

# Spec-ulation

- **Speaker:** Rich Hickey
- **Conference:** Clojure/Conj 2016 - Dec 2016
- **Video:** <https://www.youtube.com/watch?v=oyLBGkS5ICk>

slide title: Spec-ulation

Rich Hickey

Hi. Once again, it is fantastic to come to the Conj and see everybody. Old friends, and all the new faces, and everybody being so happy. That is really great. It is just so important to revisit the fact that the community is a positive one that is full of optimistic people, or crazy people, who are willing to try this new stuff, and do things in a way that is different. And to help out other people who are similarly optimistic or crazy.

So this talk is called spec-ulation, and that is just a way of covering the fact that it is a rant.

[Time 0:00:57]

slide title: This is not a talk about  
                  \_spec\_

+ It is a talk about what spec is \_about\_

  + Giving something to someone that they  
    can \_use\_

  + Making a \_commitment\_

    + i.e. not taking it away later

So I think we have a few talks about spec, and there was a spec workshop. So this is not a talk about spec. It is not a tutorial about spec. It is not about the tech of spec, sort of, in any way.

But it is very much a talk about what spec is *about*, because I am not sure, when you look at spec, and especially when you hear a talk – and you see it can do this! And it is a floor wax! And it is a dessert topping! – that it is evident, necessarily, particularly that some of the design decisions are pointed at these two things, which seem to not say very much at all.

One is that spec is about being able to give something to someone so that they can use it. And the important thing about that word “use” is that it is sort of like a positive thing: here is something that you can use. As opposed to: here are some rules that you have to follow. So you want to be able to give people things that they can use. And Stu talked about getting a piece of code that had no documentation, or insufficient documentation, and wondering: what should these maps be? What are the keys? And things like that. So it is hard to use that without more of a description. So it is about that.

But the other side of it – and again, this is not about you, the user, doing something wrong, it is about me, the provider, saying, “I am going to make a commitment. This is the way this thing works.” And in particular, commitment means, “And I am not going to take that away later.” So I want to emphasize that today.

[Time 0:02:46]

slide title: Change

Is it a thing?

And spec is designed around that. And that is sort of part of a bigger problem, which is change. It is interesting to look at spec and say, “spec is about doing this this way, or doing that that way, or providing these things.” But spec is really about being able to change later. A lot of what spec is, is oriented towards changing things later.

But it is an important question, because I had a conversation just today where the word “change” was used a ton of times, and we use the word “change” to sort of cover a lot of things that happen in software development. And one question we need to answer is “Is this a thing?” And if it is a thing, is it a thing that we want in our software development lives?”

[Time 0:03:35]

slide title: 'Change'

+ Origin:

+ from Latin cambire "to exchange, barter"

+ You could change a cow into wheat!

+ c.f. Eurogames

+ One-sided change is... theft?

+ Anti-social at least

+ Productivity and soul-crushing at worst

So of course, I do not think this has happened yet today. I am surprised, but here we go, the mandatory definition of a word. I was very surprised by this. Everybody said, before I do my talk I go to Wikipedia to make sure I do not say something obvious, or obviously wrong. So I go to the dictionary and the definition for “change” is sort of circular, in that one of these two words has the word “change” in it as well.

But the origins of the word were actually exchange. It was about barter, right? You can turn a cow into wheat. How many people play Eurogames? Oh, come on! Well, you know you can turn cows into wheat, and wheat into wood, and wood into stone. Apparently these things lead to great success in the Middle Ages.

So that is not transmutation, right? That is not stuff changing in place. That is exchanging stuff. And when you think about it that way, you can say, well what does it mean to just change something without somebody’s permission, or cooperation, or participation? One way to say it is that you just took something from them. But at least it is not something that is nice. But I think that in practice, we have things changed on us, and we experience this last line. How many people have ever chased down dependency problems? How many people enjoyed that? OK.

[Time 0:05:12]

slide:

We want our software (esp.  
libraries/services) to be  
different/better tomorrow.

What will that mean for our  
consumers?

So what are we going to do? It is not like software should be immutable. That is not the thing, but how do we move it forward? So I would like to find some different words than “change” in this particular case. How do we make it better and different tomorrow, in a way that our consumers can tolerate? Or at least can we consider that when we make it better?

[Time 0:05:40]

slide title: Dependencies

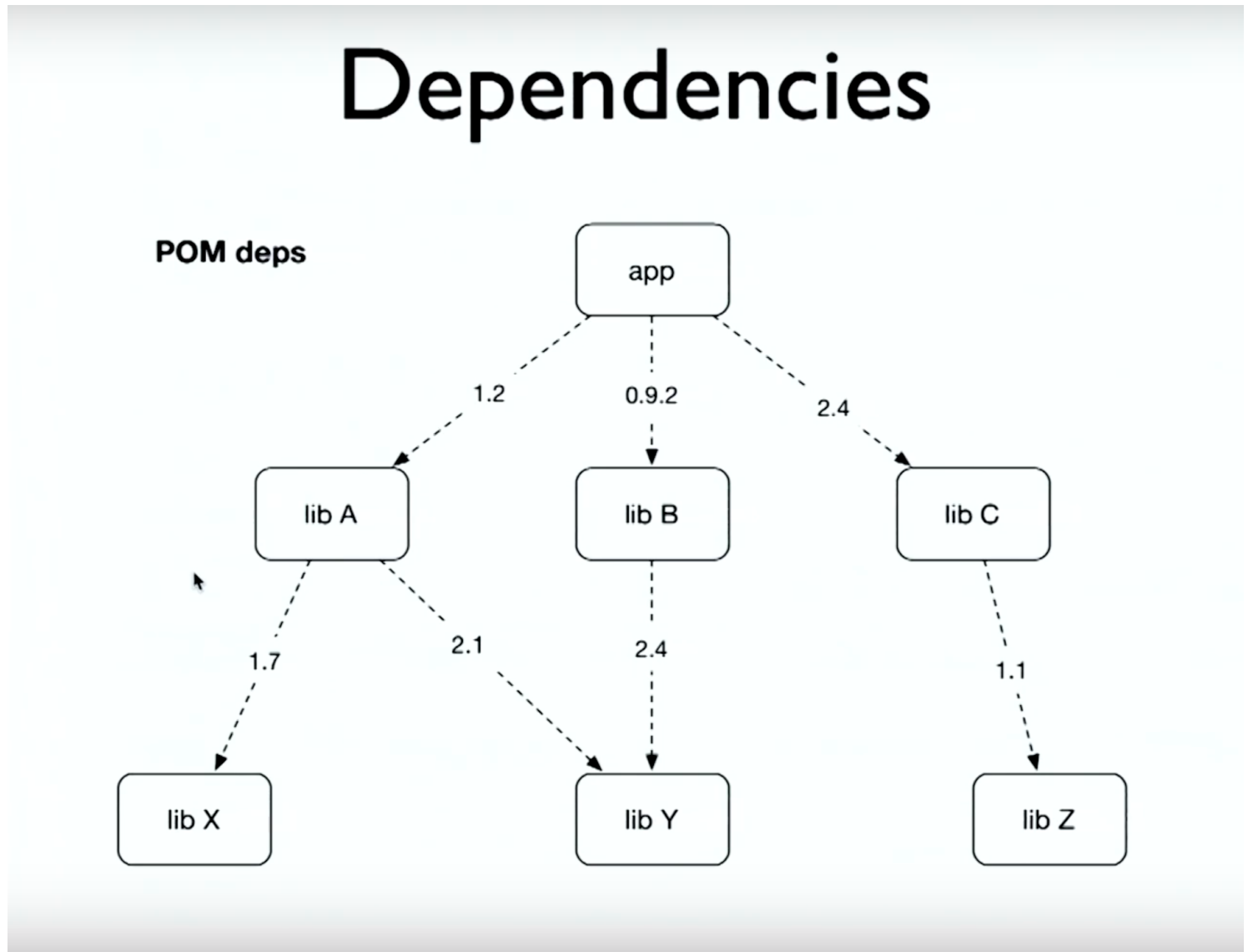


Figure 1: 0:05:40 Dependencies

So we all know how we do change. We use Maven, or something that drives Maven. And we have artifacts, which are libraries. And our application says, “I want to use these libraries: A, B, and C”. And these are the versions I want. And then library A says, “Oh, but I need library X to work, and this is the version I want. And I need library Y to work, and this is the version I want.” Library B says, “I also need library Y, and I want a different version.” And library C says, “I want library Z.”

So we have a little conflict here: 2.1 and 2.4. I do not know if you can read that. You can imagine what it says. Something that is in conflict. And then Maven has some rules that automatically make this work. Usually it will pick the later thing. 2.4 it is. And this tree, our immediate dependencies, and the transitive dependencies, are the things we need to have our program run, right?

