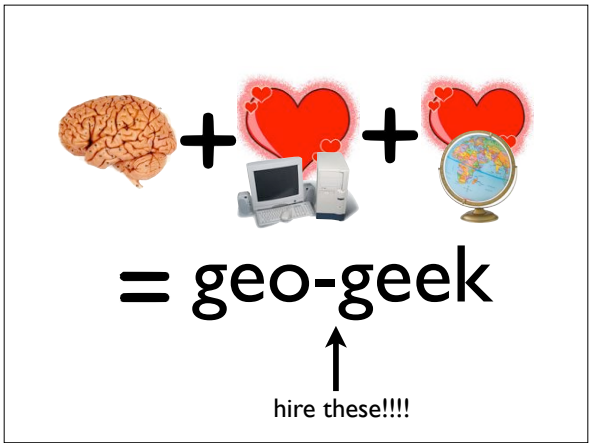
I recently came across a diagram which explains it all
in one page.



Take the personality traits of
<X> intelligence, <X> obsession, and <X> social ineptitude.

People with intelligence and
obsession are <X> geeks.
Inept smart ones are <X> dweebs,
and the inept obsessives are <X> dorks.
Those with all three traits, in the middle, are the <X> nerds.

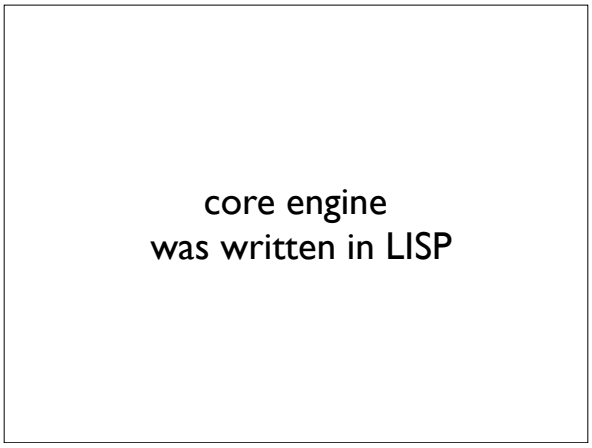
As GIS managers,
building out new systems and pushing the envelope,
you probably want



smart folks with a
mapping technology obsession,
geo-geeks ideally,
but you can settle for
geo-nerds.

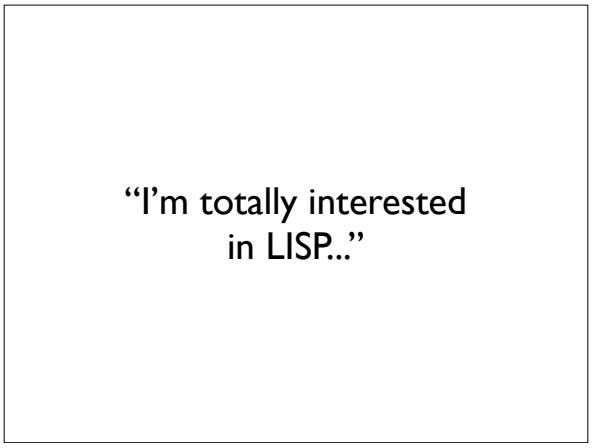
So, how do you get those
geeks and nerds to work for you?
Offer something *interesting*.
Remember, they are technology obsessives.

Paul Graham is a Silicon valley entrepreneur and a major league nerd,
who tells this story about building an e-commerce engine he eventually sold to Yahoo! in the late 1990s.



For personal technical reasons, they wrote their engine in LISP,
which was a rare choice, since most mainstream use of LISP had disappeared by the late 1990s.

But, using LISP had an odd side-effect,
which was that when they advertised job openings,
they got these amazing resumes,
rock-star candidates,
and when they interviewed them,



, they all mentioned their interest in LISP.

