Discovering RESTful Web Microservices

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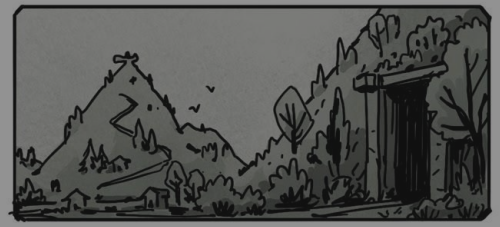

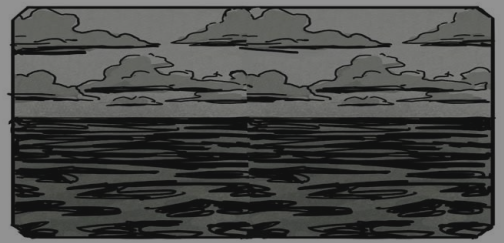


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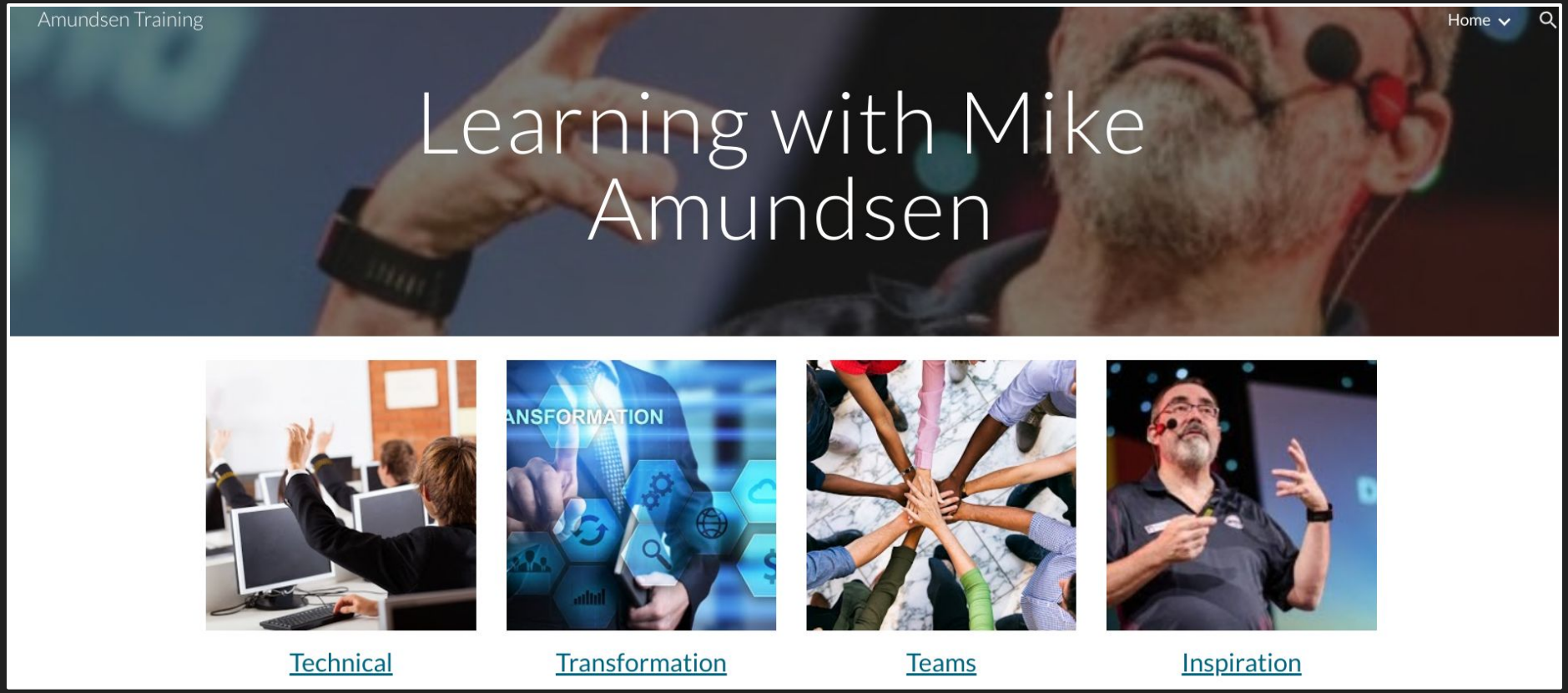


http://g.mamund.com/msabook

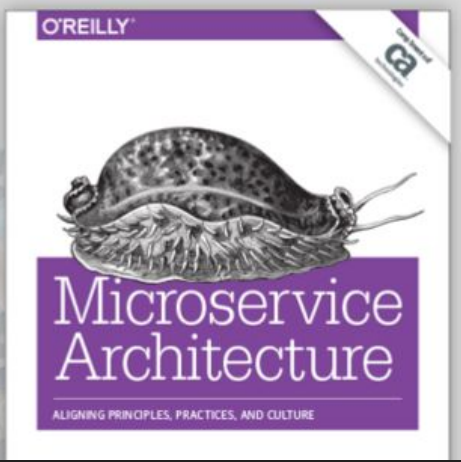
ca technologies

Microservice Architecture: Aligning Principles, Practices, and Culture

Microservices is the next evolution in software architecture designed to help organizations embrace continual change in the digital economy. But how do you design and apply an effective microservice architecture?

This new book from O'Reilly provides comprehensive guidance through seven valuable chapters that give you a deep-dive into:

- The benefits and principles of microservices
- A design-based approach to microservice architecture
- Lessons for applying microservices in practice



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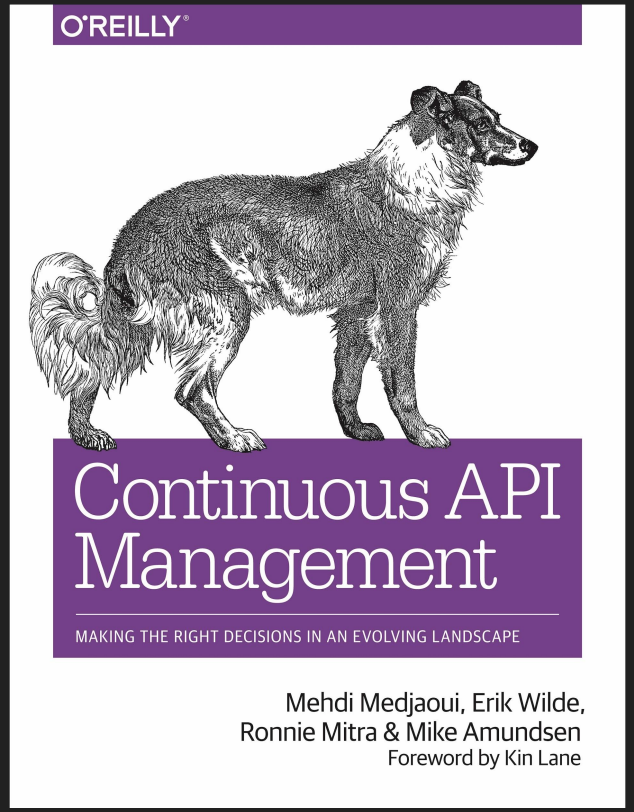
"A reusable guide to the technology, business, and politics of doing APIs at scale within the enterprise."

-- Kin Lane, API Evangelist

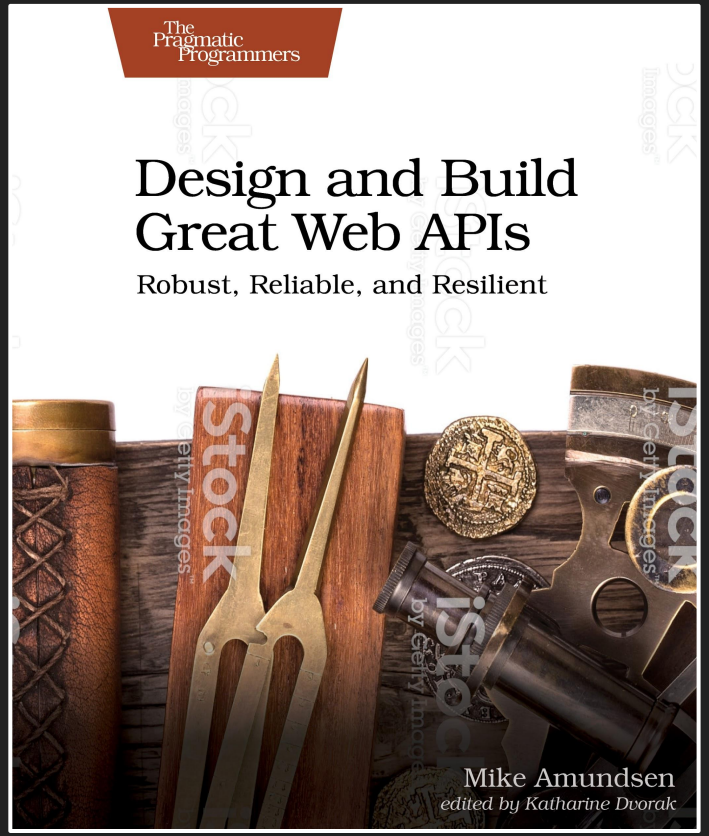


Coming Soon!

"I wish I had this book 20 years ago."

"A great classroom text or web guide."

"Useful in a way that doesn't tie it to specific technologies."



goto; chicago

Please

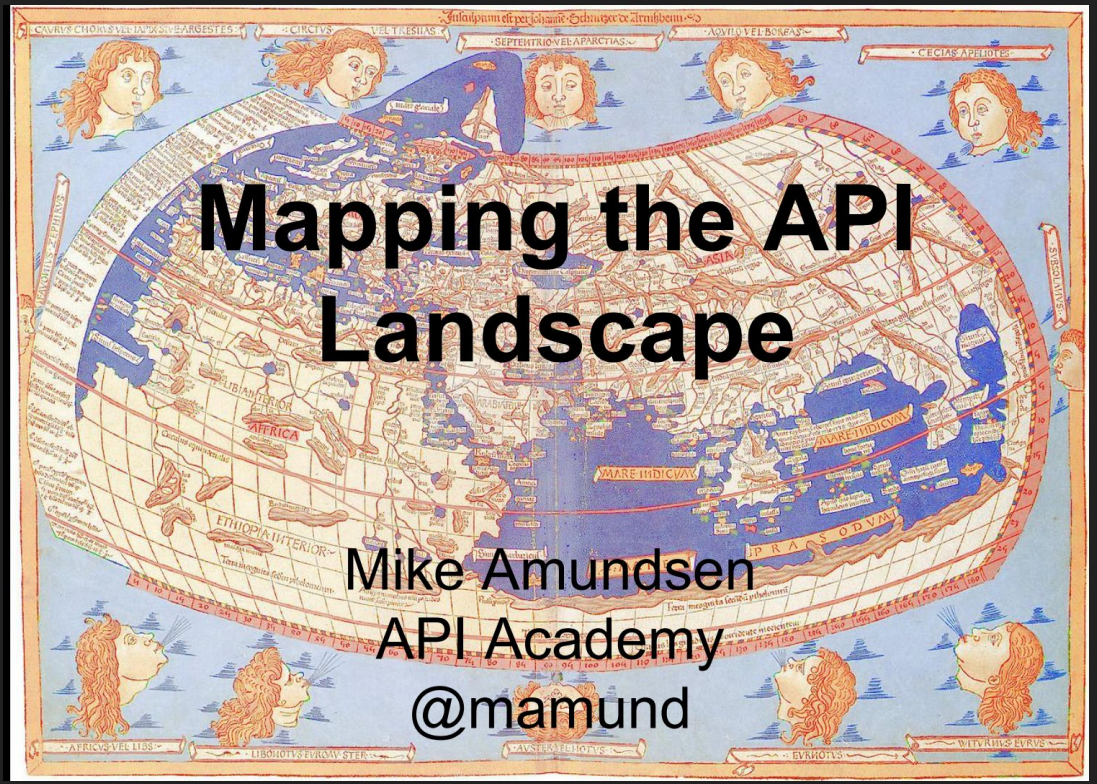
Remember to rate this session

Thank you!

follow us @gotochgo

Discovering

A few years ago, in a slide deck far away...



swagger

http://petstore.swagger.wordnik.com/api/api-docs.json | special-key | Explore

/user

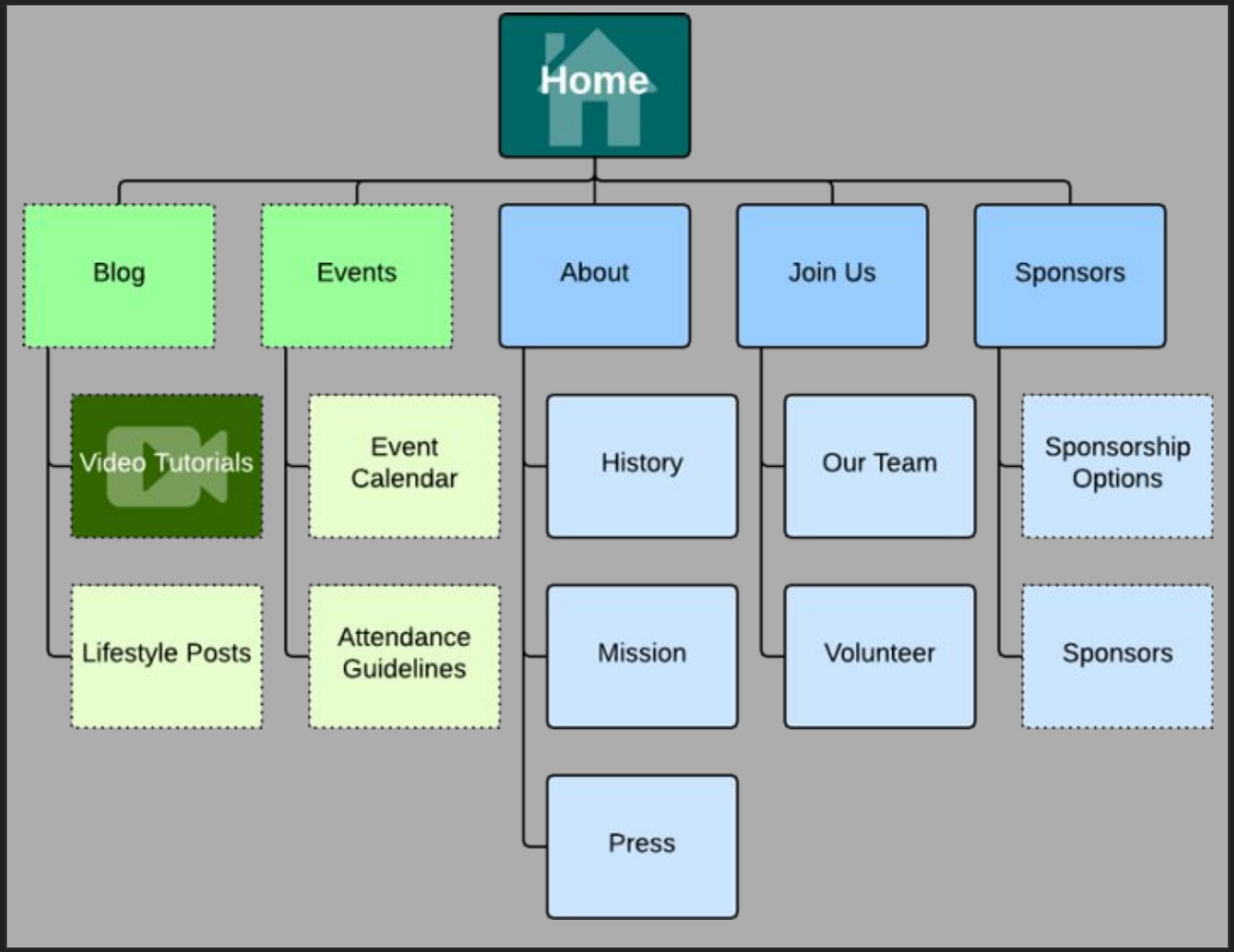
Show/Hide | List Operations | Expand Operations | Raw