You all know better than to answer yes/no rhetorical questions with a “yes”. No. No.

[Time 0:06:58]

slide:

But...

- + Artifacts don't actually `_use_` other artifacts

- + There is nothing in the `_code_` about artifacts

So the first thing is that artifacts do not use anything. A library does not use a library at that level, because artifacts are not doing anything. They are just packages. So they do not use the other artifacts. They have these lists of them for various reasons we will talk about.

The other thing is: there is nothing in the code, at least in Clojure, and I think in most languages that use this infrastructure, there is nothing in the *code* about these artifacts.

These are the two things to know.

So what does your application actually need?

[Time 0:07:42]

slide title: Dependencies Redux

And so we will look at this problem again, and we have expanded it a little bit. So when we look inside each of those artifacts, what do we see? If they are Clojure artifacts, we see namespaces. I give you this JAR, it has got a bunch of namespaces in it. Were it Java code, there would be packages in there. But it is the same kind of thing, namespaces, packages.

So there are a bunch of them. And in fact our app is decomposed similarly, right? Our app starts with a couple of namespaces that we wrote in our application space. Now those namespaces do say “requires”. So my app ralph namespace requires a ricky namespace. And my app ralph namespace requires C fred namespace. And app trixie requires B lucy.

And that is in code. That is nice. So we can see it in our program at least.

And then we go down and we say A ricky needs Y barney. Somebody else had some names this morning. Paula did. These are different TV shows, apparently. So we have barney and wilma. And for anybody who has good eyesight.

So this is the truth, right? This is the actual namespace requiring namespace, or importing package. And now this is in code, and these are the actual connections between the things. Right?

Well, anybody with good eyesight, what can you tell about this right now, already, about our app needing X, Y, and Z?

We don't need Z, right? Only ethel uses Z, and the app does not use ethel. Hmm.

[Time 0:09:46]

slide:

But...

- + Namespaces/packages don't actually `_use_` other namespaces/packages

- + At least require/import appear in the

# Dependencies Redux

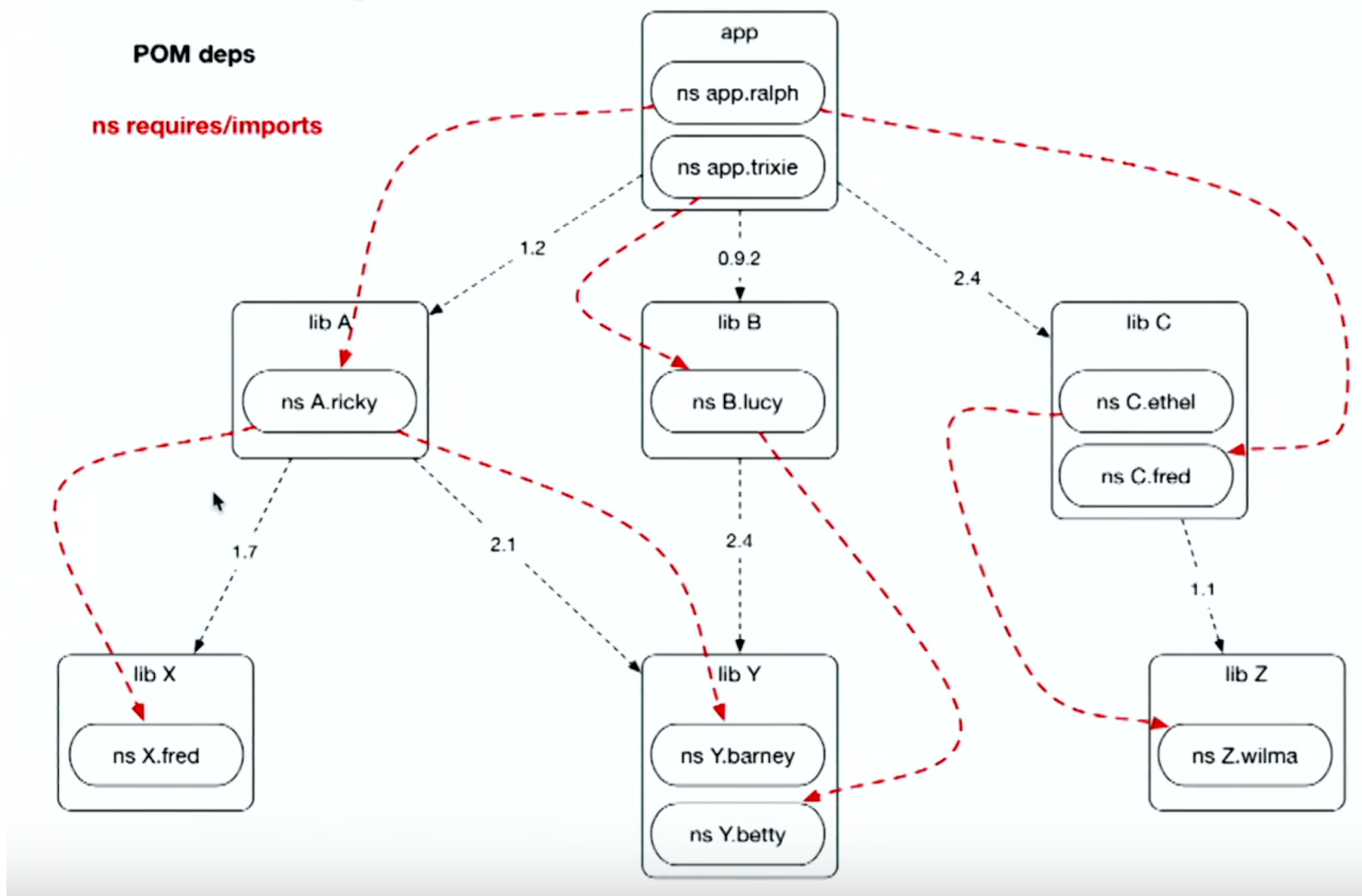


Figure 2: 0:07:42 Dependencies Redux

code

+ Where is the mapping to artifacts?

So it is actually the same thing, right? Namespaces are not code. They do not *do* anything. Well, namespaces could be effect-ful, so you could require something for a side effect. But if we set that aside, the namespace declaration that says require is not actually trying to accomplish anything itself. So they do not really use that. We like the fact that we can see this in the code.

But we have this other niggling – I would hope niggling – problem with this, which is that: how do we know which namespaces are in which artifacts? Are in which JARs? Yeah, I do not know. Somebody tells us, right? We meet somebody on the street who says, “Did you try this JAR, man? It has got fred in it. I am loving it.”

No, really, there is not a place where we keep this. So that is a problem.

[Time 0:10:46]

slide title: Dependency Truth (code)