By the 1990s,
LISP was really
mostly used in academic settings,
but also retained a
prominent role as a
customization language in...
wait for it...

uses LISP macros!

Emacs, Richard Stallman's
text editor for
uber-programmers.

So the uber-nerd programmers
who obsessed over Emacs LISP macros
were intrigued by the
chance to do web development
in LISP.

for you,
maybe not LISP...

OK, you're not going to
build your web sites in LISP.
I am not recommending that.

but maybe...

But you might build them in Python.
Or Ruby. You might run them on Linux.
You might serve them with
MapServer or GeoServer.
You might store your data in
PostGIS and PostgreSQL.
You might build your web pages with
JavaScript and OpenLayers and
GeoExt.

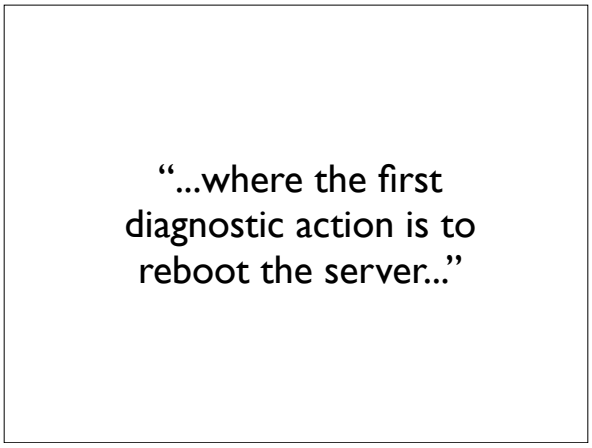
open source can help
with staff retention

no, really. it can.

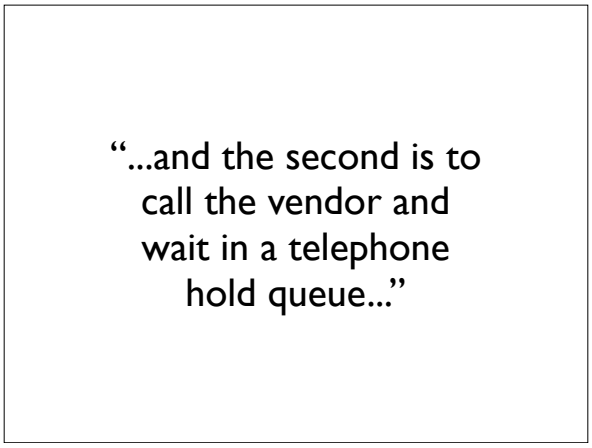
This does work
in the real world.

The city of Northglenn, Colorado
wrote a report about their experience with open source,
and they cited some of the
motivations I've already talked about,
but in the section on
"**Unobvious Motivations for Adoption**"
there is this quote:

... read ...



... read ...



... read ...

"It is easy to understand why open-source jobs are prized."

City of Northglenn, CO

... read ...

#5: market power

Finally, Market Power.

I chose not to give a deeply technical talk today, so I haven't really run through the panoply of open source GIS software that is available to you. Let me just quickly do that for effect.

databases

SQLite

INGRES

PostGIS
Spatial PostgreSQL

MySQL

For databases, you have
PostGIS,
MySQL,
Ingres and
SpatiaLite.

gis servers

Powered by MapServer

GeoServer

mapnik

TinyOWS

SharpMap
Geospatial Application Framework for the CLR

and others...

For map and feature servers, you have
GeoServer,
MapServer,
Mapnik,
TinyOWS,
SharpMap, and others.

tile cache

GeoWebCache

TileStache

TileCache.org

ka-Map

and others...

For tile caching you have
TileCache,
GeoWebCache,
TileStache, and others.

web interfaces

OpenLayers™

GeoExt

OpenScales

Polymaps

and others...

For web interfaces, you have
OpenLayers and
OpenScales,
GeoExt,
Polymaps and others.

desktop

gvSIG

uDig

QGIS

OPENJUMP

MapWindow GIS

and others...