POST	/user.json/createWithArray	Creates list of users with given input array
POST	/user.json	Create user
POST	/user.json/createWithList	Creates list of users with given list input
PUT	/user.json/{username}	Updated user
DELETE	/user.json/{username}	Delete user
GET	/user.json/{username}	Get user by user name
GET	/user.json/login	Logs user into the system
GET	/user.json/logout	Logs out current logged in user session

/pet

Show/Hide | List Operations | Expand Operations | Raw

GET	/pet.json/{petId}	Find pet by ID
POST	/pet.json	Add a new pet to the store
PUT	/pet.json	Update an existing pet
GET	/pet.json/findByStatus	Finds Pets by status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History
Mission
Press
Our Team
Volunteer
Sponsorship Options
Sponsors

LEGEND *to* MAP SYMBOLS

COUNTRY

Feature Town

desert/wasteland

grassland

swamp

hills

mountains

cave

political border

road

river

town/village

cities

tower/fortress

castle

country capital

windmill

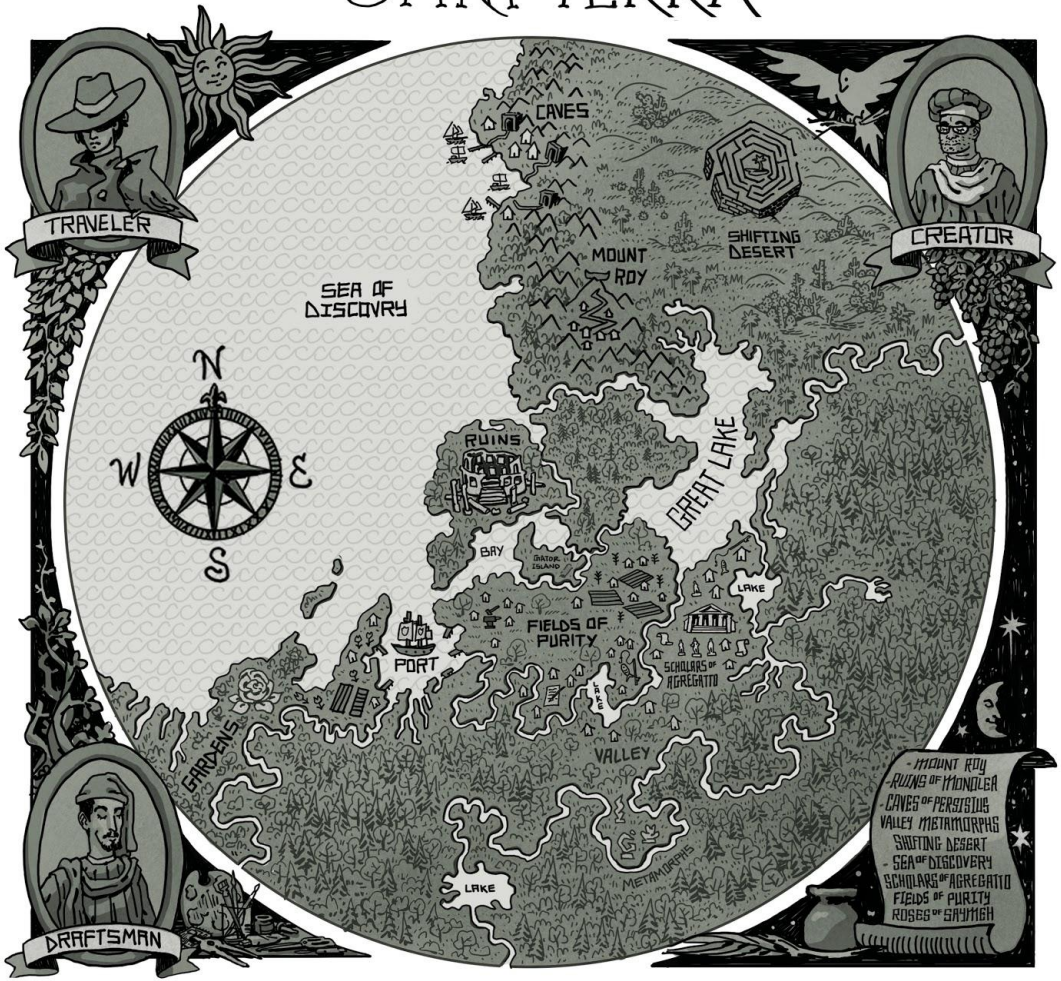
forest

lake

reef

canyon

OMNI TERRA


TRAVELER
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CAVES
MOUNT ROY
SHIFTING DESERT
SEA OF DISCOVRY
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BAY
GATOR ISLAND
LAKE
FIELDS OF PURITY
PORT
SCHOLARS OF AGREGATTO
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GARDENS
METAMORPHS
LAKE
- MOUNT ROY
- RUINS OF MONDLEA
- CAVES OF PERSISTOUS
VALLEY METAMORPHS
SHIFTING DESERT
- SEA OF DISCOVERY
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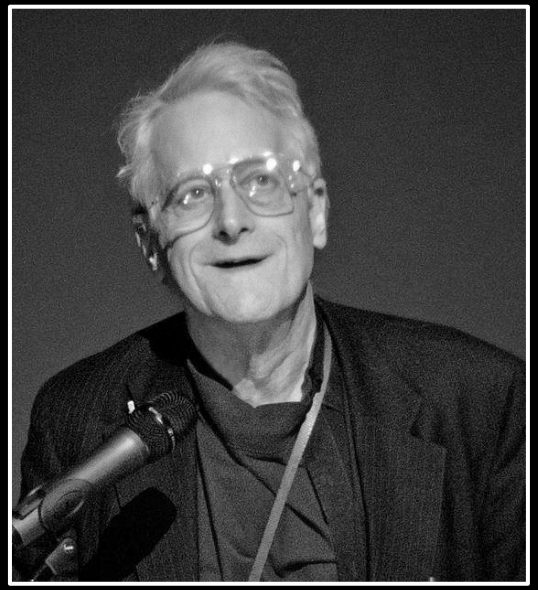
FIELDS OF PURITY
ROSES OF SAYMEH

RESTful Web Microservices?

The Web

The words hypertext, hyperlink, and hypermedia were coined by Ted Nelson around 1965.

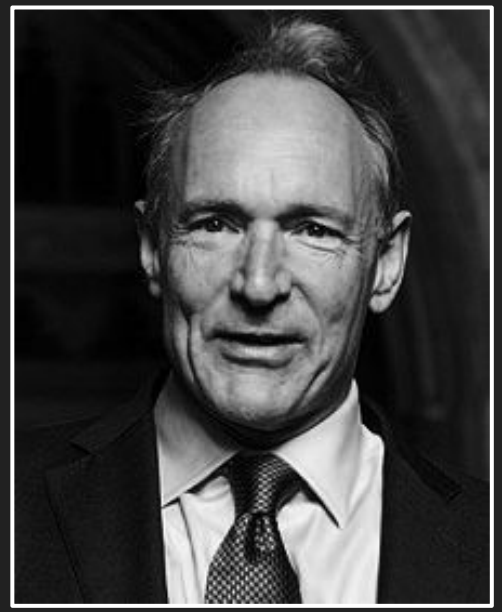


Ted Nelson

HTTP and HTML

"We should work toward a universal linked information system, in which generality and portability are [most] important."

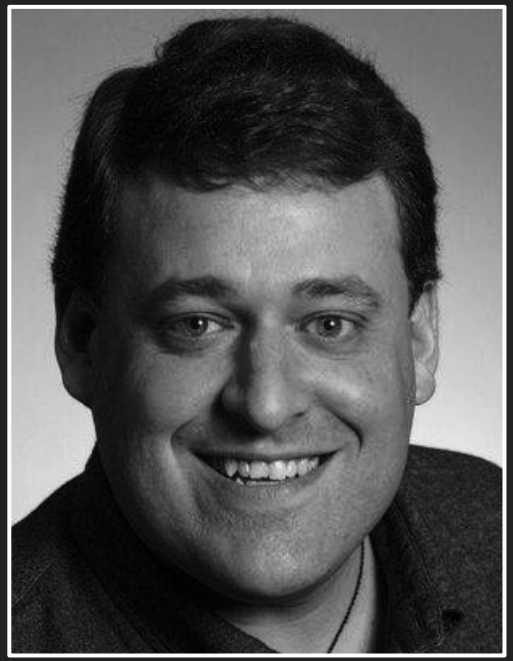
-- Tim Berners-Lee, 1989



REpresentational State Transfer (REST)

"REST emphasizes scalability of component interactions, generality of interfaces, independent deployment of components, and intermediary components."

-- Roy Fielding, 2000



Microservices

"An approach to developing a single application as a suite of small services, each running in its own process and communicating with lightweight mechanisms."

-- Martin Fowler, 2014

https://www.thoughtworks.com/insights/blog/microservices-nutshell

Microservice Characteristics

- Make each program do one thing well
- Expect the output of every program to be the input of another program
- Design and build software to be tried early
- Use tools to lighten the programming task

Unix Operating Principles (1978)

- Make each program do one thing well
- Expect the output of every program to be the input of another program
- Design and build software to be tried early
- Use tools to lighten the programming task

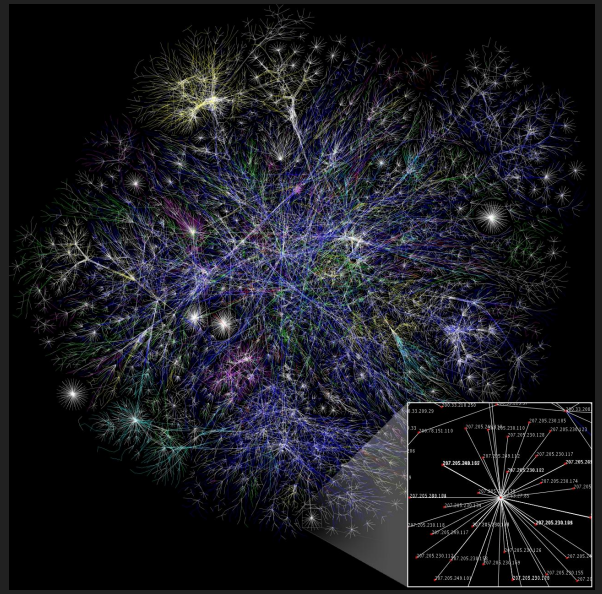
https://en.wikipedia.org/wiki/Unix_philosophy

Loosely-coupled components running in an engineered system.