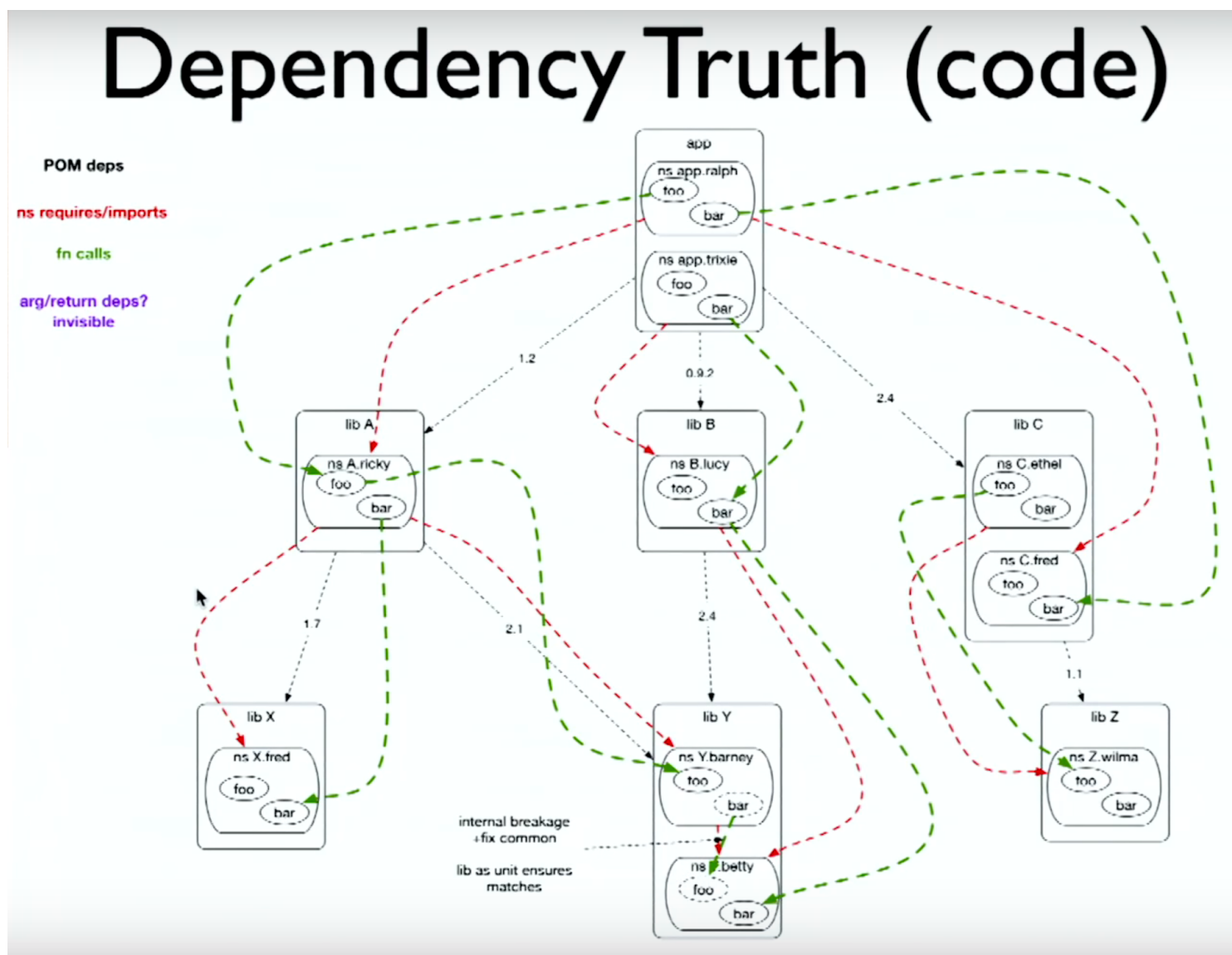


Figure 3: 0:10:46 Dependency Truth (code)

So what is the truth? The truth is, you need better and better eyesight to solve this problem. So we open it up a little bit more, and we look inside ralph. And we see that ralph actually has functions in it. There is a

function foo inside our app in our ralph namespace.

And we also see the beauty of namespaces here, because I just got tired of making up new names, and I did not want to get into TV shows, so every namespace has a foo and a bar function, but they are conflict free! Because namespaces are awesome.

So ralph foo calls ricky foo, and ricky foo calls barney foo, and ricky bar calls fred bar, and so on and so forth. These are the actual calls that are made. These are the *actual* dependencies, right? Code that needs to run needs other code in order to work. That is the truth.

So we can also see that, because those calls are evident. But one thing that is not evident. There are no purple lines, but in the legend there is purple, which is that we depend, for instance, we see that ralph foo depends on ricky foo, the function, to exist, but there are other details about that call, right? What does ralph foo pass to ricky foo? Well maybe that changes over time. I do not really know. What does ricky foo return to ralph foo, and all callers? Well maybe that changes over time. That stuff is invisible, right? Because maybe you start consuming it tomorrow. It is very subtle what you use of the return values, especially when we start returning maps.

And then for people with really excellent eyesight, what else do we discover now from this? We do not need X. Right? ralph foo calls ricky foo. It never calls ricky bar, and ricky bar was the only thing that needed X. So this is already like not great. Our dependency tree is not really reflecting our actual needs.

Another thing that is going on here in the bottom, and I am not going to talk too much about it, except to say that there are also internal calls. So inside library Y, barney bar calls betty foo. That needs to match, but nobody can see that in the direct tree, necessarily. But we do want to make sure that those things match.

And that is one of the “advantages” of pulling in an entire library, is that you know the stuff will match. Even if you are getting way more stuff than you need, whatever stuff you need should match.

[Time 0:13:45]

slide title: Do deps Force Versioning?

"What you can do is let Semantic Versioning provide you with a sane way to release and upgrade packages without having to roll new versions of dependent packages"

<http://semver.org/spec/v2.0.0.html>

+ Is that what happens?

+ Often, no, cascading version bumps

- + to let root 'know' about improvements to leaves, even if path nodes' code unchanged

- + level violation

So this is not great, but supposedly this is not a problem. One of the reasons why is because we have semantic versioning. And in the semantic versioning spec – which has been versioned, by the way. And I had to walk through like a ton of diffs to see what had changed over time, mostly I guess because I do not know how to use Git, but there was not a summary of what is different between the two things.

But it has been versioned. And of course when you start versioning your versioning ... [holds up hands in what could be interpreted to mean “I don’t know what is going on here”]

But supposedly we have these rules? We have major versions, and if the major version does not transition, we have this implication that it should still work.

Is this what happens in practice? Has anybody ever bumped a dep in order to make a library visible to an application? Yeah? Everybody, at some point, has done this? Yes! This is the answer. Yes, we all do this. It is OK. Yes.

No. This is not what happens. We are bumping versions all of the time. Something we use is better somehow in a way that our code does not care, and it does not change our code at all, we get our new dep. It changes our name. It changes the name of the thing that talks to us. And so on, and so on, and so forth.

This is a lie. This cascading version bumping happens all the time. We are just trying to communicate through this palm tree, through this thing.

And I will call this a level violation. And we are going to talk about levels.

[Time 0:15:27]

slide title: Names, Levels, Scopes,  
Contexts

- + fns depend on (call) fns by `_name_`
- + ns/packages/ requires/includes set up a `_context_` in which those calls can succeed
- + Artifact deps/poms set up a `_context_` in which those requires can succeed
- + fn name scopes include ns `_but not artifact_`
  - + artifact context is `_MAGIC_`

So what is actually happening? Well there is a stratification of problems here.

If we start at the bottom, this call truth, we know that functions call other functions by name. And it is clear ... In fact, if you just treated the namespace declarations as aliasing, forget about code loading, if they were just aliasing, they tell you enough. They would tell an analysis tool enough to know, when you said “foo” over here, you were talking about ricky’s foo, and therefore you need to know about ricky’s foo. The actual “requires” is just creating an execution context in which that call will work. That the code for ricky’s foo will be available. And that requires will do that. It will also make a whole bunch of other code you do not call available, but we know it will cover your need, so we put that in our code. So it creates a context.

If we go up a another level to the artifacts, the same thing is happening. Those palms are saying, “I need these other libraries.” They create a context in which those requires are going to succeed. That this thing requires this other library, this other namespace, that will be there because somebody on the street told us that if I use this JAR, fred will be there, and therefore it will work.

But the problem that is really broken is at this last level – the person on the street told us to do this – is pure magic. There is nothing in code about this thing, and that is going to come back later.

So we now understand the levels: functions calling functions, namespace requires, artifacts.

[Time 0:17:18]

slide title: Basis



- + Why put things in our deps/pom?
  - + We need access to libs while developing
  - + Maven chases transitive deps
  - + Incorporated in artifact to communicate needs to our consumers
  - + "we tested against x.y.z" [~~strikethrough style on that whole line~~]
- + But, coarse-grained, implies too much
  - + doesn't capture actual deps, just context

So why do we do this? What is this doing for us? I do not think it is just inherently terrible, but what is happening? Can we disentangle what we are trying to say?

So why do we put things in our deps, or POM, or project file, at all?

And one is that we need the code when we are working. We are writing our app. We are not writing this library. It used to be, before we had deps, that we would download JARs, and we would make classpaths ourselves, and say, “use this classpath”. It actually was not worse than this, to be honest with you, because there is something about a list that you made, and you know what is in it, and you know what is not in it, and you know what it says, that is somewhat – well, it is certainly more tangible.

But it is somewhat more reliable than this next point, which is that: what is also nice is we conveniently say we needed A, B, C, and the fact that X, Y, and Z were needed was just solved for us. Maven will nav through the transitive dependencies and pull everything else in. So there is an ease factor to point two here.

The other thing we do with these deps, or the POM, is that we turn around, or our build turns around, and propagates them into our artifacts, so that Maven can do this with our stuff. Can continue to nav down. And let somebody who uses us. And in particular, when I am talking about “us” today, I am mostly talking about when we write libraries. When you are the consuming app it is somewhat different, and I will talk about that later. But in particular, when we are writing libraries, so we are writing A, B, or C, we use X. We need that in our POM, so someone who uses us gets X in addition to us, so the whole ease thing and stuff works.

So that is why we do it. I think one of the things people *imagine* happens from putting in this project file is: we give some integrity promise. We make some integrity promise about: we have tested our library against this thing. I do not care, because the chances of me running against the thing you tested against are slim in the end. And we will talk about that later. I think that is a non-benefit. You imagine it, but it is not true.

