Kafka, Camel, and other IBM i integration techniques

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IBM i

IBM

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Quick Exercise…

I'm going to show you **three slides**

They all have something in **common**…

See if you can **figure out what it is**!

2

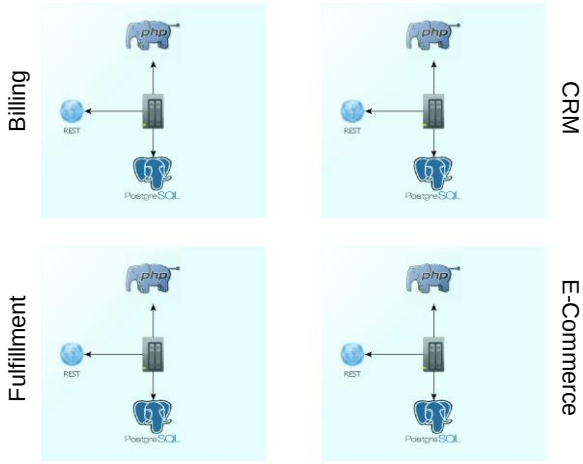
The Chupacabra

3

A Magical Unicorn…

4

A Fully Homogeneous Enterprise Landscape…



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- ✓ **None of these things exist in real life!**

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Agenda

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Apache Kafka

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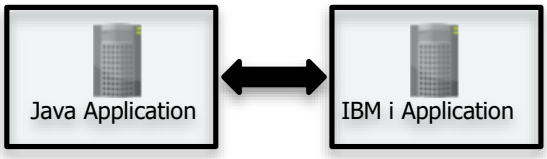
Traditional Enterprise Messaging

- Applications often have a need to send information back and forth to one another in a normalized fashion
- Before the advent of messaging systems, it was often difficult if not impossible to “federate” applications written in disparate languages or residing on heterogeneous platforms
- For instance, JMS, the Java Messaging Service, arose out of a growing need to federate very different systems with each other



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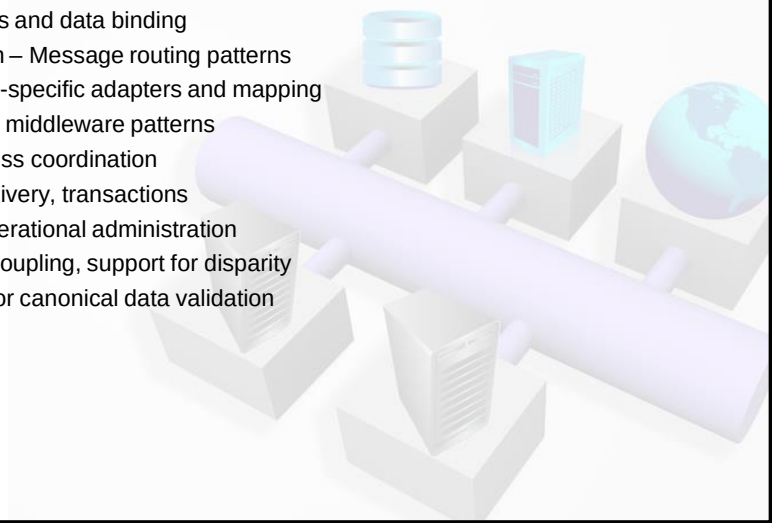
ESB Capabilities

- In general, an ESB should provide the following functionality:
  - Transport Invocation – protocols and data binding
  - Data routing and transformation – Message routing patterns
  - Platform mediation – Language-specific adapters and mapping
  - Messaging – Message oriented middleware patterns
  - Orchestration – Business process coordination
  - QoS – Security, guaranteed delivery, transactions
  - Administration – Monitoring, operational administration
  - Platform agnosticism – Loose coupling, support for disparity
  - Data validation – Schema and/or canonical data validation



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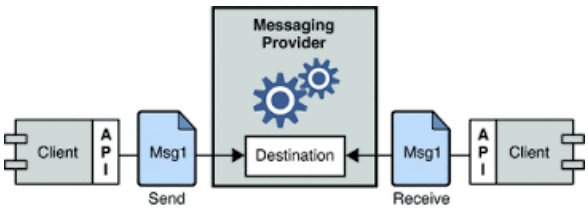
Message oriented middleware

- If you don't need a full ESB, you may still be making use of (and paying for) commercial messaging
- Technically, MOM is any platform that sends and receives messages between distributed applications
- Commercial versions include IBM MQ, Amazon SQS, and Oracle AQ, many others
- This pattern allows for asynchronous processing, and normalization of data exchanges
- Clients connect to a messaging provider, and send and receive messages via that provider



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Meet: Some Really Good, "Free" Solutions!