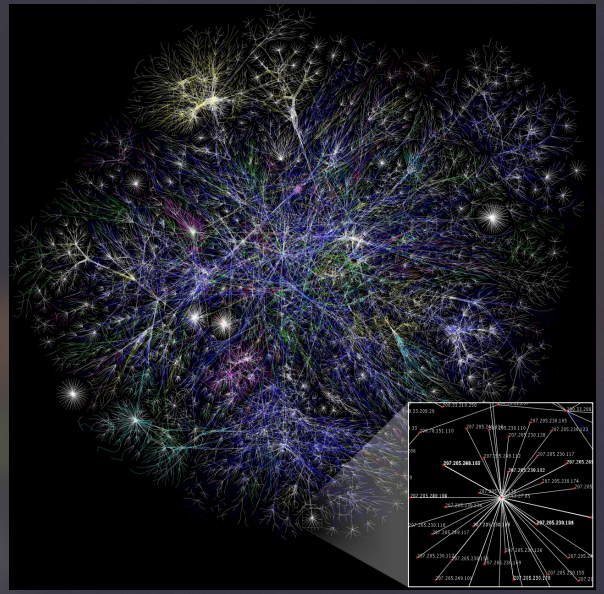
Traveling

Traveling

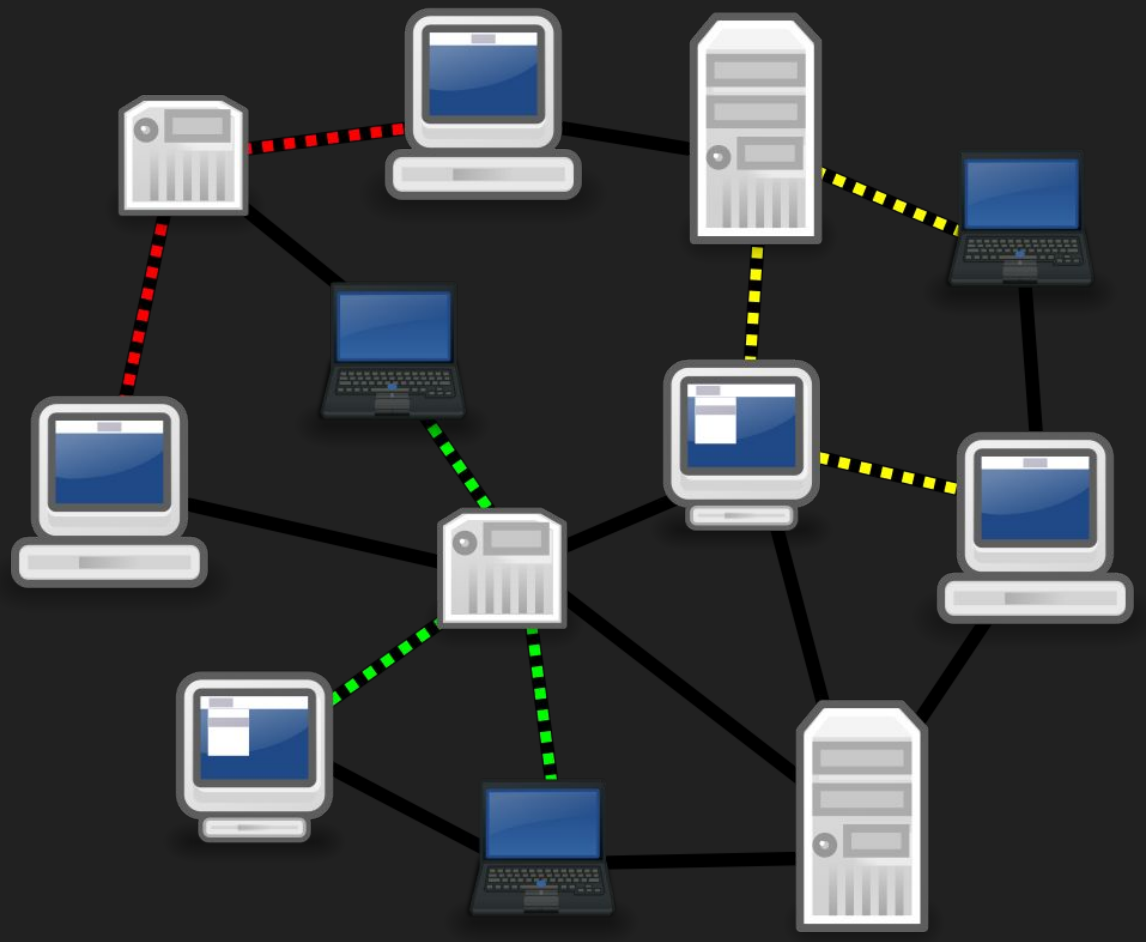
Traveling the Network

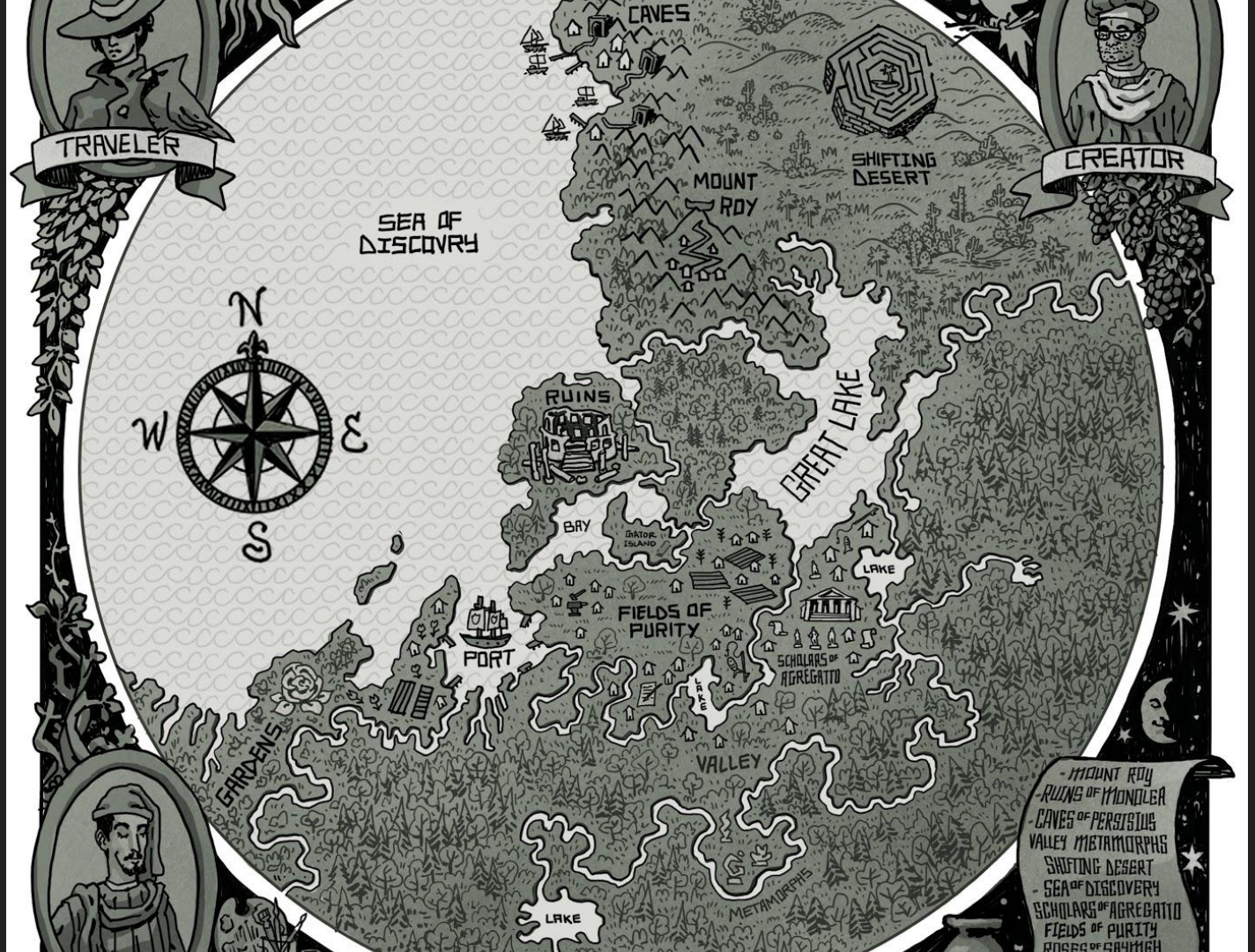


Programming the Network



```
RedBoot(tm) bootstrap and debug environment [RAM]
(Panasonic Avionics Corporation) release, version ("560328-212" v "1.07" b "0126
") - built 15:35:59, May 22 2013

Platform: SM-02 (I386)
Copyright (C) 2000, 2001, 2002, Red Hat, Inc.

RAM: 0x00000000-0x000a0000, 0x00100000-0x01000000 available
Current Boot Count is 0

verifying MBR...  Fix MBR:
 Partition 0:  already exists
 Partition 1:  already exists
 Partition 2:  already exists
 Partition 3:  already exists

verifying image... OK.
 == Executing kernel in 5 seconds - enter ^C to abort
  Load Address 0x00000000
  Image length 0x00e2f5d5
 Loading kernel binary...
 Read image signature... 1f 8b
 Decompressing image...
  _
```

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VALLEY METAMORPHS
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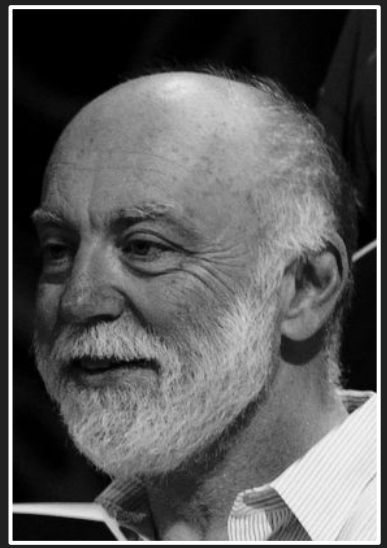
SCHOLARS OF AGREGATTO
FIELDS OF PURITY

Fallacies of Distributed Computing (1994)

1. The network is reliable.
2. Latency is zero.
3. Bandwidth is infinite.
4. The network is secure.
5. Topology doesn't change.
6. There is one administrator.
7. Transport cost is zero.
8. The network is homogeneous.



L Peter Deutsch

https://en.wikipedia.org/wiki/Fallacies_of_distributed_computing

Programming the Network

"There is no simultaneity at a distance."

-- Pat Helland (2005)

Pat Helland

"Data on the Inside vs. Data on the Outside, Helland (2005) http://cidrdb.org/cidr2005/papers/P12.pdf

“Bugs will happen. They cannot be eliminated, so they must be survived instead.”

-- Michael T. Nygard

The Pragmatic Programmers

Release It!

Second Edition

Design and Deploy
Production-Ready Software

Michael T. Nygard

Edited by Katharine Dvorak

Nygard Stability Patterns

- **Timeout**
- **Circuit Breaker**
- **Bulkhead**
- **Steady State**
- **Fail Fast**
- **Handshaking**

"The journey of a thousand miles begins with one step." -- Lao Tzu

Let's talk about code for a bit...

Let's talk about ***code*** *for a bit...*

OMNI TERRA


CAVES
FIELDS OF PURITY
VALLEY
LAKE
METAMORPHS
DRAFTSMAN
- MOUNT ROY
- RUINS OF MONDLEA
- CAVES OF PERSISTUS
VALLEY METAMORPHS
SHIFTING DESERT
- SEA OF DISCOVERY
SCHOLARS OF AGREGATIO
FIELDS OF PURITY
ROSES OF SAYMEH

Stateless Microservices

- Simple processors (converters, translators, etc.)
- No dependence on other microservices
- No local data storage (disk I/O)

The most common MSC example, but the least useful!

Stateless Microservices

- No shared state
- Easy to replace
- Easy to scale up

Stateless Microservices

```
// http server handling data conversions
function conversionServer(request, response) {
  response = convertValue(request);
  return response;
}
```

But, what about the network?

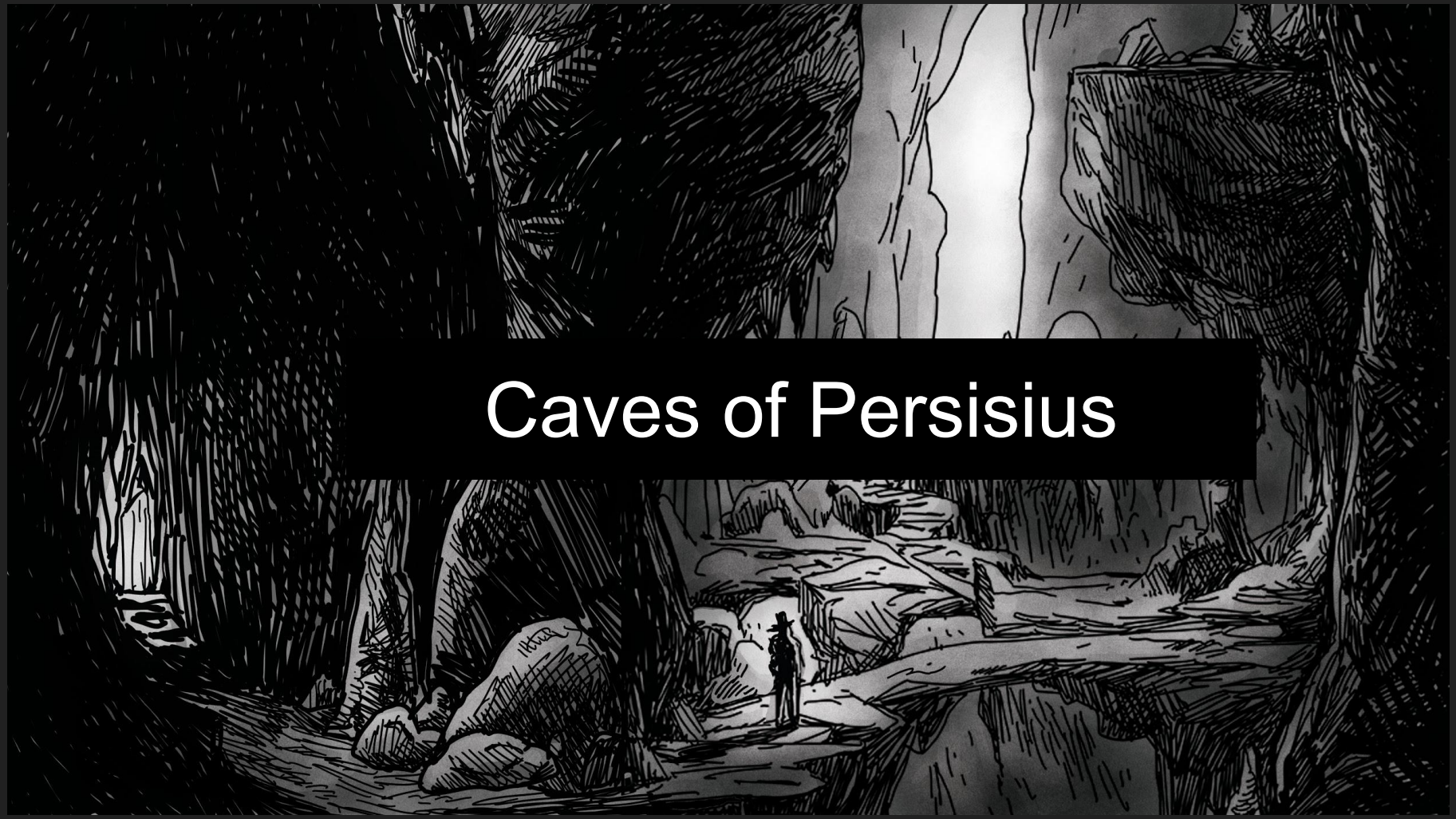
Programming the network

- *What if the work takes too long?*

Stateless Microservices

```
// http server handling data conversions
function conversionServer(request, response) {
  if(request.timeBudget > my.averageResponse) {
    response = FailFastError(request);
  }
  else {
    response = convertValue(request);
  }
  return response;
}
```

1. Fail-Fast


Caves of Persisius

Persistence Microservices

- Simple (local) storage (reads and/or writes)
- Disk I/O dependent
- Possibly VM or one-U dependent

Commonly needed MSC, not the easiest to implement.

Persistence Microservices

- System of Record/Source of Truth
- Relatively easy to scale for reads (CQRS)
- No cross-service two-phase commits (Saga)

Persistence Microservices

```
function updateOrders(request, response) {
  response = localStorage.write(request);
  return response;
}
```

But, what about the network?

Programming the network

- *What if the work takes too long?*
- *What is the dependent service doesn't respond in time?*
- *What if the dependent service is down?*
- *What if the storage overflows (data, logs, etc.)?*

Persistence Microservices

```
function updateOrders(request, response) {
  if(request.timeBudget < localStorage.latency) {
    response = FailFastError(request);
  }
  else {
    response = setTimeOut(circuitBreaker(
      localStorage.write(request),
      {timeout:10,maxFail:3,reset:30}
    ), timeBudget);
  }
  return response;
}
```

1. Fail-Fast
2. Timeout
3. Circuit Breaker
4. Steady State

Scholars of Aggregato

Aggregator Microservices

- Depends on other ("distant") microservices
- Network dependent
- Usually Disk I/O dependence, too

The most often-needed; most challenging, too.