But again, the problem is that this is coarse grained. These things do not tell us what is actually happening, and they just create a context.

[Time 0:19:48]

slide title: (Ex)changes in Software

- + What is `_required_`?
  - + `fn` - args
  - + `ns` - var names

- + artifact - ns/package names/paths

- + What is `_provided_`?

- + fn - ret (proc/service effect)

- + ns - vars/fns

- + artifact - namespaces/packages

So what I would like to talk about is: how we talk about change. Because I have mentioned things change, and then we are going to change versions, or get new versions. But I want to disentangle this.

And I think that you can boil down all change into this kind of language, which is, if I am making a library, I may make requirements of the users of my stuff. So what do I require?

If I am writing a function, what I require are the arguments. You have to pass me arguments.

If I am a namespace, what do I require? Just names, right? A namespace is sort of like a lookup. You give me this name, I give you this var, or the function, the thing in it.

Go up a level again. What do artifacts require? If I give you a JAR, what are you going to do? You are similarly going to look for stuff in there, with either a name or a path, you are going to find the actual class file or clj file, given some name. So there is a sense in which namespaces and artifacts are just functions of names to stuff. A namespace is a function of a name to a var or function. An artifact is a function of a name to a namespace or package.

Then you can flip it around, and you can say: what does a library provide?

A function provides its return. If you gave me what I required, I will provide to you this result. And of course I would like to broaden this discussion to include services and procedures, and things like that. So if your thing is effectful, one of the things you provide is that effect. If you call this thing with these arguments, the thing will be in the database, or I will send an email for you, or some other thing.

What does a namespace provide? It is just a lookup. You give it a name, it gives you the var or function.

What does an artifact provide? You gave it the name, it is going to provide you with the class files, the packages, this kind of stuff.

So that is how we exchange things.

[Time 0:22:11]

slide title: Growing Your Software

- + Accretion

- + provide more

- + Relaxation

- + require less

- + Fixation

- + bash bugs

So what I will say is that you can now look at the kinds categorically, the kinds of changes you would make in these ways. The first is this idea of growing your software. Your software is going to do more.

The first thing is just accretion. What happens when you accrete? You say: I am going to provide you more. You were giving me seven before, and I gave you back 42, and now I am going to give you back 42 and some wheat. More stuff.

So this is not a lightweight use of this word provide. I mean very specifically we need to say the words provide and require. So we are going to provide more. That is straight accretion.

The other thing is relaxation. It used to be you give me two wheat and a donkey, and I will give you some steel. And now, I do not need the donkey. Just give me wheat and I will give you steel. So I require less. That is a relaxation on my part.

And there is a nice Zen-like thing of saying the less you need, the more you are growing.

It is a ... well, whatever. I will not push that. I am not that touchy feely.

And the other is fixation. And this is another cool thing. I looked up “fixation”, and it actually means to fix things. It does not mean to be paranoid. So then the final thing is just fixing stuff, which does not impact what you provide or require. It just means you are now doing it correctly, or maybe faster, or maybe with fewer requirements. You know, fewer dependencies, or something else. But whatever. It does not impact what you provide or require.

[Time 0:24:14]

slide title: Breaking Your Software

+ Require more

+ Provide less

+ Unrelated stuff under same name

Because again, this blanket concept of change, it also is used, casually in conversation, to talk about these things, which is breaking your software. How do you break your software?

You require more. Oh, that two wheat and a donkey? It is not enough. I want gold, too, and a ruby, and then you will have steel.

And it is sort of evident. We use bigger sentences to mean, “I broke you” and “it is incompatible”, or something like that. But we should be using these small things. I just require more. If you require more, then somebody who is giving you less now is not going to get what they want. It is not going to work for them. It is broken.

The flip side is, you are providing less. Well I was giving you steel, and now I am going to give you tin. And good luck with your building. So you are providing less. You are returning less than what you promised previously.

The other sort of categoric “why are you doing this?” is just changing. You know, we were calling that “trade”, and now we would like “trade” to mean something completely different, so we are just going to use it for something else. And so if you were calling “trade” – it is like the classic thing. If you have homophones, or something straight out like “draw”. Drawing pictures. We used to draw pictures for you, and now we draw guns for you. Just the semantics are shot. It is a complete do over.

[Time 0:25:55]

slide: Change is Not a Thing

- + It's one of `_two_` things

- + Growth

- + Breakage

- + In the small (fns), `_spec_` can help us determine which, prevent breaking specs

- + As long as we don't try to do something silly like `_versioning_` specs!

So the thing here is that change is *not* a thing. We should not really be saying, “I changed it”. Because you are telling me nothing when you say that. You are telling me nothing, because I just described two ...

[goes back to “Growing Your Software” slide]

This is great. I like this. I am happy to give you less. I like the new gold you are giving me. Awesome, awesome sauce.

[moves to “Breaking Your Software” slide]

Here I am really angry at you. This is not good.

[back to “Change is Not a Thing” slide]

So calling it change is just not useful. We need to talk about one of two things. It either grew or it broke. There is growth and there is breakage.

So one of the things that spec is designed to do is to help us understand, and maybe even programmatically detect, when we have accidentally broken something, when we just intended to grow it. And I make an argument for growing it in a minute. But that is an important part. So that is why spec uses set logic for maps, and uses regexes for sequential syntax, is because there is already logic for determining growth-like compatibility of those two things. There is already math for that stuff.

So it is not just going to be this “I promise you” kind of used car dealer thing. We can run a program and maybe determine this. We do not have those programs yet for spec, but spec is designed to support them being written.

So that helps us in the small, as long as we do not do something like try to version specs. Version 2.0 of the spec says you need to give me gold now. Do not do that.

[Time 0:27:56]

slide title: Recognizing Collections

- + You only 'change' a collection by adding/removing members

- + Adding = growth, removing = breakage

- + Namespaces - collections of vars/fns

- + Artifacts - collections of namespaces/packages

- + Don't conflate levels!

+ My family doesn't change when I put on a hat

So what about change in the large? Well, the key thing here I would say is that we need to start recognizing when things are collections, because this is only two rules for collections.

If something is *just* a collection, including an indexed collection – you give me the name, I give you a thing. But that is still a collection. It is just an index keyed collection. There are only two operations. There is adding stuff to the collection, or removing stuff from the collection. Adding stuff is growth. Period. It is just easy. It is just accretion. And removing stuff is always breakage. Always. Removing is breakage from a collection.

But the important thing is: when you look at software, you need to see these collections. Because the other problem we have all the time is: we keep conflating changes at different levels. And the versioning system encourages that.

And namespace is just a collection of vars. Artifacts are just collections of namespaces or packages. We need to see that. spec uses sets for maps. It does not let you say what the keys mean. For this reason. It is the same thing. Maps are collections of keys. They are not the stuff inside the keys. If I put on a hat, it does not change what my family is. I am still a member of my family. My family contained these people before. It stays the same people later. I did not version my family when I put on a hat.

But we do this all of the time. All the time. We do not see this. So you have to recognize collections. So really all of the interesting stuff happens at the leaves, and everything else is a collection with these two rules. Adding stuff fine, taking stuff away is breaking.

[Time 0:29:52]

slide title: "Semantic" Versioning  
"Semantics"

+ 1.2.changed

+ "you don't care"

+ 1.changed.0

+ "you don't care"

+ changed.0.0

+ "you're screwed"

All right. Now we get really ranty. Semantic versioning. I looked this up in the dictionary and it was not there. What if we had dictionary versioning? There is sort of a fundamental problem with this idea of semantic versioning, which is like “things mean what they mean, until they do not mean what they mean”. This is helping me how? I do not really see it.

So let us dig into the semantics promised by semantic versioning. If you change the patch part, you do not care as a consumer. If you change the minor version, you also do not care. You just do not care. These things, they have this great semantic: four is more than three. That is it! I am glad there is like a manifesto about this.

But what about the major component? What does it mean? It means you are screwed. Right? That is the semantic of the major component. It is terrible. It is an absolute catastrophe, because it does not tell you in what way. Right?

[Time 0:31:18]

slide title: Even worse...

- + "you might be screwed"

- + Considered covering of change at \_all\_ levels

- + Good luck determining where

- + Might just as well change the name

What it really says is “you might be screwed”. So if somebody says, “you are screwed”, you are like “oh, that is terrible. Ugh.”

If somebody says, “you might be screwed”, you are like “oh, man”. It is worse! It is clearly worse.

And why is that? It is because this level thing did not occur to the people who did this. Smash all of the levels together. Any change, anywhere, of anything that might be any of the things that we just carefully pulled apart and said, “you are requiring more, you are providing less”. [gestures that it is all mashed together] It is this big ugly thing, where anything could have happened, and we are just telling you, “watch out!” Watch out.