On the desktop you have
gvSIG,
uDig,
QGIS,
OpenJUMP,
MapWindow, and others.

libraries

GEOS Geometry Engine Open Source

GDAL

PROJ.4

JTS

GeoTools The open source Java GIS toolkit

and others...

Underneath it all are libraries like
GEOS, GDAL, OGR, Proj4, JTS, and GeoTools,
which can be leveraged with
scripting languages like
Python, Perl, Ruby, Groovy, ASP.Net and others.

sounds complex?

Sounds complex, yes?

I give a talk,
which five years ago was a quick 20 minute talk
and has now metastasized into a
90 minute marathon,
where I cover all these options in detail,
and afterwards **exhausted** people come up to me
and say,

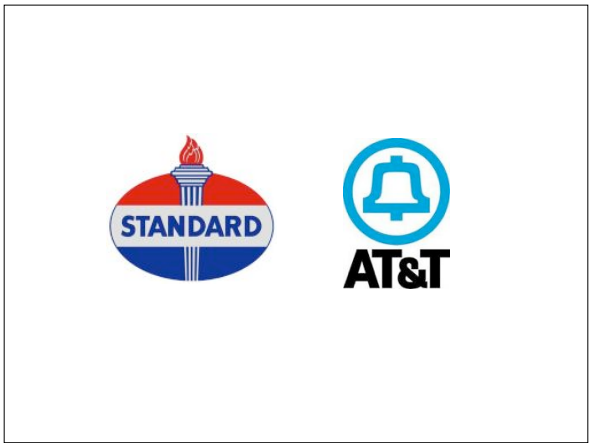
"open source offers too many choices"

"it's easier with just one vendor".

Which is odd, because we deal with lots of choice
in all the other markets we navigate every day.

There's lots of kinds of cars,
there's lots of kinds of blue jeans,
there's lots of kinds of coffee.

And we have a good idea of what a market with
just one vendor looks like.



We actually have laws against it.

Proprietary software has a dirty little secret, and it is a secret that lives in plain sight.

proprietary licensing creates de facto monopolies

Even in otherwise competitive markets, the effect of proprietary licensing is to create an instant de facto monopoly.

one
one
one

How many companies provide support for your proprietary software: <X> one.
How many companies provide upgrades: <X> one.
How many companies provide enhancements: <X> one.
Proprietary companies guard their aftermarket monopoly zealously.

ORACLE is suing SAP for competing on support

ORACLE profit margin on support: 800%

Last year Oracle sued SAP for the crime of selling Oracle support to SAP customers.

And there's good reason Oracle is suing: <X> the profit margin on Oracle support is 800%.

do you have
market power?

It is all about market power.

Open source vests the market power in the software user, not the vendor.

As a manager, you probably don't care about tinkering with the internals of your software source code,
but you SHOULD care about
holding on to your market power as a customer.

Bob Young
Founder
Red Hat Linux

Bob Young, the founder of Red Hat Linux, asks this question of customers:

"Would you buy a car with its hood welded shut?"

Would you buy a car with its hood welded shut?

"No, right?"

No, right? So ask the follow-up question:

"What do you know about modern internal combustion engines?"

What do you know about modern internal-combustion engines?

"Not much."

And the answer for most of us is "not much".

"We demand the ability to open the hood of our cars because it gives us, the consumer, control over the product we have bought, and takes it away from the vendor."

"We demand the ability to open the hood of our cars because it gives us,
the consumer, control over the product we've bought and takes it away from the vendor. "

"We can take the car back to the dealer;
if he does a good job, doesn't overcharge us and adds the features we need, we may keep taking it back to that dealer. "

"But if he overcharges us, won't fix the problem we are having or refuses to install that musical horn we always wanted --
well, there are 10,000 other car-repair companies that would be happy to have our business."