Aggregator Microservices

- Sequence vs. Parallel calls
- Timing is everything
- Easy to scale (should be…)

Aggregator Microservices

```
function writeOrders(request, response) {
  var resourceList = ["customerDB", "orderDB", "salesDB"]'
  var serviceList = gatherResources(resourceList);
  response = serviceList(request)

  return response;
}
```

But, what about the network?

Programming the network

- *What if the work takes too long?*
- *What if a dependent services doesn't respond in time?*
- *What if a dependent service is down?*
- *What if storage overflows (data, logs, etc.)?*
- *What if a dependent service is unhealthy?*
- *What if traffic for a service spikes?*

Aggregator Microservices

```
function writeOrders(request, response) {
  var resourceList = ["customerDB", "orderDB", "salesDB"]'

  setTimeOut(function(request,response, resourceList) {
    var serviceList = gatherResources(resourceList);
    if(serviceList.estimatedCost > request.timeBudget) {
      response = FailFast(request);
    }
    else {
      if(serviceList.healthy === true) {
        circuitBreaker(serviceList, request,
        {timeout:10,maxFail:3,reset:30});
      }
    }
  },request.timeBudget);

  return response;
}
```

1. Fail-Fast
2. Timeout
3. Circuit Breaker
4. Steady State
5. Handshaking
6. Bulkhead

Nygard's Admonition...

Joe asks:

Is All This Clutter Really Necessary?

You may think, as I did when porting the sockets library, that handling all the possible timeouts creates undue complexity in your code. It certainly adds complexity. You may find that half your code is devoted to error handling instead of providing features. I argue, however, that the essence of aiming for production—instead of aiming for QA—is handling the slings and arrows of outrageous fortune. That error-handling code, if done well, adds resilience. Your users may not thank you for it, because nobody notices when a system *doesn't* go down, but you will sleep better at night.


But Wait...
There's
MORE!

*Let **not** talk about code for a bit...*

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W
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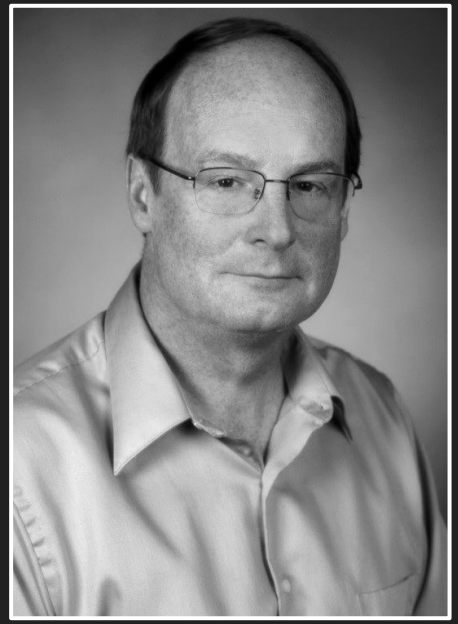
MOUNT ROY
WS OF MONDLEA
S OF PERSISTUS
VALLEY METAMORPHS
SHIFTING DESERT
SEA OF DISCOVERY
SCHOLARS OF AGREGATIO
FIELDS OF PURITY
ROSES OF SAYMEH

Aim for Interop, not Integration...

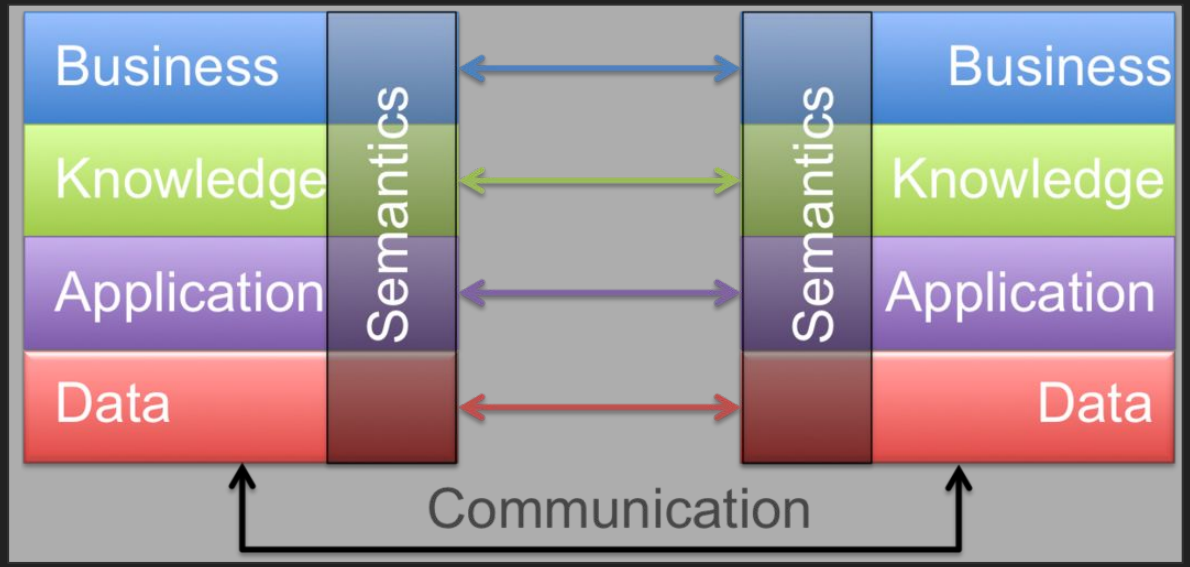
"Interoperation is peer to peer. Integration is where a system is subsumed within another."

-- Michael Platt, Microsoft



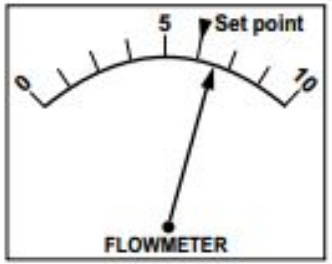
https://blogs.technet.microsoft.com/michael_platt/2005/08/30/integration-and-interoperability/

Aim for Interop, not Integration...



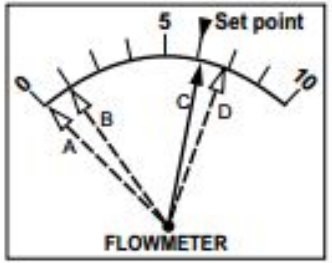
Signal, Sign, and Symbol

Jens Rasmussen



SIGNAL

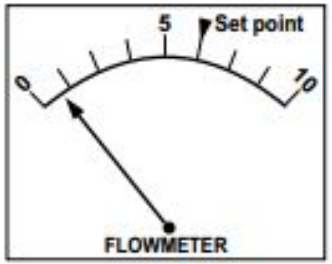
- Keep at set point
- Use deviation as error signal
- Track continuously



SIGN

Stereotype acts

If Valve Open	If C, ok If D, adjust flow
If Valve Closed	If A, ok If B, recalibrate meter

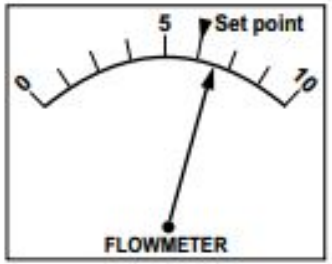


SYMBOL

If, after calibration, is still B, begin to read meter and speculate functionally (could be a leak)

Signal, Sign, and Symbol

- Signal: Protocol
- Sign: Format
- Symbol: Vocabulary



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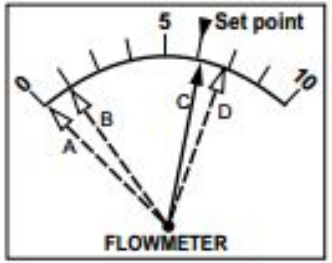

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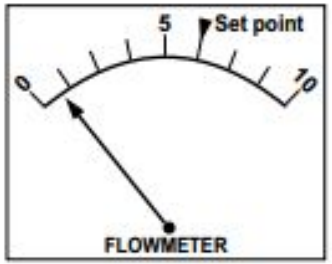
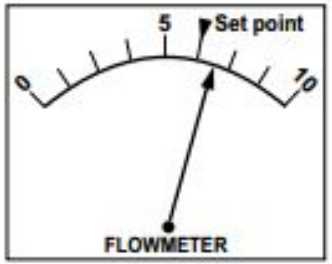


SYMBOL

If, after calibration, is still B, begin to read meter and speculate functionally (could be a leak)

Signal, Sign, and Symbol

- Signal: Protocol
  HTTP, CoAP, etc.
- Sign: Format
  HTML, HAL, etc.
- Symbol: Vocabulary
  ALPS, DCAP, etc.



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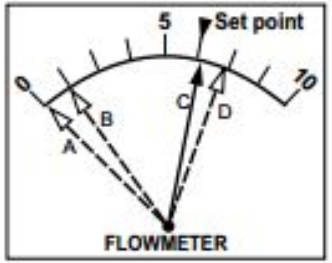

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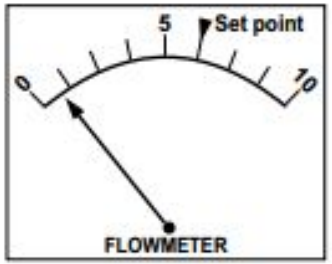
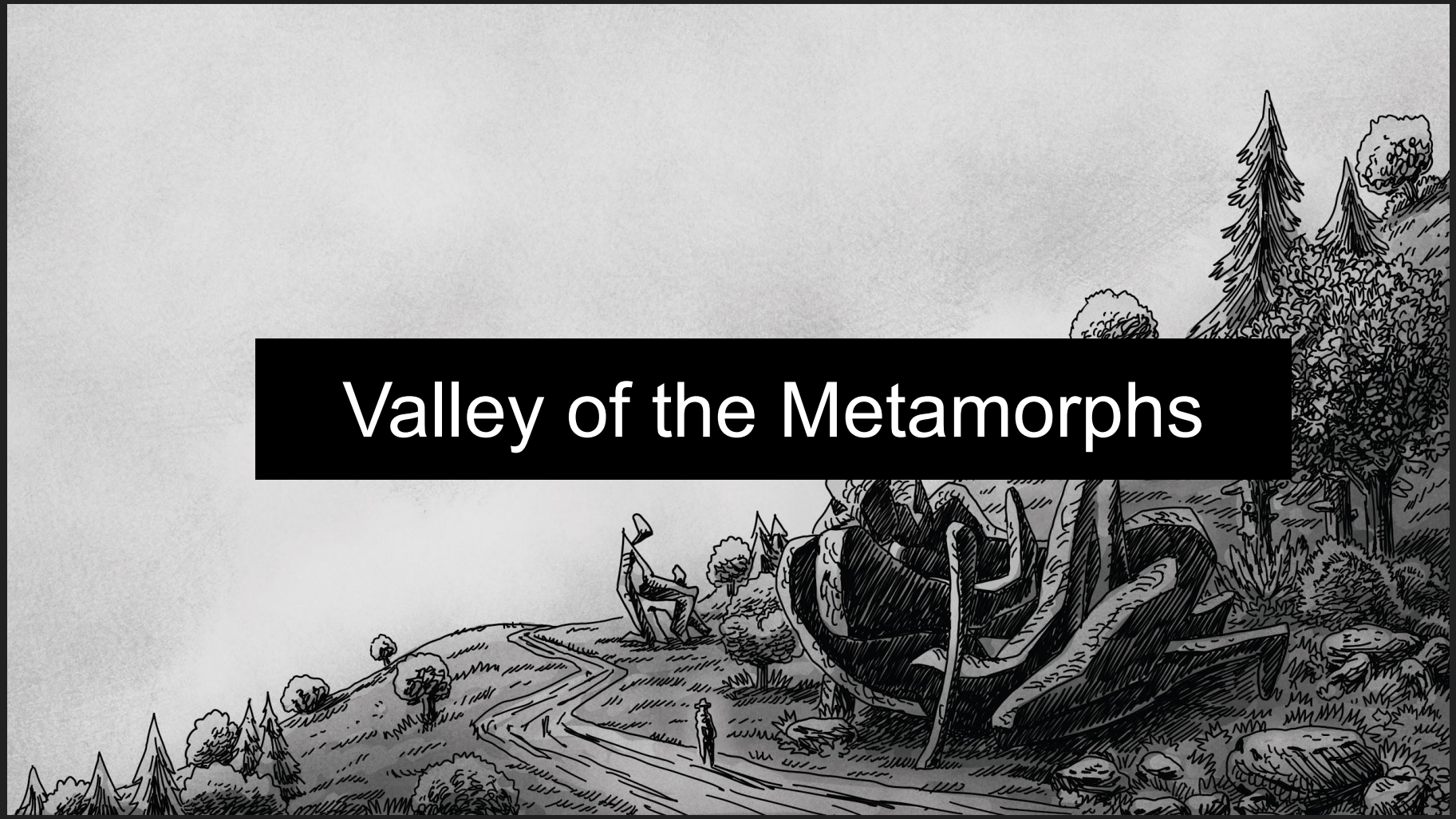


SYMBOL

If, after calibration, is still B, begin to read meter and speculate functionally (could be a leak)

Valley of the Metamorphs



Three Rules for Not Breaking Things...

1. You can't take things away
2. You can't change the meaning of things
3. All new things must be optional

You can't take things away...

```
*** REQUEST ***
GET /status HTTP/1.1
...

*** RESPONSE ***
200 OK
...
{
  "status" : "All OK"
}
```

```
*** REQUEST ***
GET /status HTTP/1.1
...

*** RESPONSE ***
400 Bad Request
```

```
*** REQUEST ***
GET /status HTTP/1.1
...

*** RESPONSE ***
HTTP/1.1. 301 Moved Permanently
Location: http://new-status

*** RESPONSE ***
HTTP/1.1 200 OK
...
{
  "status" : "All OK"
}
```

You can't change the meaning of things...

```
*** REQUEST ***
GET /status HTTP/1.1
...

*** RESPONSE ***
200 OK
...
{
  "machinesActive" : "42"
}
```

```
*** REQUEST ***
GET /status HTTP/1.1
...

*** RESPONSE ***
200 OK
...
{
  "status" : "All OK",
  "machinesActive" : "42"
}
```

All new things MUST be optional...

```
*** REQUEST ***
GET /status?machines HTTP/1.1
...

*** RESPONSE ***
200 OK
...
{
  "machinesActive" : "42"
}
```

```
*** REQUEST ***
GET /status HTTP/1.1
...

*** RESPONSE ***
400 Bad Request
```

```
*** REQUEST ***
GET /status HTTP/1.1
...

*** RESPONSE ***
200 OK
...
{
  "status" : "All OK",
  "machinesActive" : "42"
}
```

SOFTWARE ARCHITECTURE

What is
the best practice for
versioning
a REST API?