And I do not think that is useful. I think Stu said it before, trying to steal my thunder: you might as well just change the name. Going to 2.0 is not helping anybody.

[Time 0:32:24]

slide:

Might just as well change  
the name

[Time 0:32:27]

slide:

MIGHT JUST AS WELL  
\_CHANGE THE NAME\_

Yeah. Just change the name. I mean, what does it mean? I mean, it is just completely not meaningful to do this to somebody. It just isn't. It is just like, “now we are playing a different game, and it is called the same name. Have a seat. You do not know how it is played. You thought you did. I predict you are going to lose.”

[Time 0:32:52]

slide:

But...

that's not change,

That's a new thing!

Right.

And I think the thing is, you are like, “well then I am not changing it.” That is a new thing! Yeah. That is exactly right. It is a new thing.

[Time 0:33:06]

slide title: Which Name?

### Levels again

So this raises the question of which name do you change? Because we just saw this smashing together up into the version of the artifact is probably not good. So if I am going to say to you, “change the name,” I need to be able to answer this question: what name should I change?

Should I change the whole thing? If I am requiring more in one of my functions, should I change the artifact name to “new game”?

[Time 0:33:39]

slide title: Requiring More args?

Providing Less on return?

+ i.e. incompatible spec

+ `_New function_`

`old-ns/foo-2` or `new-ns/foo`

+ N.B. - the namespace is part of the name

+ ns aliases can ease transitions

And no, it is the same thing, right? You are going to go look at the levels for providing, requiring. So are you requiring more arguments, or more from the arguments? Or are providing less in your return? We recognized these things as breakage before.

Essentially, we are going to be able to say: this spec is incompatible. The spec for your revised function is incompatible. And if it is, I want to see a new function. And in Clojure you have two ways to do that. You can stay in the same namespace and you can have `foo-2`.

Or maybe you made a systemic kind of change, so it is like: we have been passing around this thing, and now I realize that everywhere in our API we should be passing around two things. Well just make `API2` namespace. You can keep all of the inner functions the same. Which is fine. I mean, I know thinking of a good name is hard. But namespaces mean you can glom some different thing on the front and have good name. New place [new namespace name], good name [same original name inside of the original namespace]. You do not have to go on and on. But in practice I would not either be afraid of `foo-2`, because it just does not happen that often. It really just does not.

And one of the things that is really great about this is to remember that the namespace is part of the name. There is really nothing called `foo` in Clojure, except like a local variable. Everything else has a big hairy name that includes the namespace before hand. We are always dealing in Clojure with these nice hopefully globally unique names. And spec leans on that, and you can lean on that to make these kinds of changes.

The other thing we have are the aliases, which help again. Because I could take some code that used `game1` namespace and called `game1/foo`, and now it wants to call `game2/foo`, and it can just say `g/foo` everywhere in the code, and just change the ns declaration and say `require game2 as g`.

Now if I just did that and walked away from the code, it would break, but when I am doing that, I am saying, “well I am moving to the new thing. I should read the new specs, read the docs. I know some of the names have been reused.” But I am in charge, right? When do I need to do that? When I feel like playing the new

game. If I want to continue playing the old game, which maybe I am decent at, I am going to do that. I got a lot of wheat to get rid of.

[Time 0:36:13]

slide title: Providing Fewer fns/  
vars?

+ New namespace/package

So what about if you want to get rid of a fn? I mean, I just hate this function! I hate it! I hate it! I hate that people call it. I just want it out of my life. There are no functions like this in Clojure.

So the way to do that ... What have you changed, if you want to get rid of a function? You did not change the function, really, because it is gone. What did you change? You changed the collection. The collection no longer has the thing that was in it. So where are functions? They are in namespaces. So the namespace, that collection level, has changed. So you need to pick a new namespace. And again, a major refactoring might be a way to do this. We have deprecated a whole bunch of functions. Blah, blah, blah. And we are going to move to library 2. And really the biggest change there is not that any of the functions are different. It is that half of them are missing. We just do not want to have them any more. So we have a new namespace, the game2 namespace, and we just took out a bunch of stuff. And that is what really is different about it.

So this is the way to do that.

[Time 0:37:18]

slide title: Providing Fewer  
namespaces/packages?

+ \_New artifactId\_?

+ but... that's what MAJOR segment is for?

+ no, "\_any\_ backwards incompatible changes"

i.e. too-broad "semantic"

+ The problem is artifact->namespaces magic  
means possibility of collision

+ No 'scope' implicitly renaming children

All right, moving up another level. What about at the artifact level? So what if I want to get rid of this namespace? I hate this namespace. People are still using this namespace. I gave them a better namespace three years ago. They should be using that. I am tired of these people. I am going to take this away from them. I just really want to do this. What should I do?

Well, again, because of the levels thing, we are getting rid of something in the collection, and the collection is the artifact. And you would think by applying this logic that you should just change the artifactId. And you could. You definitely could.

The first objection I would expect here is “that is what the major version is for. That is what it is.” And it isn’t. Unless they are going to have semantic versioning 3.0, which completely changes what this means for everybody who uses it, and breaks all uses of it, and all presumptions about it forever for everyone.

Which they are not going to do, because, in fact, they do not believe in semantic versioning. You could not



version Semantic Versioning into supporting this change, and that shows that it is broken, right? Semantic Versioning cannot support this change. You cannot have Semantic Versioning 3.0 do this without breaking everybody in an unfixable way.

So unfortunately they already decided what this means, and this is a quote from the spec: “*any* backwards incompatible changes” across all of the levels. We cannot suddenly make it mean: only removals of namespaces or packages would cause this to move.

So it has got too broad a semantic. So that is not it. The problem we have here is that magic I talked about earlier. If I just say: this is game2 library. Inside it it has got turn1 namespace, but game1 library also has turn1 namespace. And where is the mapping from artifacts to namespaces? I do not know. The guy on the street, he is not there today. It is nowhere. There is not a place for this.

So we can have these clashes. How many people have ever had a clash where two JARs they included had the same package in them? Woohoo! How many people enjoyed that? So this can happen, and there is really nothing there. The thing that solves this for us when we made this change at the namespace level was the fact that that implicitly gave us a new scope. It really actually renamed everything in that thing. If I still had foo and bar, I have game2 foo and bar. They are not in conflict with game1 foo and bar. I am sort of OK.

If I do this up at this level [artifact level], I am not OK, because it is actually not an implicit change.

Some of the ways to deal with this would be actually renaming your namespaces to match this change. Because usually your namespaces have some relationship to the artifact name. The library name is in both. I am not actually sure if that is the right answer to this, but I would like to fix this.

[Time 0:40:32]

slide:

```
Doesn't Doing the
Right Thing Name-wise
Make You Reluctant to
    Remove Things?
```

Yes. Good.

So this just seems like a lot of work, right? And doesn't this make you reluctant to remove things? This is a rhetorical question. The right answer is yes! It does. It makes me reluctant to remove things.

And it should. Why should you get so up tight about someone calling the function that you do not like any more? So what? Like really, what is more important?

[Time 0:41:01]

slide title: Breaking Changes are  
                  \_Broken\_

- + Full stop
- + Don't do it
- + Don't try to figure out the best way to do it
- + Avoid \_breakage\_ by turning it into \_accretion\_
- + old and new can co-exist

OK, so here is the root of the rant. Breaking changes are broken. It is just a terrible idea. Don't do it. Don't do it. Don't try to figure out the right way to do it. Don't get together on the Internet and say, "Oh, we have all agreed, major version makes this possible. Woohoo!" It is a bad thing. You don't want to do it. Don't figure out the best way to do it.

This method of renaming turns breakage into accretion, right? We still accomplish the same thing, right? We got rid of that pesky function, because we have a new namespace that does not include it. We clarified these arguments, or we really need new stuff to do this new job. Well, we wrote a new function to do that, and it sits along side the other one. This is gigantic, because this coexistence means that people can just freely proceed. Otherwise, they have to be paranoid all of the time. Because how many people have ever encountered a breaking change that *didn't* move the major version? And how much fun was that?

It does not matter. The version does not matter. What matters is that you did this. It does not matter how you covered it, or did not cover it, or what you said, or how you excused it, or whatever. It is just not good. So we like this. They can co-exist. We want to turn breakage into accretion.

[Time 0:42:24]

slide title: So Maven is Broken?