Making an enterprise commitment to a single vendor puts you permanently into the

this is not a good negotiating position

... worst negotiating position possible.

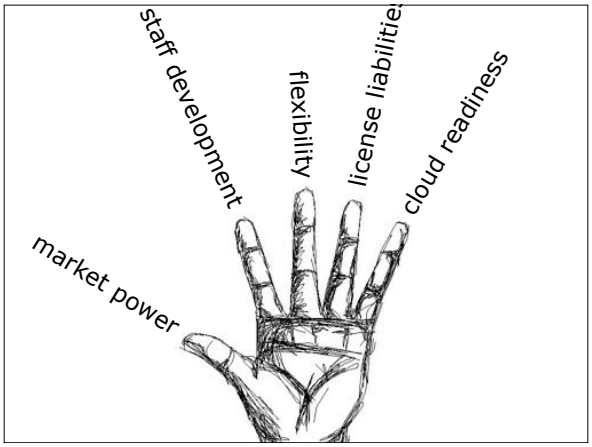
You go into every negotiation
with no alternative position,
no other store to storm off to.

The only leverage you have left
is the threat to buy nothing at all.

Which isn't much of a threat.

Speaking of market power, does anyone else see the resemblance between these images?

OK, I can't bring that segue back on topic. Not a good detour perhaps.



To maintain market power,
<X> to provide our staff with new growth opportunities,
<X> to build heterogenous systems,
<X> to lower license liability,
<X> to be ready to scale,
for all those reasons it makes sense to have open source as an option.

HOW to start?

But how to start?

Pierce County
WASHINGTON

- 2007, 100% ESRI
- limited budget
- talented staff
- interest in new ideas

Way back in 2007, Pierce County, in Washington State, was a 100% ESRI and Microsoft shop, with a limited budget for new software acquisition.

It did have some talented technical staff, and a GIS manager, Linda Gerull, who was interested in new ideas.

In the fall of that year, she learned that the international

"keep an eye out for alternatives"

2007 FREE AND OPEN SOURCE SOFTWARE FOR GEOSPATIAL (FOSS4G) CONFERENCE
VICTORIA CANADA SEPTEMBER 24 TO 27, 2007

... open source GIS conference was being held just to the north in Victoria, and took the opportunity to send several of her staff.

<X> "Keep an eye out for alternatives", she told them.

When they came back, they had lots and lots of alternatives, they were very excited.

But they couldn't just tear down their infrastructure and start again,

experiment,
but...
maintain service
continuity

how to replace
cutting edge technology
from the last century...

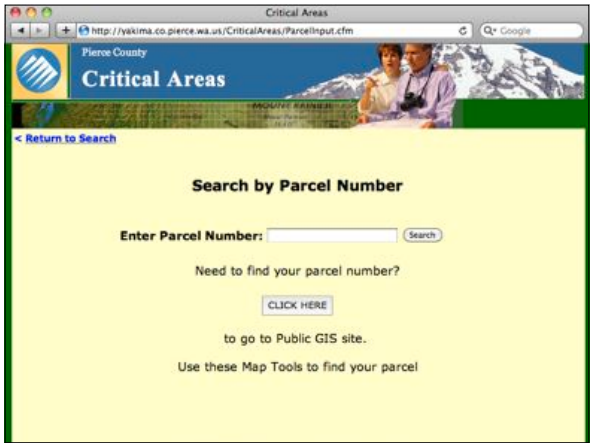
MapObjects®

they had to maintain
service continuity.