ε | VOLVE '13

10

Roy Fielding, 2013

REST

What is
the best practice for
versioning
a REST API?

DON'T

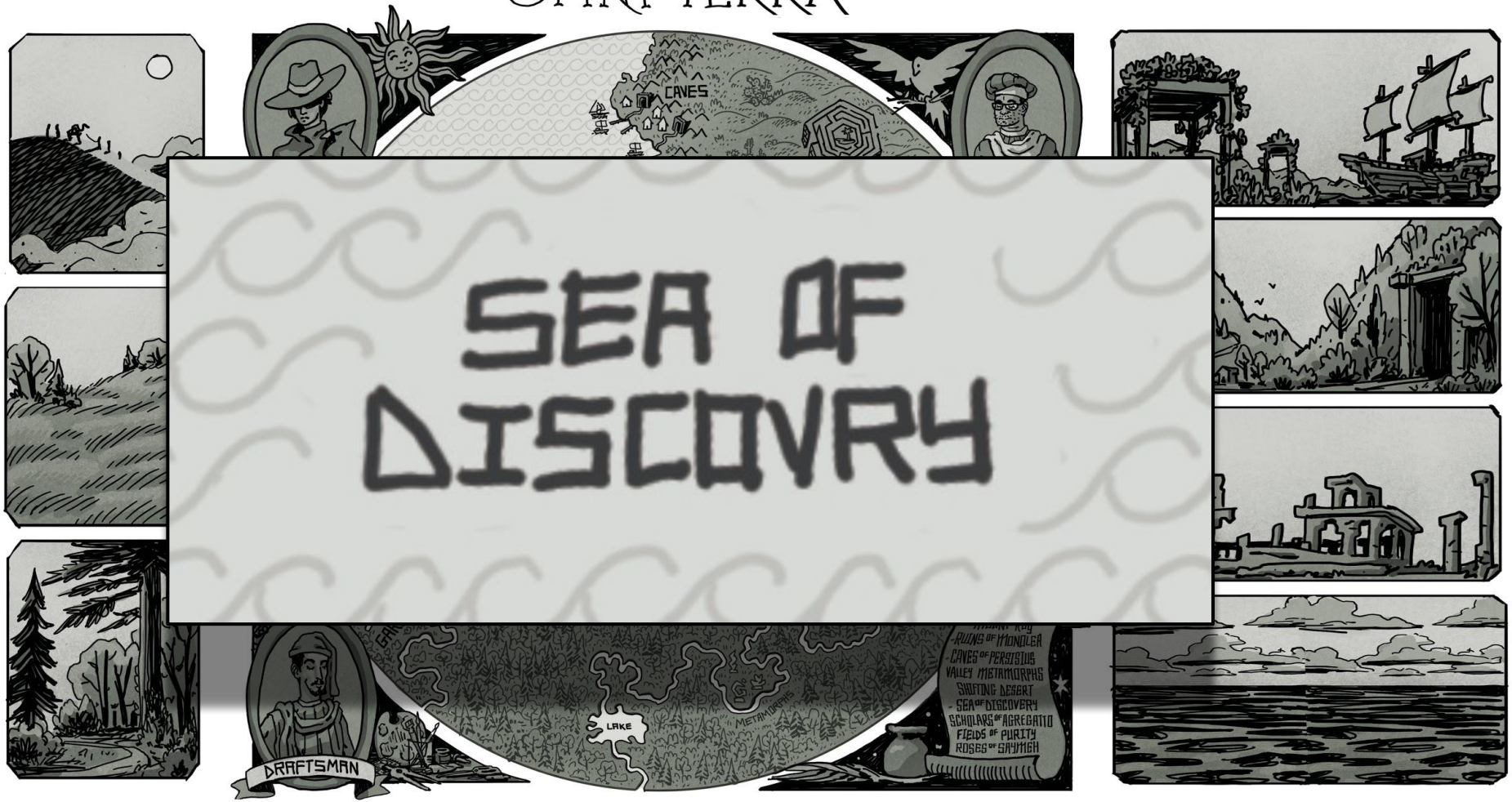
Versioning an interface
is just a "polite" way
to kill deployed applications

ε | VOLVE '13

22

Roy Fielding, 2013

OMNI TERRA



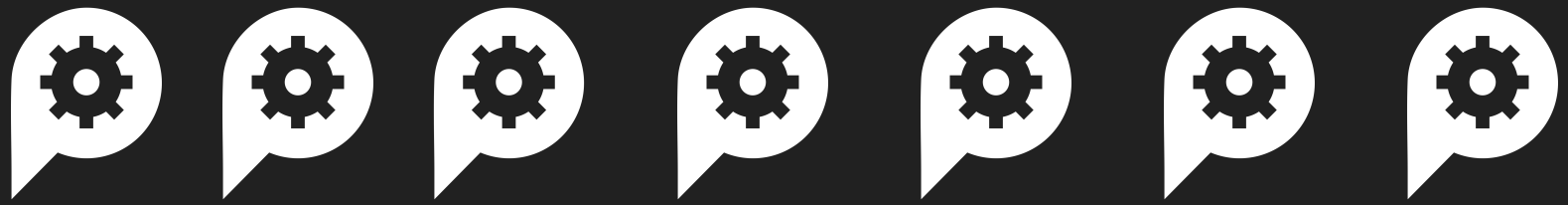
SEA OF DISCOVRY

Service Discovery

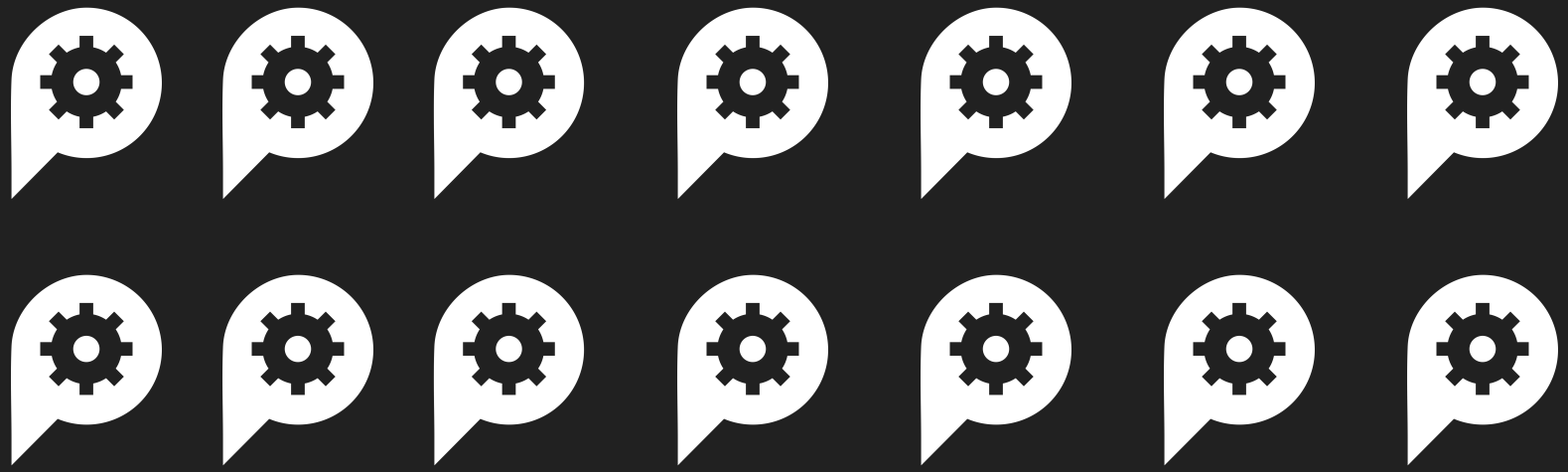
"How do you get communication started among totally uncorrelated 'sapient' beings?"