- + Not really - how we use it may be broken
- + Maven central doesn't let you 'change' artifacts
  - + and never 'breaks', is not versioned!!
  - + no "I'm using maven central 1234567.0.0"
- + You're always happy to use latest maven central
  - + Why?
  - + it's an accreting collection of immutable things

So, is Maven broken? Right, this is what we do with Maven. Not really, right? We are doing this to ourselves. Maven is actually quite interesting.

First of all, Maven does not let you change artifacts in it. It does not let you do this.

And Maven never breaks. And Maven is not versioned. Is there a Maven central version 1,600,017? There is not! How could this work? How could this be? All of these people changing all of this stuff all of the time, and Maven never breaks? It never breaks because it says, "that is for losers". I am not doing versions. Maven central is a big name you can rely on. Go to Maven central and you can find everything you have ever found in there forever and ever and ever. That is the idea of Maven central.

You do not say: I am going to use Maven central 5062. I mean the number would be astronomical, right? And like, "oh no, I used Maven this" And then we will have Maven versioning versioning. Maven central versioning.

We do not do that. And yet, it works, right? It is crazy. We have all presumed what this name "Maven Central" means. We all share it, and we also all share an understanding, and actually sort of a peaceful feeling, that it will continue to mean what it always meant, forever and ever and ever. How could this work? How could it work?

It is very straightforward. It is an accreting collection of immutable things. As functional programmers we should be, "Like, duh!" Of course this works. This is what we do, in the small, every day. And at the very top

end of the ecosystem, this is how it works also. So at the bottom it works like this, and at the top it works like this.

[Time 0:44:27]

slide:

(insert rotten sandwich image here)

So I will just advise you right now not to look up rotten sandwich on the Internet, because it is quite unpleasant. But you can imagine this beautiful sandwich, right? At the bottom we have our functional programming, and we know what we are doing. We have all this ...

I was having a conversation today with somebody, and we were talking about talking to Java people about using Clojure. And I do think it remains one of the biggest challenges you have in trying to evangelize Clojure is that you are eventually going to end up in a point where you are trying to say to somebody: Clojure solves the problem that you do not know you have. And that problem is like this intense anxiety and pressure you feel dealing with mutability on an ongoing basis.

And until you have experienced that lifting, and Clojure is not the only language that can do this for you, but until you feel that lifting, you do not really know what you were suffering from before. It is like, if someone was standing on your foot every day, you would not even know. And then they get off your foot, you are like, "Woah! That is pretty good! Walking is a lot easier now."

So we have experienced this at the bottom. And we actually do experience that same thing, like I said. When you use Maven central, you also feel the same way about it. I am not really afraid I am going to go look in there and JAR XYZ 1.2.3.4 is going to be different tomorrow, or missing. I am not really worried about those things, because they have these rules that play the game I have been describing so far, which is: names should be enduring in their semantics, and you should be accreting immutable stuff.

But in the middle, we are messing this up big time. The way we do artifacts, the way we do namespaces, the way we just trash function signatures, is a complete mess.

[Time 0:46:28]

slide: So SemVer is Broken?

+ Yes

+ It is, in part, `_about_` how to ship breakage

+ and the other 'semantics' are of little utility

+ What instead?

+ Maybe chronological versioning?

+ `YYYYMMDD.HHMMSS`

+ Conveys more and supports some forms  
of relativism

So this is not a surprise at this point in the talk. Is Semantic Versioning broken? Totally. Yes, broken. Bad idea. We should abandon it as soon as possible, because it is fundamentally, in the biggest semantic it has, not the small ones which are like "4 is bigger than 3" – in the biggest semantic it has, the semantic about major

version change, it is a recipe for how to break software. That is what it is. That is what Semantic Versioning is.

Here is how you break software. Here is how you screw up your users. Here is how you make life difficult for people. Here is how you undermine software development. But it is a standard! And it has a web page and everything.

I am not actually advocating for something in particular instead, except to say that it does not matter a whole lot. Meaning, as long as you have something that still has the property that 4 is bigger than 3, some sort of sequentiality to it, you have a lot of options here.

One of the problems with versions, even if you get rid of the major version, this minor version thing, is that it is completely self-relative, right? 1.2 is bigger than 1.3, but I have these 6 libraries. This is 1.2. This is 3.7. This is 4.1. One of these 3 is 11 years old, and the other one was released yesterday. Can you tell which one? No. These numbers, they do not relate to each other.

Now that is not saying you could take this chronological versioning and do something deterministic with it, because you do not know what people saw. But you could use Lamport like logic to know what they could not have seen, which is not nothing. You do not have that, otherwise.

So if your artifact name is a stable thing, as stable a thing as Maven Central, you have a lot more flexibility about this. You could do something like this. It would convey more information than 4.3 does, and have some sort of possibilities for relativism.

[Time 0:48:47]

slide title: What about Git?

- + Wonderful, immutable, truth-of-the-code system, widely adopted
- + Content-based addressing
- + Almost completely ignored by artifacts/versioning, even though code basis
- + Deserves a role
  - + but, SHAs vs order/causality/readability

What about Git? So this is another thing. I mean, obviously these approaches predate Git. Everything we are doing about JARs and Maven and stuff is really pre-Git.

But Git has these great properties that definitely co-align with a lot of what I am saying, right? It is immutable. It is truth-of-code. It really is about the source code, as opposed to stuff you just made up about it later. I mean “4.3”. What does it even mean to say “this is 4.3”? Oh, that is good. I mean, it does not mean anything. So the truth is always the code.

Now, it is quite widely adopted. It has a nice property of being able to do content-based addressing. Like I said, it is pretty much ignored by these systems. It is not their fault. It is just that they existed before it does.

It does have some challenges. I think this should participate. I started this talk by saying, “the truth is actually the code dependencies”, and Git is where the code is being managed. But the way Git talks about stuff is via SHAs, and people do not like SHAs. They like the characteristics of it, in terms of being a universal unforgeable key. But it does not convey anything about order unless you have the rest of the repo. It does not

imply anything about causality. I mean “4 is greater than 3” at least says that. It came after. And there are readability issues.

But I think that there is a way to integrate this stuff, and I think it would be driven from the bottom back up to make a solution.

[Time 0:50:37]

slide title: It's a Social Thing

- + We won't be able to tech ourselves out of this
- + We need to agree that treating each other well is important

Now this is not like me preaching to you. I think we all could do better with this. Clojure does not have a perfect track record in this area.

But the most important thing is that we are not going to be able to tech ourselves out of this. What did I say about Maven, and it is actually not broken, right? What is broken is what we are putting into it is broken. For that to be different, we need to not put broken stuff in there. And that is a social thing. That is about considering other people.

[Time 0:51:17]

slide title: Local dev vs Open dev

- + Incompatible churn acceptable in private
- + Slack is not standup
- + OS user base is `_open_` and `_unknown_`

One of the things that I think makes this challenging is open source. Because when we work in a local team, or whatever. In your team. It might be a distributed team. But when you work in your team, you have a small set of people, and you have standups, and you are working on private stuff that does not get published, and no one is consuming it except yourselves. You have everybody in on the call, and we say, “You know what? I think we did this wrong. We really do need wheat and corn to do this job. All right. Well, we have got to change all of our calls to pass corn. Everybody good on that? Yeah. Sally, when can you have yours done? Tuesday. I will have mine done by Friday. All right, by next Monday we will all be passing wheat and corn. Everybody OK? Yeah, yeah, yeah, yeah, yeah. Great. Have a good day. Standup is over.”

Now we move to the Internet. And we have Slack. And it feels like that, right? We are hanging out. Our friends are there. A bunch of people who work on this library are there. We are like, “Ah, you know what? This library. It is just not good. We are passing wheat, and we need wheat and corn. What do you think? Oh, yeah, I think so, too. Everybody on Slack that day agrees: we should be passing corn. All right, good. I am going to go do it. I am just going to do it.” Boom. Git commit. Github. Artifact gets in Clojars. “I talked to everybody on Slack.” It does feel like it is the same.

Because it is what we want. It is what we would want open source to be. Sort of like the team is now everybody. But there is two things. Maybe everybody who actually is an author of that library was in Slack. But it is different, right? On standup, everyone who was an author was on standup, and everyone who was impacted was on standup. On Slack, maybe everyone who was an author was on Slack. Everyone who was impacted? Phhhh! Who knows who they are? Who knows who all of the users of their libraries are? Unless it is nobody, then you do not know.

So the user base is open, and it is unknown. You have to be caring about these people that you do not know. I know, in this political climate, it just seems like something wild to say, but you actually do. You have to care about these people that you do not know. And in software we need to do the same thing.

And so open source development, it is not the same. Slack is not standup.