So,
the team started experimenting
by duplicating some
existing services that were

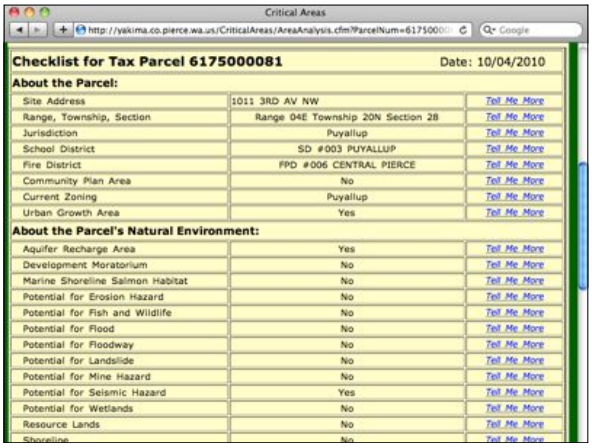
built using
old MapObjects technology and
slated to be replaced anyways.

Some of them were very
simple services with
minimal user interface,



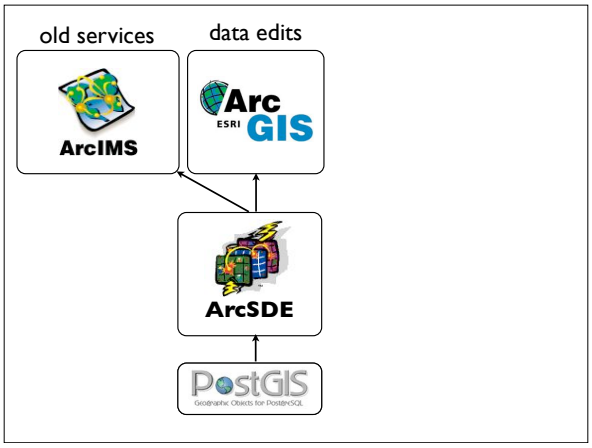
like this Critical Areas query form.

It just takes in a parcel number or
address and returns a



simple report on
environmental factors based on a
query of 18 layers.
MapObjects was unstable,
ArcIMS was too slow,
but open source
(PostGIS in this case)
was just right.
The form didn't change at all,
just the backend.

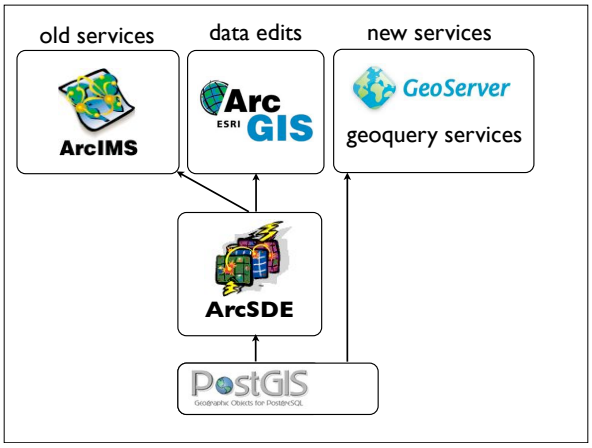
As their confidence in the tools grew



they looked at migrating
core bits of infrastructure.

Most recently, they replaced their
SQL Server database with
<X> PostgreSQL and PostGIS.

The key here is that they are
continuing to run ArcSDE on top.
This allows them to use their
existing data management tools,
like ArcGIS,



but use a pure open source
web services stack
directly against PostGIS.

So the changes are incremental,
and exploratory.
Pierce County still runs
ESRI software and
ArcGIS desktops,
but the number of

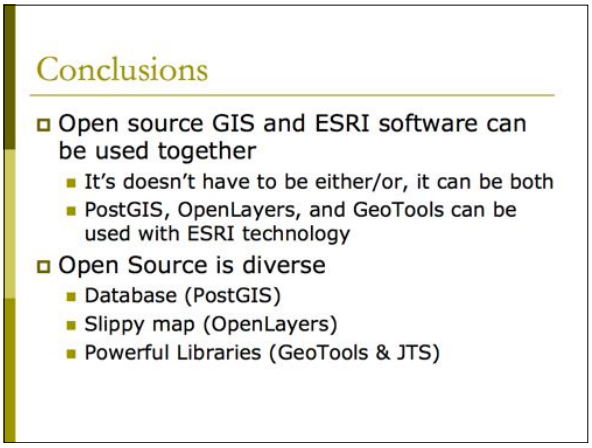
more options

fewer licenses

more budget room

options they have for deploying new systems is
much higher, and the
<X> number of licenses they require is going
down, not up, and
<X> Budget flexibility is increasing.