-- J. C. R. Licklider, 1963

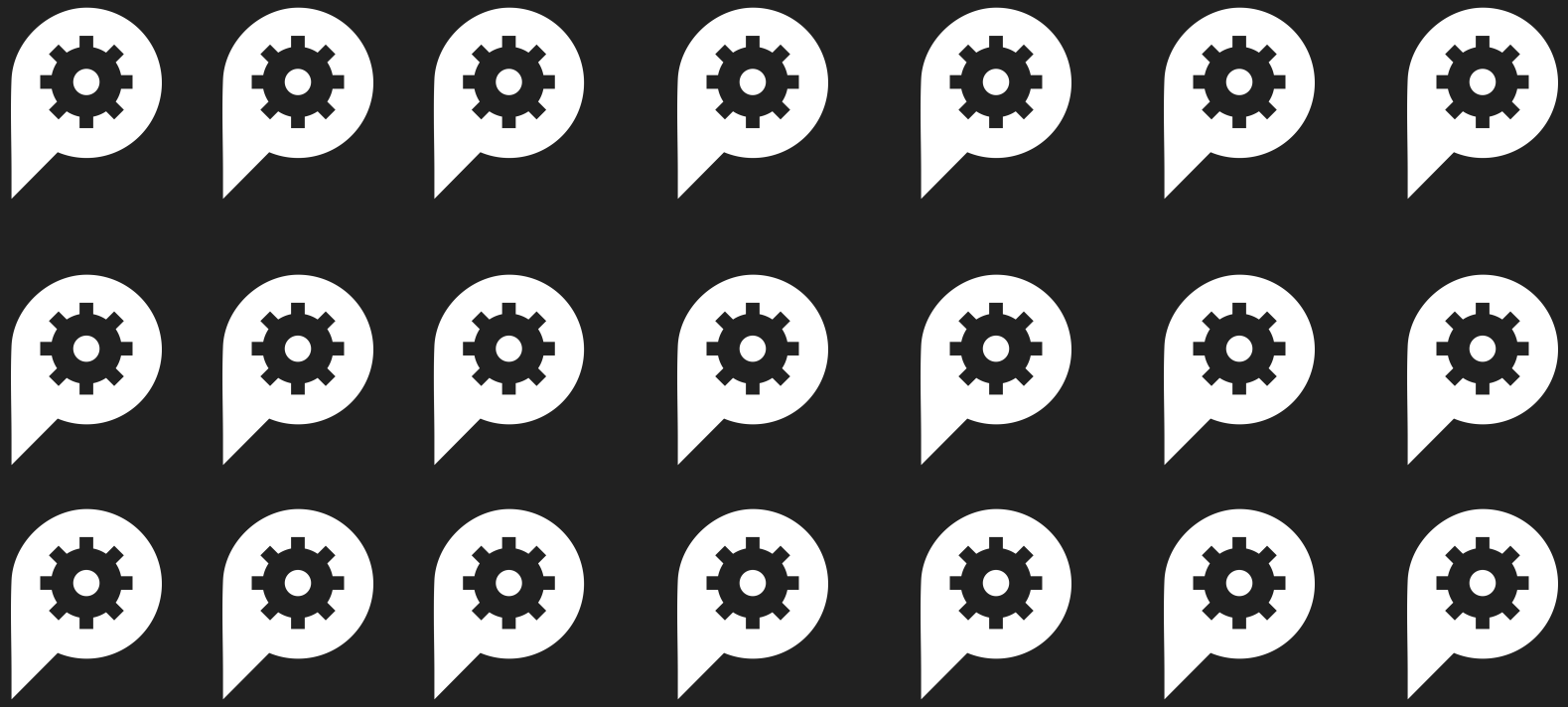
Service Discovery



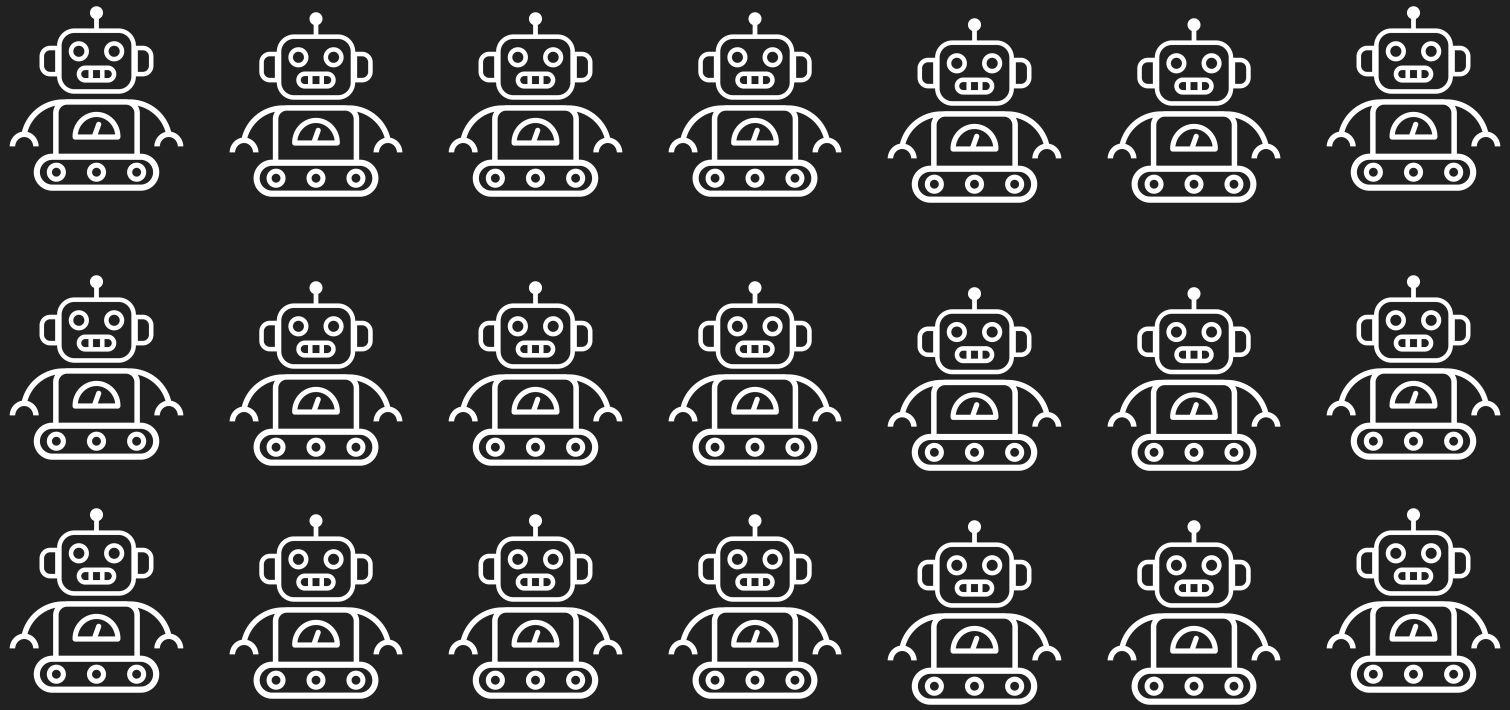
Service Discovery



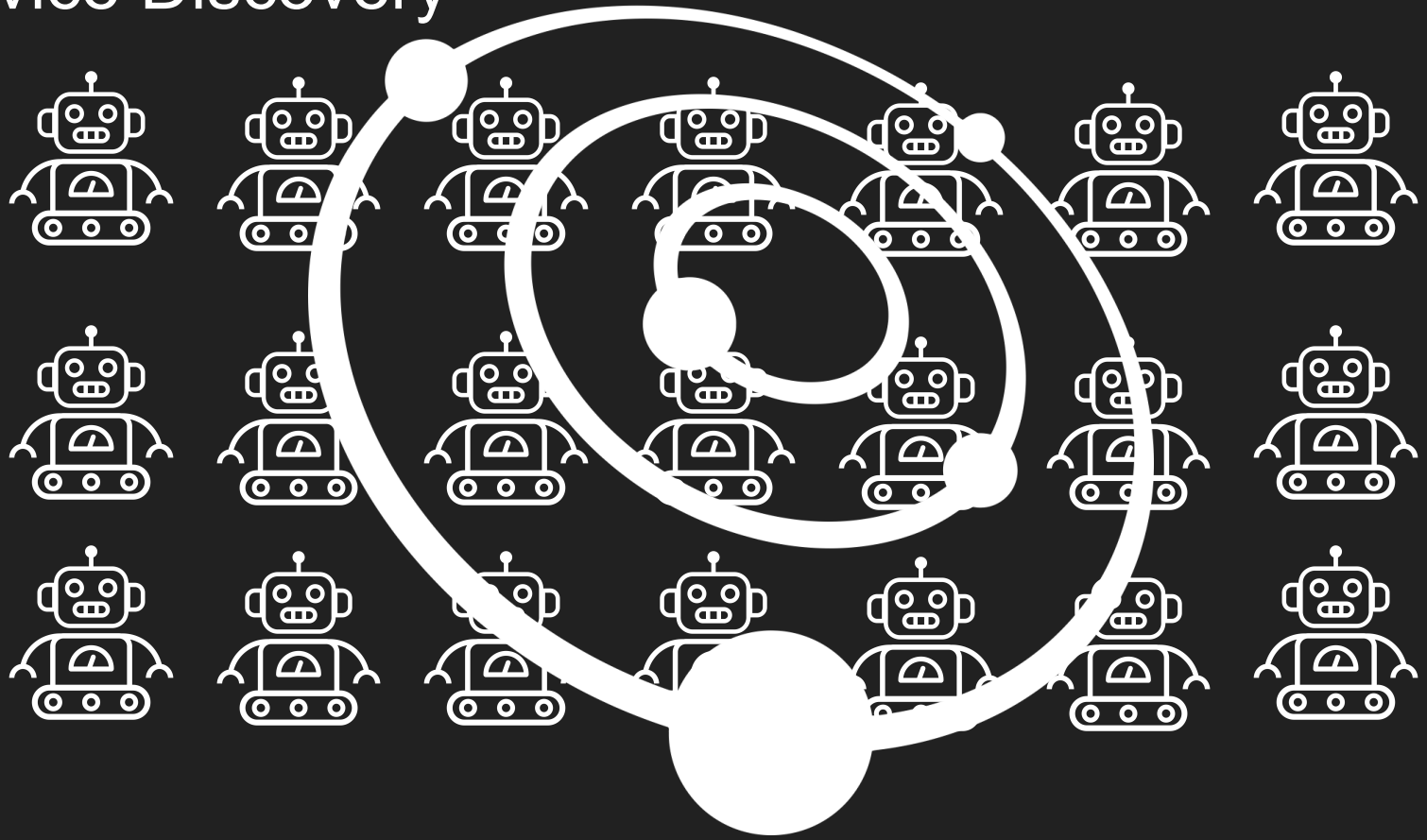
Service Discovery



Service Discovery



Service Discovery



Licklider Memo (1963)

ADVANCED RESEARCH PROJECTS AGENCY

Washington 25, D.C. April 23, 1963

MEMORANDUM FOR: Members and Affiliates of the Intergalactic Computer Network

FROM: J. C. R. Licklider

SUBJECT: Topics for Discussion at the Forthcoming Meeting

First, I apologize humbly for having to postpone the meeting scheduled for 3 May 1963 in Palo Alto. The ARPA Command & Control Research office has just been assigned a new task that must be activated immediately, and I must devote the whole of the coming week to it. The priority is externally enforced. I am extremely sorry to inconvenience those of you who have made plans for May 3rd. Inasmuch as I shall be in Cambridge the rest of this week, I am asking my colleagues here to re-schedule the meeting, with May 10th, Palo Alto, as target time and place.

The need for the meeting and the purpose of the meeting are things that I feel intuitively, not things that I perceive in clear structure. I am afraid that that fact will be too evident in the following paragraphs. Nevertheless, I shall try to set forth some background material and some thoughts about possible interactions among the various activities in the overall enterprise for which, as you may have detected in the above subject, I am at a loss for a name.

In the first place, it is evident that we have among us a collection of individual (personal and/or organizational) aspirations, efforts, activities, and projects. These have in common, I think, the characteristics that they are in some way connected with advancement of the art or technology of information processing, the advancement of intellectual capability (man, man-machine, or machine), and the approach to a theory of science. The individual parts are, at least to some extent, mutually interdependent. To make progress, each of the active research needs a software base and a hardware facility more complex and more extensive than he, himself, can create in reasonable time.

In pursuing the individual objectives, various members of the group will be preparing executive the monitoring

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In pursuing the individual objectives, various members of the group will be preparing executive the monitoring

Licklider Protocol (2008)

Networking Working Group — M. Ramadas
Request for Comments: 5326 — ISTRAC, ISRO
Category: Experimental — S. Burleigh
NASA/Jet Propulsion Laboratory
S. Farrell
Trinity College Dublin
September 2008

Licklider Transmission Protocol - Specification

Status of This Memo

This memo defines an Experimental Protocol for the Internet community. It does not specify an Internet standard of any kind. Discussion and suggestions for improvement are requested. Distribution of this memo is unlimited.

IESG Note

This RFC is not a candidate for any level of Internet Standard. It represents the consensus of the Delay Tolerant Networking (DTN) Research Group of the Internet Research Task Force (IRTF). It may be considered for standardization by the IETF in the future, but the IETF disclaims any knowledge of the fitness of this RFC for any purpose and in particular notes that the decision to publish is not based on IETF review for such things as security, congestion control, or inappropriate interaction with deployed protocols. See RFC 3932 for more information.

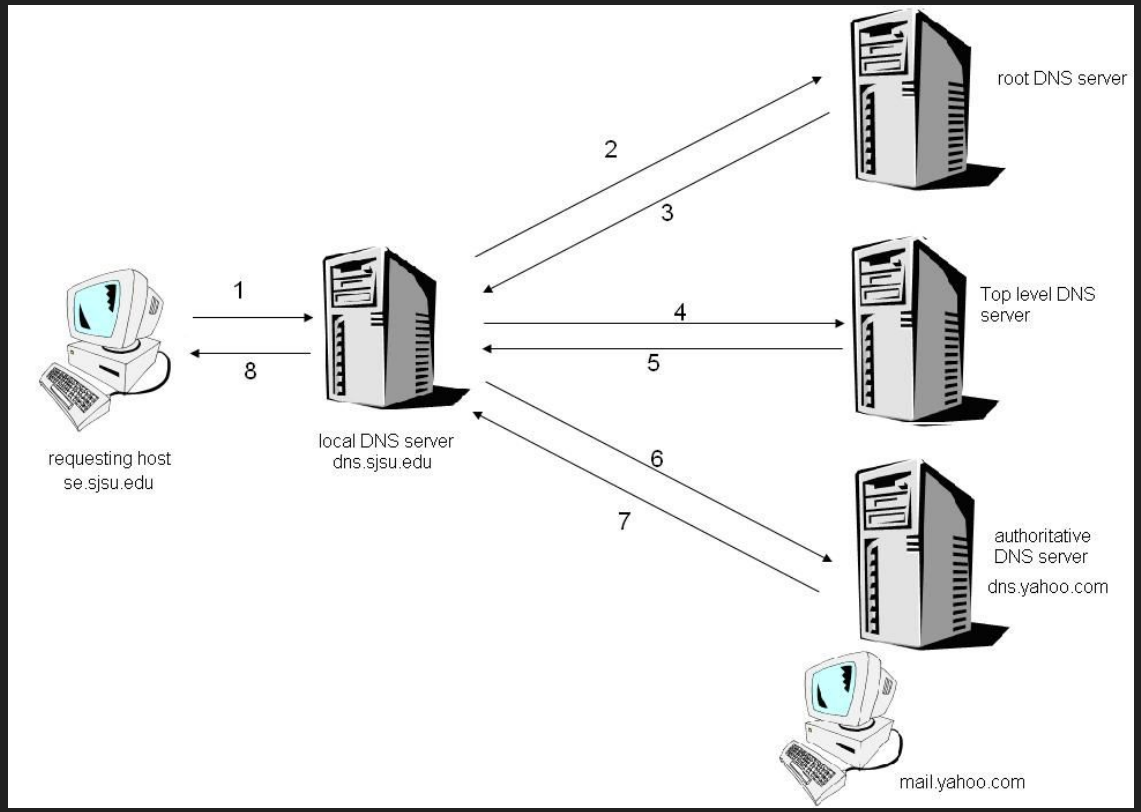
Abstract

This document describes the Licklider Transmission Protocol (LTP), designed to provide retransmission-based reliability over links characterized by extremely long message round-trip times (RTTs) and/or frequent interruptions in connectivity. Since communication across interplanetary space is the most prominent example of this sort of environment, LTP is principally aimed at supporting "long-haul" reliable transmission in interplanetary space, but it has applications in other environments as well.

This document is a product of the Delay Tolerant Networking Research Group and has been reviewed by that group. No objections to its publication as an RFC were raised.

Ramadas, et al. — Experimental — [Page 1]

DNS for discovering machines



But we need to discover ***services...***

Discovering Interoperative Services… (DISCO)

Discovering Interoperative Services for Continuous Operation (DISCO)

Mike Amundsen
<mca@mamund.com>

Table of Contents

Status

Status
Working Draft — *Only experimental and 'proof-of-concept' apps should be built on this unstable draft.*

Repository
https://github.com/rwmbook/registry-docs

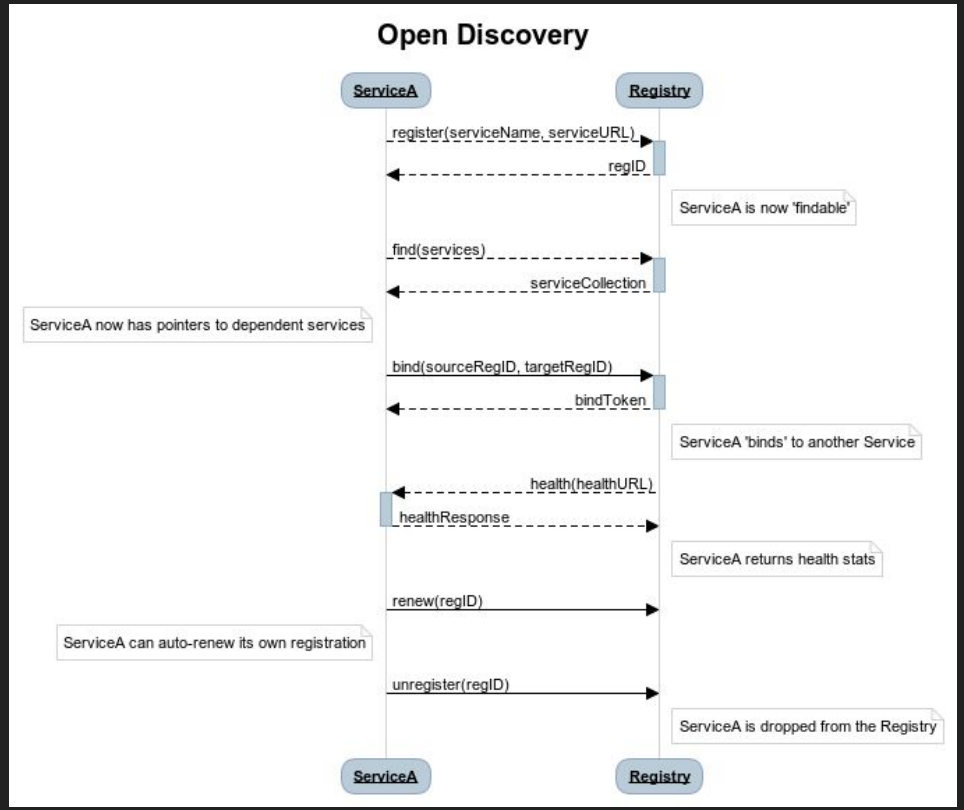
Last Updated
2018-03-10

Summary

This document details an *adhoc specification* called **DISCO** (**D**iscovering **I**nteroperative **S**ervices for **C**ontinuous **O**peration). DISCO is a simple language for managing the adding/removing of services as well as the ability to search ("find") and make connections with ("bind") registered services.

DISCO was designed to be easy, open, lightweight, and extensible. For this reason, readers/implementers may find things "missing" or "underspecified." This is intentional. Getting started is meant to be easy. And local customization is supported as needed. This allows the DISCO spec to safely grow and improve over time without breaking exsting implementations.