[Time 0:54:15]

slide title: Coding for Growth

- + `_Open_` specs and data formats are `_key_`
- + Specs are about what you `_can_` do, not about what you `_can't_`
- + Prohibition turns growth into breakage, cascades
- + Always presume you might be handed more than what you need or know about
- + ignore, or have policy for it

So how do we code for growth? Alex Miller has talked about spec a bunch, and so has Stu, and the number one question they get about spec is: “Why don’t you let me say disallow any other keys in maps? I am angry about this. I cannot check for correctness without this thing.” It is the number one beef.

And we saw this beautiful talk by Paula about logic this morning. Guess what most logic systems do not have? In fact, I do not know of any logic systems that do have it. They do not have something that says, “and nothing else will ever be true”. And the reason why they do not have it is because then you could almost do no good logic with that system. You could never ever know or calculate anything you did not know on the very first day.

So open specs, and open data formats, which we like, right? We use maps. We use them all of the time. In general, we should be writing code that does not care if there are keys in the map that we do not care about. But it is like a *critical* thing about spec. spec is about what you could do. It is not about what you cannot do. Because tomorrow, maybe I could turn wheat into cows. I do not know. I want to retain the flexibility to be able to do that, especially if I can figure out how to do that. It might be a cool thing.

So you cannot let your checking problem du jour dominate your specs. That is not what specs are for. They are about what people can do.

You could make something with spec that could do that extra thing. Do not put it in your specs. That is not your public thing. You want to add another layer of spec that shuts down stuff, or run an additional check, to help people detect errors and stuff like that, that is fine. But do not put it in your primary public spec. Your primary public spec should be oriented towards growth, because otherwise you are gonna have nowhere to go.

Because what happens? If I let you prohibit things, I promise you that this is what is going to happen. And believe me, every engagement we have had where people have said, “I really want to say you can’t.” Two days later, their world broke, because they had nowhere to go. If you say you cannot do X, it means you can never do X. And if you are going to try to make it OK to do X later, then you need a new name.

But now we did the opposite of what I was saying before. Right? What I said before is, “If you are going to break somebody, use a new name.” Now we are saying, “If you want to grow, use a new name.” That is awful, because that is going to cause your thing to change, the key that was in your map to change, your spec to change, the spec of the thing that included you to change, the spec of the thing that included that to change.

spec is designed so that that does not happen. That as long as you make growing changes, you do not need to cascade up. spec is not like semantic versioning that way.

But if you do this, you will turn that completely upside down. You will have this problem. So this is why you cannot. I do not have a shorter way to do that, but that is why it is this way.

The other thing you have to do if you want to code for growth is: you always have to presume that people might hand you stuff that you do not know about. That has just got to be OK, although it is a coding discipline to deal with that. A lot of people have a “just take everything that is in the map and put it on the screen.” You know, maybe you should select keys. Because if you just throw everything on the screen, and they just gave you their social security number, because they are already anticipating API 2.0, which grows in that way, that is not good. So you have to either ignore it, or have a policy for it, or something like that. But you should be OK with it. You should not be disallowing this stuff.

You can make checkers that run occasionally to do whatever, but as a specification, this has to be OK.

[Time 0:58:31]

slide title: What about Iterative  
Development?

- + Alphas are OK
- + But maybe should be in artifactId?
- + Or - incremental API 'publishing'
- + Open source is not an excuse for indefinite public thrashing around

So what about iterative development? This all sounds like, “I have got to get it right the first time.” And that is not the case. You are going to have a place where you are just trying to figure it out. You get off the hammock, hope you went on the hammock a little bit, you came in, you started typing. You push something, and you look at it. People kick it around, and they say, “Oh, I tried it and it is not that great.”

That is fine. You just need to be clear that you are there. You are in that mode. And people should expect to have to move along. If they want to use your alpha, they want to be on your standup. They want to be in that circle.

But I think what we need is something more fine grained than artifact releases to be a tool for publishing. Actually calling an entire API an alpha is somewhat of a problem. Because then you need this big moment to get out of that. So I think that is an area where we could do something more specific.

But, that is not to say just leave your thing 0.0.967. At a certain point, you are going to have users, and whether you change it to 1.0 or not, they are going to be depending on your stuff.

But I do think we need to be clear about where your promises lie. What did you actually promise. Yes, you discovered the fact that if you give me a ruby, I will give you a magical sword, but I never told you I would do that.

[Time 1:00:14]

slide title: The Only Truth is  
Runtime

- + Deps/POMs are just suggestions

- + can be full of 'conflicts'
- + Someone needs to build a classpath
  - + that alone determines runtime context
- + Possibly a lib set that `_none_` of the components have ever run against

Did I go this far already? Yeah, OK.

So now we have talked through, we start with code, we get to artifacts. There is this magical jump there. But there is this other problem which I talked about when you are building your library, which is: I do not care what you said in your POM for your library. That does not mean that you are going to get what you said. The very first slide, one library wanted Y 2.1, and another library wanted Y 2.4. Well they both cannot get what they want, and your app needs to use both of them. So there is no truth in this transitive dependency tree. It is all suggestive.

I would like this. I would like that. It is like a Christmas list. Santa is saying: “Hmmm. All right. Maybe.” But not everyone is going to get the train set.

So the truth is the runtime classpath, if you set aside tricky classloader stuff. Somebody has to make that classpath. They will maybe take as input, well probably take as input the dependency tree they find from Maven. But then they are going to have to resolve things. Maybe a human being is going to get involved and say, “I know these two things do not work.” But it is quite possible that your library is going to run against a set of components that it has never ever run against.

So you cannot say, “Well I built this thing and it works with 2.1”. I do not care. I need to run it with 2.4 because it is running in a context. That is the thing about contexts, is that you are not guaranteed your context. You get put into a different context. That is what context means.

[Time 1:01:59]

slide title: Testing is Runtime  
Dependent

- + And runtimes are independent (if related) of dev- and build-time deps
- + Plus, you can't test against an open set of consumers
- + Artifact release testing is inherently limited
- + We could be reifying artifact sets at a macro (e.g. app or multi-app) level

So this has an impact on testing. We think we tested. Oh, you know. Reproducible development. Reproducible builds. Oh. [TBD] A lot of times, the things that you depend on, it does not impact the bytes of your build at all. You are just getting some testing with this library today. But it is an independent thing.

So you cannot test against an open set of consumers, and you cannot test against changes to your downstream dependencies, all the time, which means that the actual testing you do of your artifact at release time is limited. It should be about: does my thing do what it says? Do my own tests succeed? But it is not really communicating a lot about the dependencies, because they are going to change.



But I do think we need a higher level way to talk about artifact sets that is independent of this tree. Admittedly, as an application, I do not want to have to write an explicit file with every JAR that is the flattening of the transitive tree. But how many people have ever had to exclude, or put an explicit version of a library in? Yeah. And was that fun? No. But it should be something that is more practical. We should be able to have tools that start with the code and say, “You know what, you do not even need libraries X and Z at all. I am just not going to include them.” And your life is simpler. We should have things that say, “We are rolling this stuff up.”

If we were doing what I was saying about names being enduring, that tool would have a lot more leeway in what it could do. It could just say, “I am just going to use the latest of everything.” And it could know latest without you telling it, as a side effect of updating your deps and updating your version.

[Time 1:03:47]

slide:

(Live Coding Demo)

All right.

A hush comes over the room. I mean, this is just, I had a template for the talk, and it said “insert joke here”.

[Time 1:04:01]

slide title: What about Web  
Services?

- + Same problems, same mistakes
  - + 'versioning' non-answer
  - + conflating collections w/contents
- + Web service is collection of ops
- + ops require/provide
- + Accretion could prevent a lot of client/  
service version hell

So what about web services? It is the same thing, right? Some people are like, “Oh, JARs. Oh, man. You are old. We do everything with web services now. And I do not care about JARs. I do not have JAR versioning. I do web services. I just talk to services.”

It is the *same* thing. It is the same thing. It is the same problems. It is the same mistakes. Everything is the same. How many people have versioned web services? Do you have major versions? Woohoo! And it is no better.

Versioning is still not an answer, and it is still this same mistake. How many people version their web service when they change the arguments to a function? You do it. I mean, it is OK. You do it. It is what industry practice is. People are doing this, right?

But that is a level violation, right? If you have an operation in your service, and you modify what it does, it is putting on a hat. Your web service is not a different service. Your service provides a set of operations. A web service is a collection of operations. The end. It is a collection. That is the end of that level. There are two things you can do to a web service. You can add operations, or get rid of operations.

Then you can mess around with the operations. And you can look at them, just like we looked at functions. What do they require? What do they provide? Is there a way to grow web service operations? Yes. Especially if you take these approaches about openness, and open specifications, and open data formats.