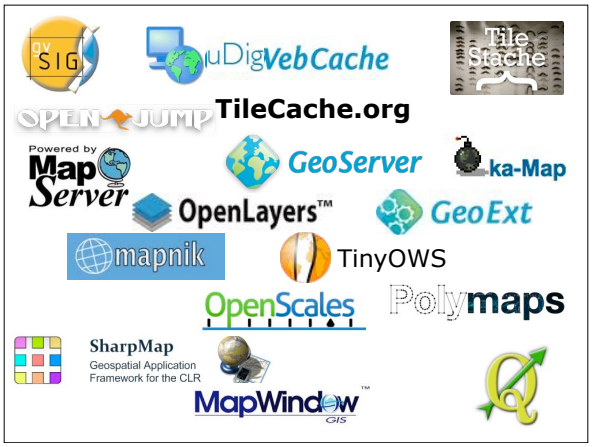
At the same time, the staff has enjoyed learning
the new technology.



This is the conclusion slide from a presentation
Pierce County's Jared Erickson, gave at the
Washington State GIS conference this spring.

Open source and ESRI **can** work together.
Open source provides a diverse range of options.

Now,
Pierce County experimented with a limited
number of open source components:
PostGIS, PostgreSQL, GeoServer, OpenLayers.



But as we saw earlier,
there are a lot of choices,
in every product category.

choosing
open source
components

So how should you
choose open source components?

David
Wheeler

dwheeler.com/
oss_fs_eval.html

David Wheeler, who I mentioned previously in the context of open source versus proprietary, also has a very complete document on "How to Evaluate Open Source Software"

like COTS
evaluation
but some differences

Much of the evaluation is the same as with proprietary COTS (commercial off-the-shelf software), but some key things are different.

First, there will not be

this won't happen

sales reps and there may not be sales material or brochures.

this will happen instead

You may have to download, install and test the software yourself.

But this is a **good** thing.
This is a feature, not a bug.

Trying the software yourself will give you a

reality-based understanding

marketing-based understanding

reality-based understanding of its features, capabilities and weaknesses, rather than a
<X> marketing-based understanding.
(I always get taken in by the glossy brochure)

beware feature check-lists

open source may have fewer features...

but adding features is an option!

Second, you have to beware of engaging in simple feature check-list comparisons.

<X> Open source often has fewer features than proprietary software,
or the features are not well enumerated in a glossy brochure,
<X> but open source has a far faster and cheaper pipeline
for getting new features added.

Powered by MapServer

XMP metadata embedding

Guttered on-the-fly tile generation

Faster JPEG decoding

PostGIS Spatial PostgreSQL

Path crossing function

Nearest neighbor indexing

Curve stroking

You might want special purpose features for your project,
like this list of obscure functionality.
A vendor would never add these, because “too few customers want them”.
However, these are all examples of features I added on small
services contracts to customers from Australia, the USA, Spain, and Germany.
None of these cost more than $4000.

want a new feature in ORACLE SPATIAL ?

(a) become 

(b) chat up Larry 

In constrast, if you want to get a feature added to Oracle Spatial, you have to
(a) become the Department of Defence and
(b) lean on Larry Ellison while yachting.

want a new feature in PostGIS Spatial PostgreSQL ?

(a) give me $2K-10K 

(b) wait 2-6 weeks 

If you want to get a feature added to PostGIS, you just have to
(a) give me $2-10K and
(b) wait 2-6 weeks.