The DISCO "language" supports the following features:



open-disco.org

Discovering Interoperative Services… (DISCO)

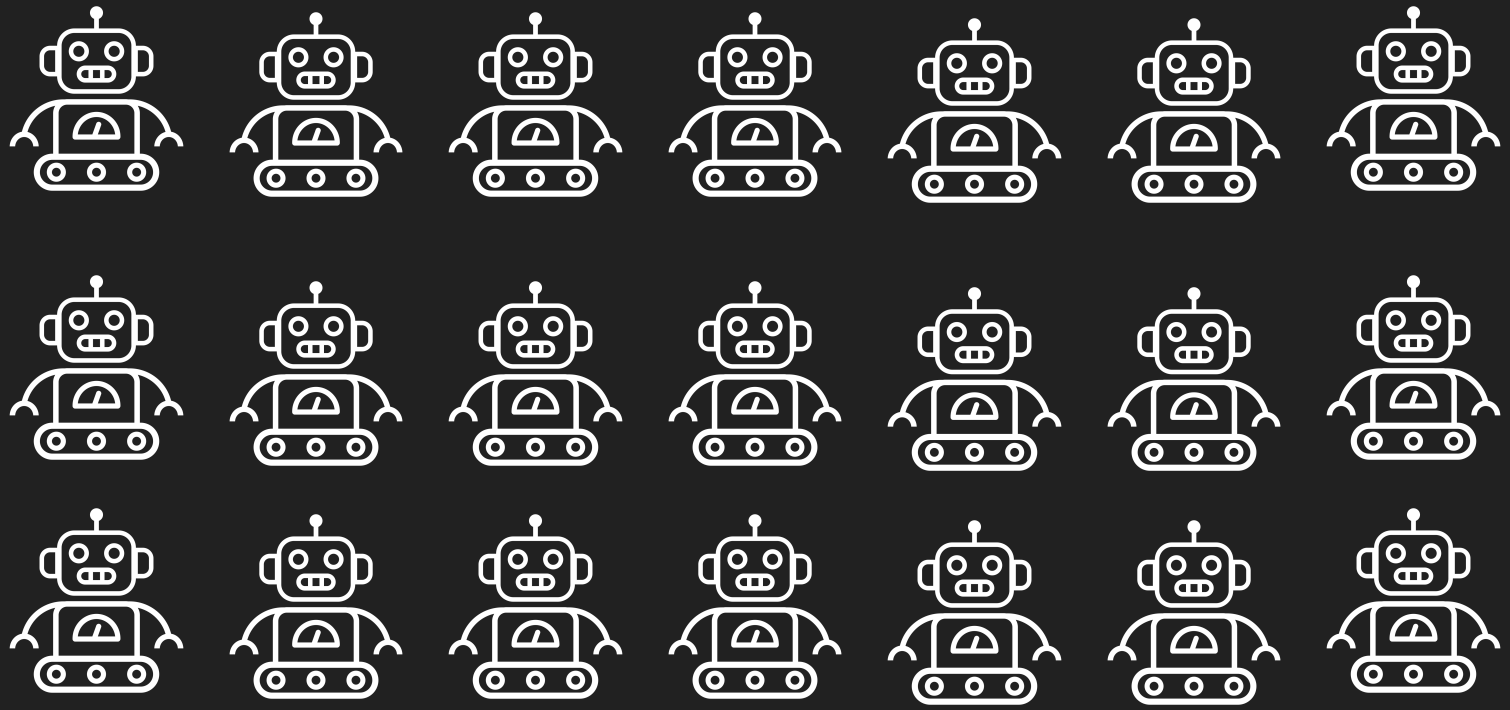
The DISCO "language" supports the following features:

- `register` : add a service to the shared registry
- `find` : query the registry for services (dependents) to consume
- `bind` : notify the registry the intention to connect with and use another service
- `renew` : renew a service's registry *lease* to prove is is still up and running
- `unregister` : remove a service from the registry

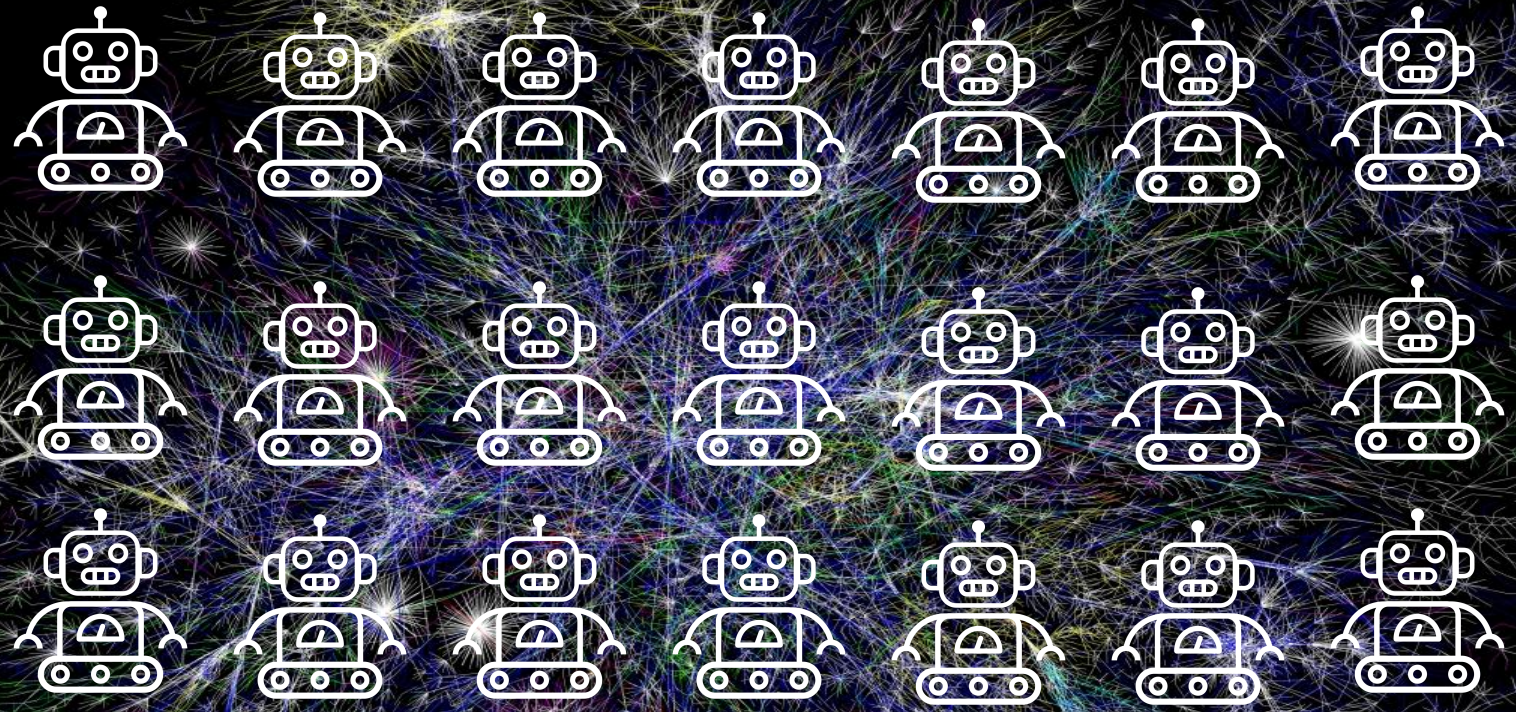
Discovering Inter-operative Services… (DISCO)

```
// register this service w/ defaults
discovery.register(null, function(response) {

  // sample service discovery action
  discovery.find(null, function(data, response) {

    // select endpoints from query
    if(data.success===true) {
      // launch http server
      http.createServer(zipServer).listen(8080);
      console.info('zip-server running on port 8080.');
    }
    else {
      console.error('unable to bind to dependent services');
      process.kill(process.pid, "SIGTERM");
    }
  });
});
```

Service Discovery

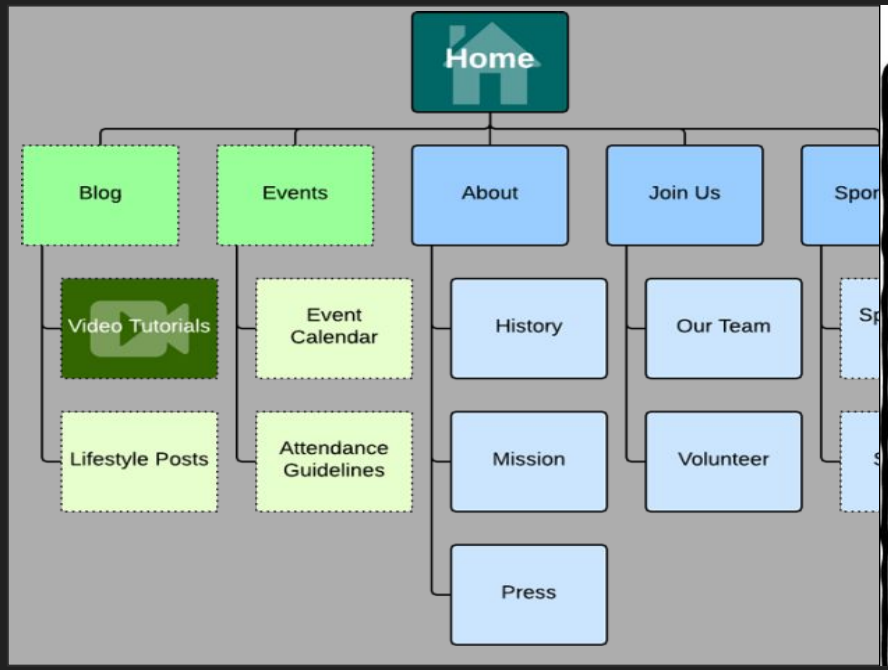


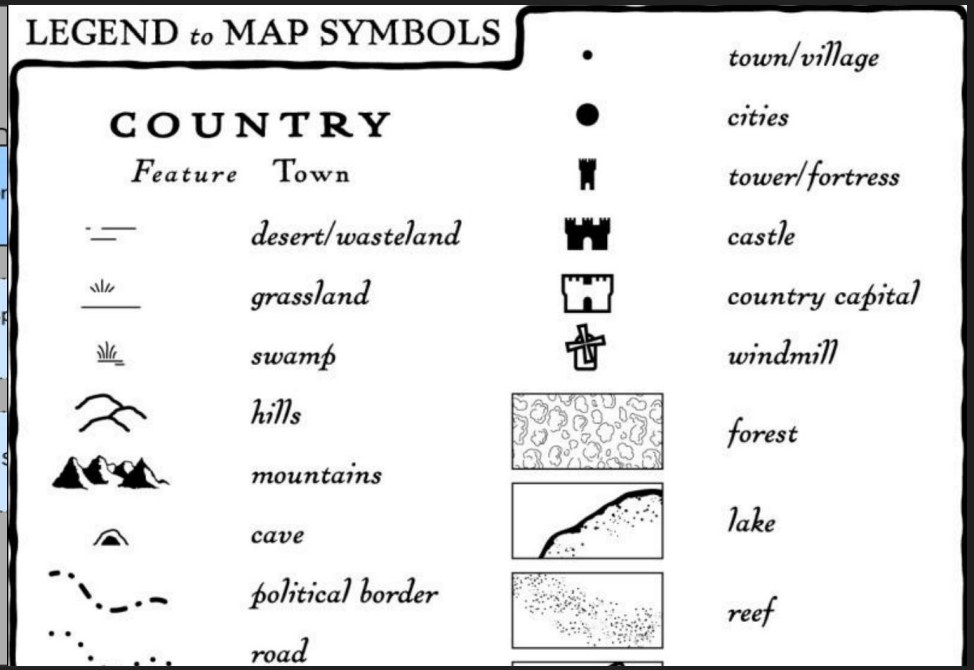
Service Discovery



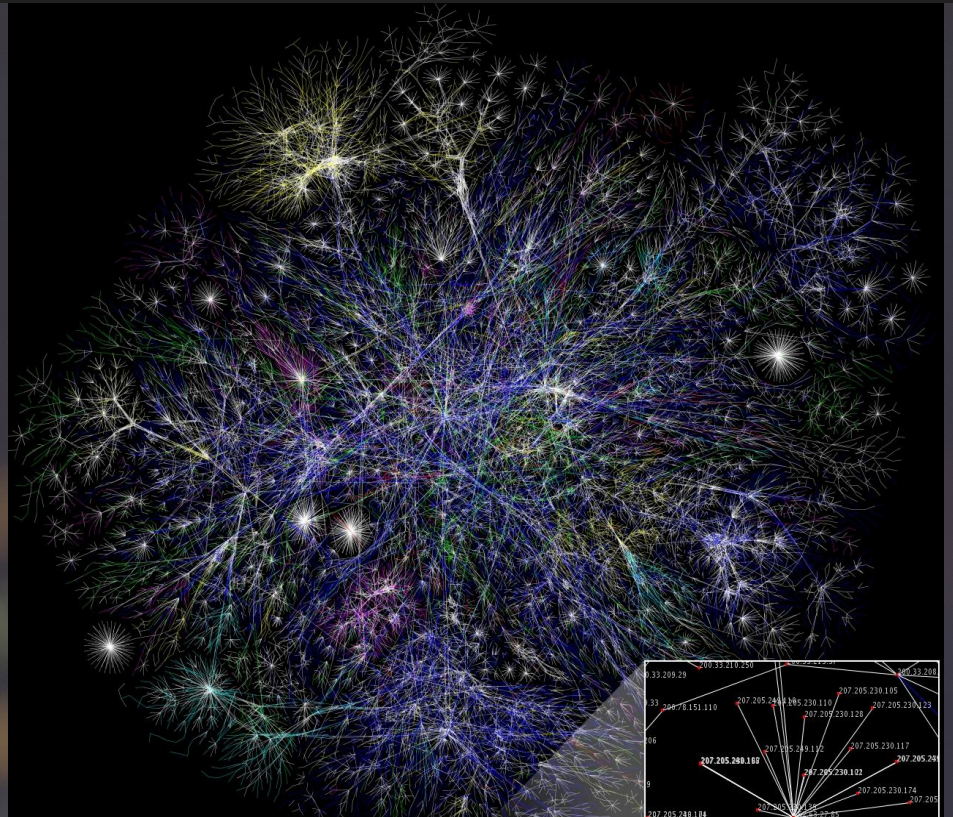
So...

We need better maps...





So that we can program the network...