Is there a way to provide more back from a web service and grow that way? Totally yes, as long as you have expressed to your consumers, “I am going to give you at least this, but I may give you more.” And then we can grow together.

Similarly, you can break them in the same ways. Requiring more. Providing less. And when you think you want to do that, well think twice. Because what happens if you, instead of saying I am going to break foo, you make foo2? If you were going to break foo, what would you have to do? What happens today? You break foo, you say we have version 2 of our API. You have to tell everybody and their mother version 2 of the API is coming Tuesday. Switch here, talk to this new endpoint, blah, blah, blah. Change your world. There is no getting around that.

Now what happens if you just put foo2 next to foo? You can still tell people. They can say, “I am in Bermuda this week, but next week I will try foo2. That sounds awesome.” But right now, my web service is going to keep working, because it calls foo, and you did not take it away from me while I was on vacation. Accretion solves the problem in exactly the same way.

[Time 1:07:03]

slide title: We Need to Bring FP to  
the Library Ecosystem

- + Currently update-in-place, excused but not corrected by versioning

- + dependency hell == mutability hell

- + Makes programming fragile

- + Libraries less useful

- + Even undesirable, whatever their features

So what we need to do is bring functional programming to the library ecosystem. That is it. We need to take this thing. We need to make it a good sandwich, that the top and the bottom and the middle are all good.

Right now, we do update-in-place. We excuse it with this versioning thing, which is just not good. Dependency hell is not a different thing than mutability hell. It is the same thing. It *is* mutability hell. It is just at this scale. It makes programming fragile.

But the worst thing is this: it makes libraries less useful. How many people are reluctant to take on dependencies? Yeah. I am. And it is not just because they bulk up my thing. It is because I am afraid. I am afraid of other people. But I do not *want* to be afraid of other people. And I do not think we all should be afraid of other people.

And this is the thing that is really sad about this, is that you made your thing, and you open sourced it, and you got on Slack, and you were feeling all really good about things, but people do not trust you. And it is not necessarily because you did anything wrong. It is because they have seen this happen. And like I said before, it is sort of a social thing.

[Time 1:08:18]

slide title: "This is Impossible/

## Impractical"

- + Nope
- + Many examples of decade+ compatibility
  - + Unix APIs
  - + Java
  - + HTML
  - + Clojure?
- + Compatibility a prerequisite of success?

Now, how many people are saying, “No”? This all sounds fine, but it is easy for me to make a little piece of data immutable. It is easy for me to know that 42 cannot change to 43, but at this scale I just have new requirements all of the time. You cannot possibly make a big thing that does not change.

This is just not true. Look at these things. Has anyone tried to call something from Unix that was there in 1970-something? It is still there. It still works the same way. Anybody ever tried to run an old Java program? It still works. People are still using the same old HTML. It is still working. And I think Clojure core also has had this approach. I do not think we have done it perfectly, but it is a value prop.

So when I keep saying no, and when stuff just stays there that you think, “Ew! We should get rid of this. I hate this function!” This is why it is still there. Because I do not want to do that to people. And I think that whatever makes things successful is somewhat unknown, but I really believe that compatibility is a prerequisite to being successful. You cannot ignore this and have something that is going to endure, that people are going to value. And if you want people to value the stuff that you write, you need to consider this.

[Time 1:09:47]

slide title: What If We Never  
Broke Anything?

- + names become enduringly meaningful
- + orthogonal compatibility checking becomes possible
- + fine-grained deps can be explored
- + use the latest with impunity
- + compose with impunity

So what would happen if we never broke anything? Names would be enduringly meaningful. Maven Central. I know what it does for me, and it will always do that.

This compatibility checking I was talking about. It would be possible, and we would also be able to sort of just move to the latest and let a testing thing that is independent of any of the authors go and figure out the right thing. Figure out who needed what when, what the times were. Here is a set that works, because it is not going to have to be afraid of these breakages.

We could look into fine grained dependencies, which is something I think is particularly interesting, and I will talk about it in another slide.

We could use the latest with impunity. We do that with Maven Central, right? We are not like, “Oh, man, I need to get at Maven Central from three weeks ago.” We do not ever say that.

And the other thing that is super critical to software development is that we can compose with impunity. When we take two things, and then a third thing needs one of the other things, and we do not really know if we can put them together, we are missing composition, which is something we value as functional programmers.

[Time 1:10:54]

slide title: Open Challenges

- + We can't 'see' some changes
  - + collection adds are easy
  - + fn args/ret not visible in source
  - + specs can help
- + spec compatibility context-dependent
  - + provide vs require
- + repo->artifact->namespace not first class
- + tooling that reinforces the status quo

So I think there are a bunch of open challenges here. One is that there are some changes we cannot see. I talked earlier about arguments and returns. It is harder to see than the presence of a function, or the dependency on a function. Collections are straightforward. But when we start using spec more, it will help here, because we will be able to see in a growing change to a spec, that something changed. The calls do not necessarily look different yet, or in a way that is machine detectable, but the spec will look changed in a compatible way, and kept the same name. And we can see that happening.

The spec compatibility is a little bit tricky, because compatibility somewhat differs depending on whether you are providing something or requiring it. Because you can make a spec bigger or smaller, and we know in one case it is breaking, and in another case it is not. So this directionality is something that I want to build into spec. Being able to determine the difference. This spec in this context is a providing context vs. a requiring context.

I mentioned repo to artifact to namespaces. It would be great to fix that. It would be great to have global registries of: given this namespace, here is the repo, here is the artifact. And then we could work from the bottom up, as opposed to, “I talked to Fred, and he said use this JAR. And then I found Incanter was in it. That’s cool!” It should work the other way.

And another big problem is just that we have tooling that says, “Do this!” And we have culture that says, “Do this!” We solved this problem. We have major versions for this.

[Time 1:12:39]

slide title: Opportunities for  
Clojure

- + spec
- + Flexible (vs fragile/brittle) dep awareness
- + Explicit code->artifact/repo support
- + First-class, fine-grained 'publish' for APIs
  - + ditto deprecation
- + Testing based on fine-grained deps
  - + generative testing needs this

OK, so Clojure can help. We have spec. I think that will lead us to flexible dep awareness, as opposed to this fragile/brittle thing, which is talking about too much. We saw it was already broken, even at the first example.

Maybe we can do something explicit about code to artifacts, which I was just saying.

I also mentioned before, public is not really that great because a consumer of your alpha needs access to something, so you really need to say something else when you say, “I am publishing this. I am making a commitment now.” And similarly you might want to say it is deprecated. It does not mean I am going to take it away. It just means, “Hey, look over here. There is foo2. It is better. It is twice as fast, and it makes cows.”

The other thing that is going to come out of this is testing based on fine grained deps. I do not want to steal Alex’s thunder, but this is something that we are already working on, because it is necessary for generative testing. Right now, you press save in your editor, and all of your tests run, because your tests are pretty useless. You wrote them yourself and they do not test anything. But generative tests are useful, but they take a long time.

But the thing is, why should we ever test this function more than once? If we did not change this function, should we test it again, and again, and again, and again? Should I test it, and you test it, and somebody else tests it. It is pointless. We should have SHAs for code, and say, “I tested this SHA. It is done.” And I tested the SHA in this context with this other function. We know what the fine grained deps are. This is something that you could have.

And then, yeah, you could press save, but only the stuff that actually is affected by what you did would get this, admittedly, more expensive generative testing.

[Time 1:14:23]

slide title: Exchange > Change

- + Grow your software
- + Give birth to variation
  - + don't break, accrete
- + Think of the children consumers [~~strikethrough~~ on "children"]
- + Move forward without burning bridges
- + Create a lib/service ecosystem of which we can all be proud

All right. I know everybody wants to eat, and I certainly do.

So what I am going to say is: you should value exchange over change. Writing libraries for other people to use is about exchanging. If you need to change it, you need to be considerate, because the primary thing is exchange, not change.

And there are two really good ways to do this. One is to grow your software. Just grow it. The other is to turn what would have been breaking into accretion. In other words, if you are going to have a variant, give birth to a variant. Do not muck with a thing.

Think of the children. Think of the consumers. And that is not to say that consumers are kids. I mean, think of the children is less about the children than it is about the future. Think about the future of your software. Do you ever want to be able to change it, and fix it, and make it better, and have people rely on it, and like you? Then you need to do this. You need to move forward without sort of trashing stuff behind you.

And like I said, I think we all could do better with this, and I am certainly hopeful that we will start with some of the contribs and apply some of these new things, but I would like Clojure to lead in this area. What I have described is not unique to Clojure. It is sort of the industry standard. And it is not great. So why don't we be the first community to make it great?

That's it.

[Time 1:15:59]