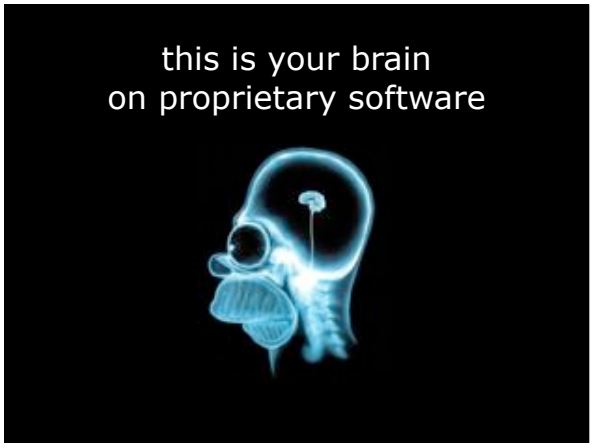
Adding a required feature to an open source project should be an easy decision process,
but it's

This feature is mission critical!
Oracle has it.
PostGIS does not.
It’ll cost $500,000 to deploy Oracle.
It’ll cost $50,000 to add feature to PostGIS.
Ergo, we should choose _____

just not one we're used to.

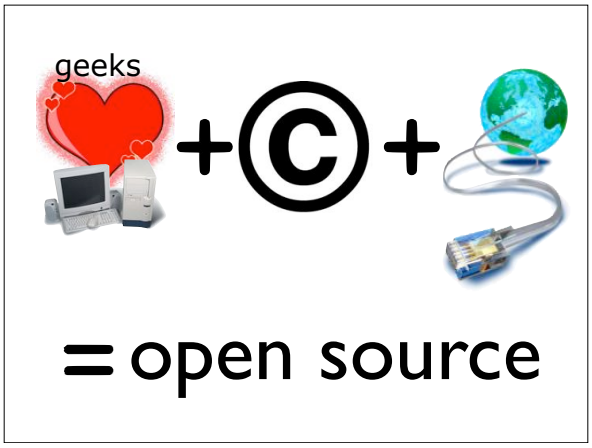
<X> This feature is mission critical. We absolutely need it for the project!
<X> Oracle has it. <X> PostGIS doesn't.
<X> It'll cost $500K to deploy Oracle.
<X> It'll cost $50K to get this feature added to PostGIS.
<X> Ergo. We should choose _____

Amazingly, this decision is still not a slam dunk for open source, probably because



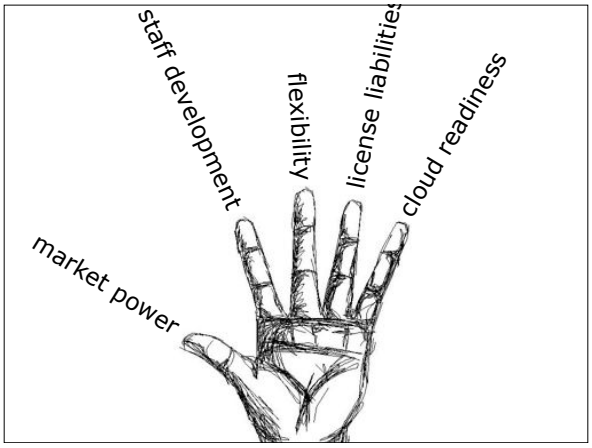
our brains just are not quite
used to thinking this way yet.

Summing up,



Open source is the collision of
a geeky love of computing with
a political philosophy of freedom with
a global community enabled by the internet.

Open source provides organizations with a
new software OPTION when building systems.



Organizations should consider open source for
the
<X> scalability,
<X> the lack of license liability,
<X> the flexibility,
<X> the empowerment of staff,
<X> and the market power of the organization.

start small

build a prototype

join the open source community

have fun!

Start small,
<X> build a prototype,
<X> join the communities around the software you use,
<X> and always always try to have fun.

thanks

ILLINOIS GIS ASSOCIATION

Thanks for your attention!
Have a great conference!