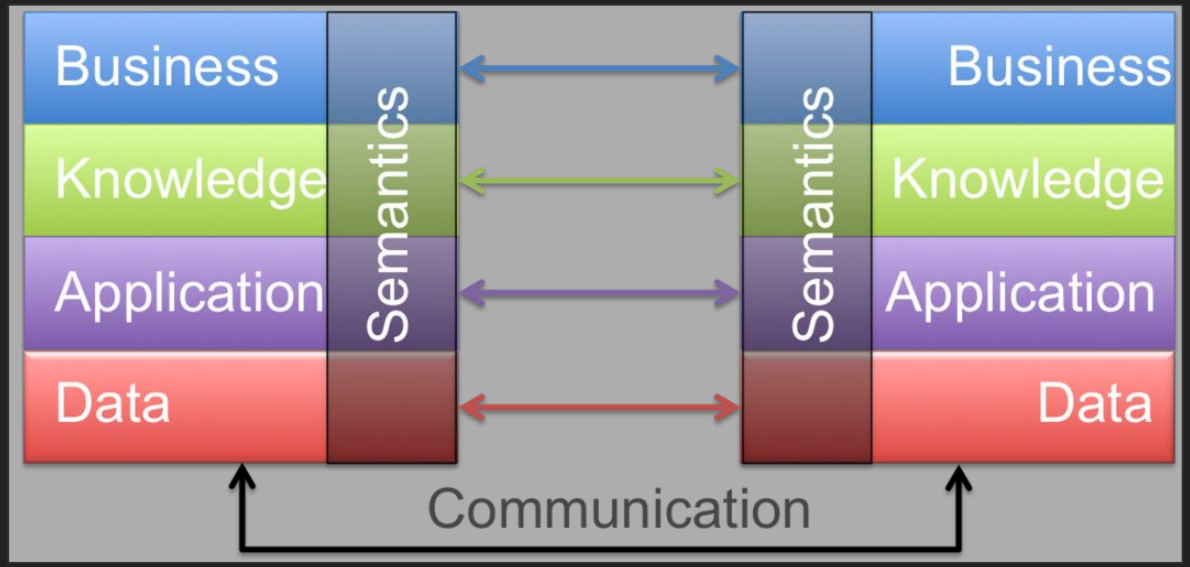


Which means applying patterns to our code..,

```
function writeOrders(request, response) {
  var resourceList = ["customerDB", "orderDB", "salesDB"]'

  setTimeOut(function(request,response, resourceList) {
    var serviceList = gatherResources(resourceList);
    if(serviceList.estimatedCost > request.timeBudget) {
      response = FailFast(request);
    }
    else {
      if(serviceList.healthy === true) {
        circuitBreaker(serviceList, request,
        {timeout:10,maxFail:3,reset:30});
      }
    }
  },request.timeBudget);

  return response;
}
```

1. Fail-Fast
2. Timeout
3. Circuit Breaker
4. Steady State
5. Handshaking
6. Bulkhead

And that means understanding the role of semantics...

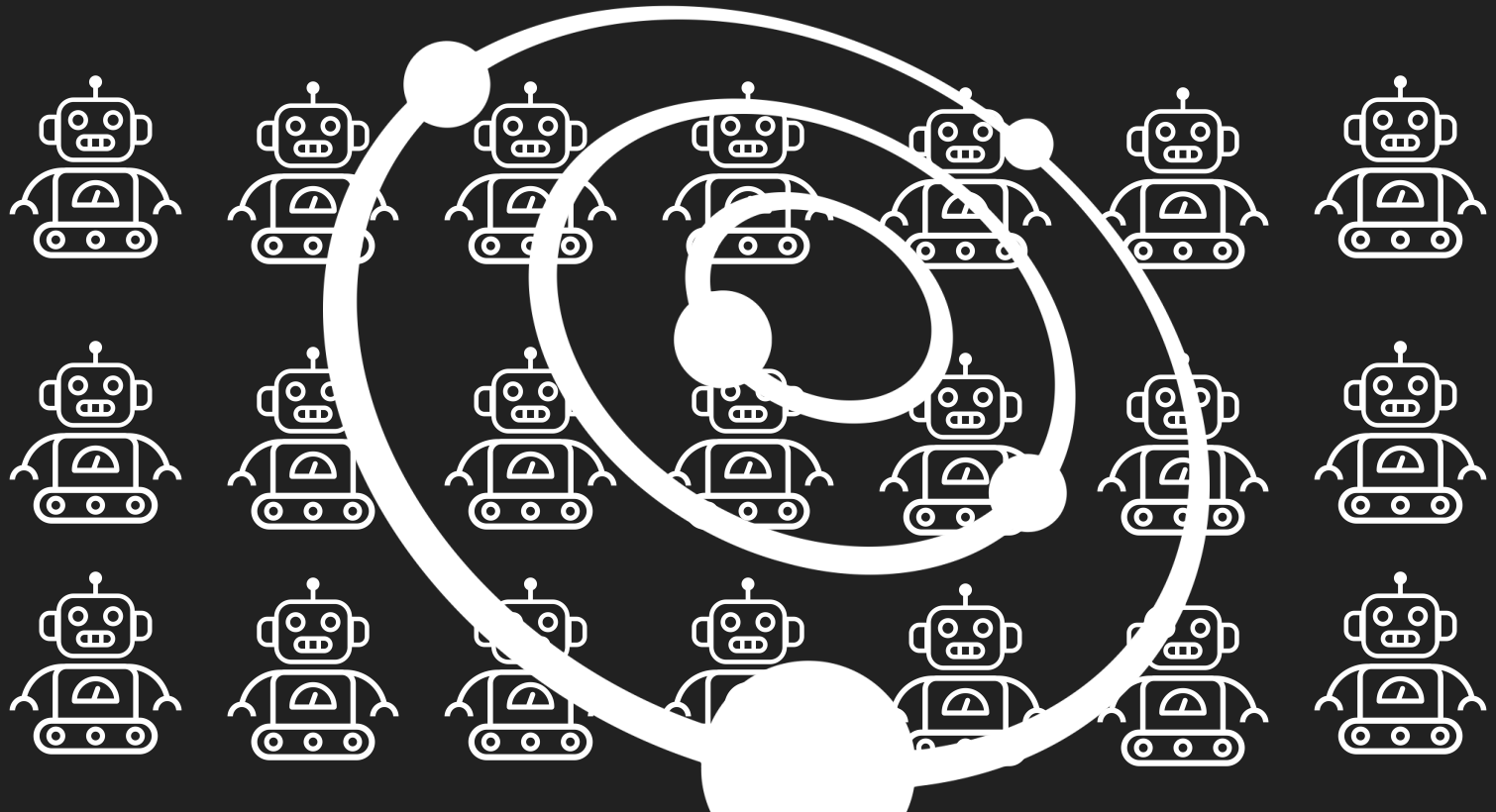


And the importance of change over time...

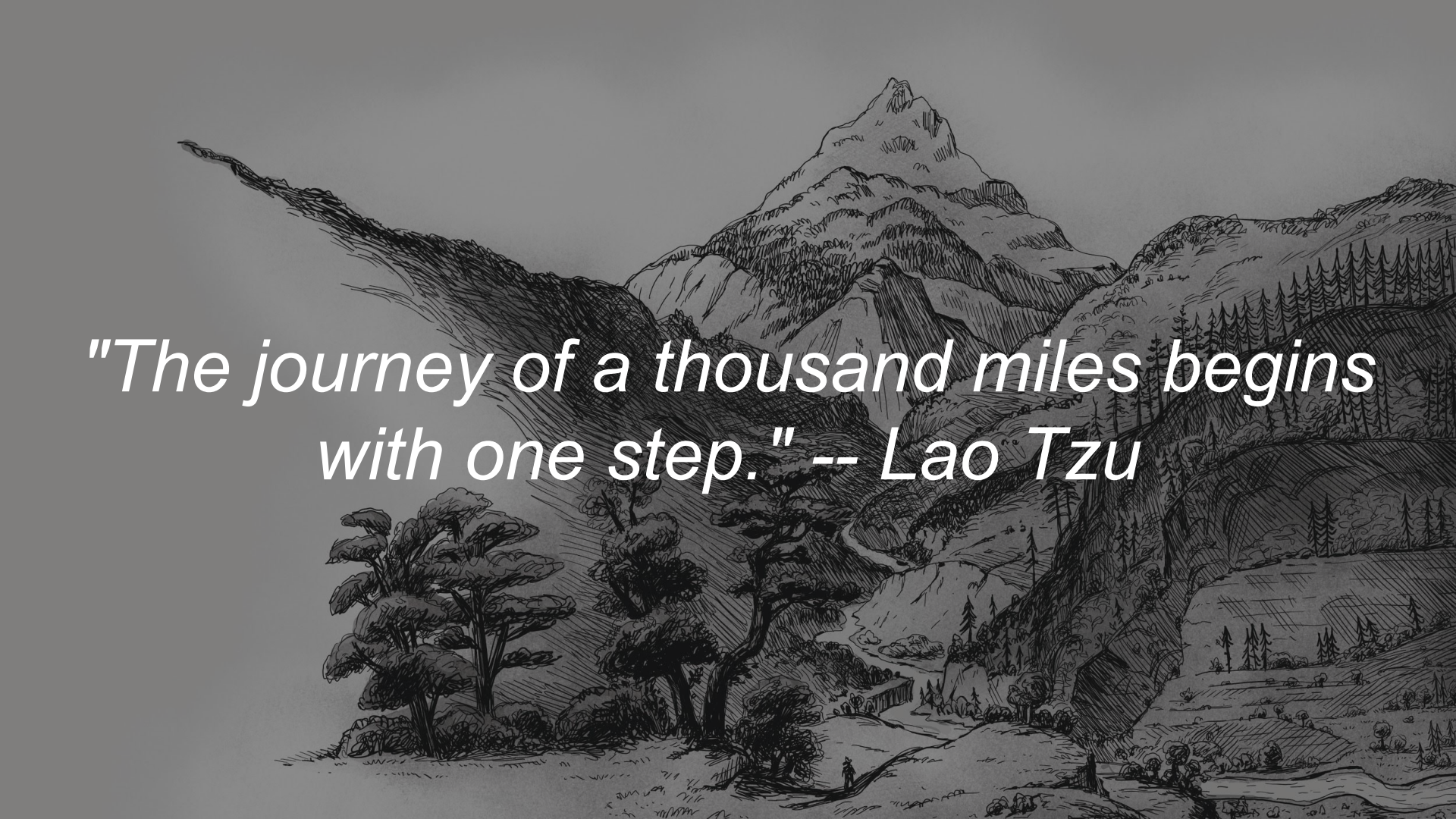
```
*** REQUEST ***
GET /status HTTP/1.1
...

*** RESPONSE ***
200 OK
...
{
  "machinesActive" : "42"
}
```

```
*** REQUEST ***
GET /status HTTP/1.1
...

*** RESPONSE ***
200 OK
...
{
  "status" : "All OK",
  "machinesActive" : "42"
}
```

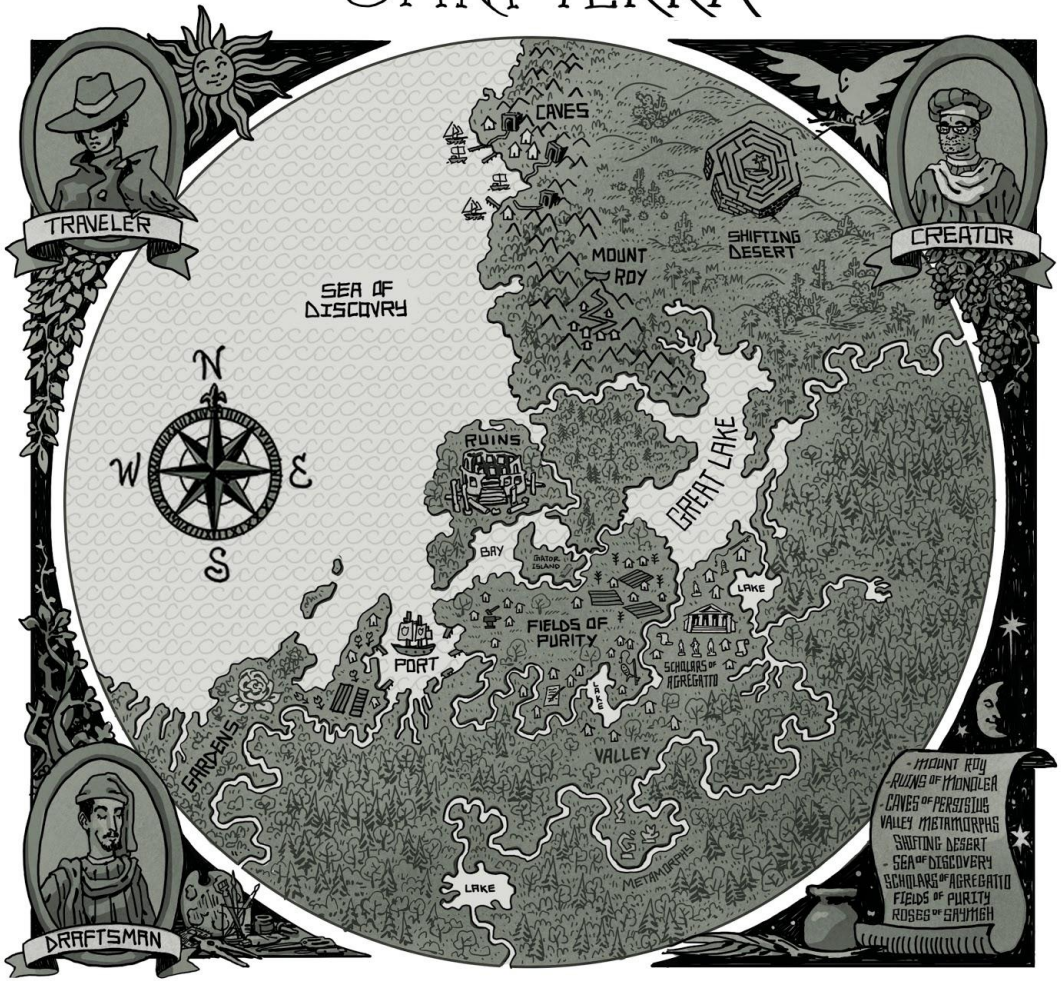
And the power of runtime service-level discovery...



That's a lot!


"The journey of a thousand miles begins with one step." -- Lao Tzu

OMNI TERRA


TRAVELER
CREATOR
DRAFTSMAN
CAVES
MOUNT ROY
SHIFTING DESERT
SEA OF DISCOVRY
N
W
E
S
RUINS
GREAT LAKE
BAY
GATOR ISLAND
LAKE
FIELDS OF PURITY
PORT
SCHOLARS OF AGREGATTO
LAKE
VALLEY
GARDENS
METAMORPHS
LAKE
- MOUNT ROY
- RUINS OF MONDLEA
- CAVES OF PERSISTOUS
VALLEY METAMORPHS
SHIFTING DESERT
- SEA OF DISCOVERY
SCHOLARS OF AGREGATTO
FIELDS OF PURITY
ROSES OF SAYMEH

Discovering RESTful Web Microservices

http://g.mamund.com/2019-04-goto-chicago

Mike Amundsen
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training.amundsen.com