- Apache ActiveMQ is a JMS implementation, and can help with both federation of systems and asynchronous processing
- Apache Camel is a sophisticated message oriented middleware language, with hundreds of integration components
- Apache Kafka is a high-throughput streaming event engine suitable for very large datasets
- So…

Apache ACTIVEMQ

APACHE Camel

kafka

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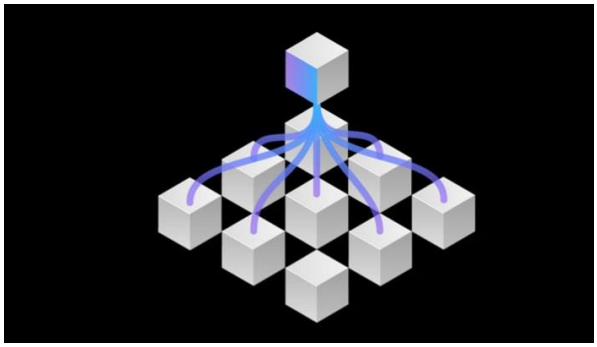
Hybrid Multicloud

- What needs drove Zookeeper, ActiveMQ, Kafka?
  - Data federation
  - Edge computing
  - Distributed computing
  - Large data workloads



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Hybrid cloud is the new normal

98%

of organizations will use multiple hybrid cloud environments by 2021

Source: IBM Institute of Business Value A field guide to multicloud management

Movement between clouds	73%	priority concern
Connectivity between clouds	82%	priority concern
Consistency of management	67%	priority concern

Sources: IDC Cloud Forecast; BCG & McKinsey

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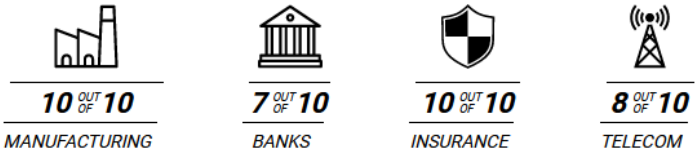
Industry interest in Kafka



10/10 Largest insurance companies
10/10 Largest manufacturing companies
10/10 Largest information technology and services companies
8/10 Largest telecommunications companies
8/10 Largest transportation companies
7/10 Largest retail companies
7/10 Largest banks and finance companies
6/10 Largest energy and utilities organizations

Analysis of key industries using Kafka. (Source: https://kafka.apache.org)

Analysis is based on the 10 largest companies in each sector.

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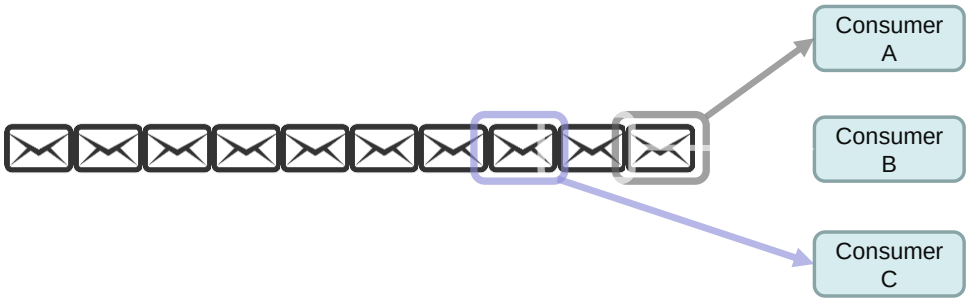
Streaming vs. Traditional Message Queuing

- Primarily, the difference comes down to how messages are processed by receiving systems
- In traditional message queueing (not topics), a single message is processed at a time, even if that payload contains a lot of data:



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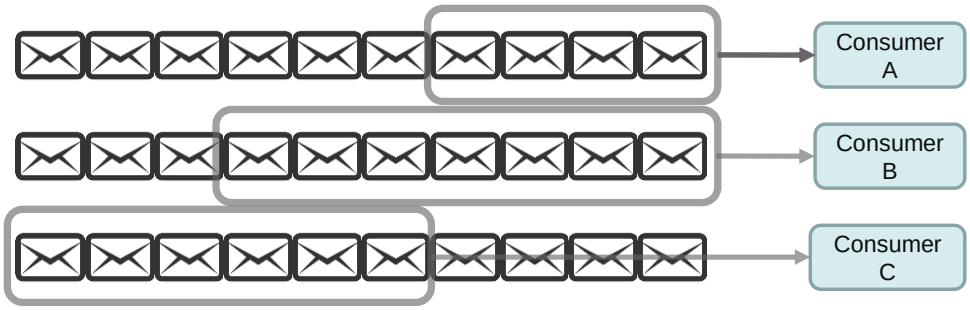
Streaming or Stream Processing

- Streaming differs in that chunks of data, or series of messages tend to be processed or at least referenced at a time
- Historical data is usually an option as well, and consumers can time slice the data they want to receive



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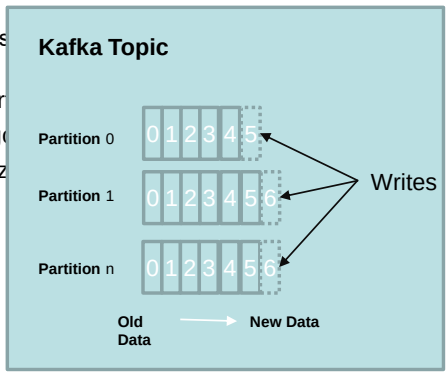
Partitions

- Kafka stores streamed data in Partitions, which are on-disk logical groupings of writes from Producing applications
- Notice that “new” writes are written to the end of these partitions and other traditional FIFO messaging solutions
- Consuming applications will be able to subscribe to a single par
- This allows for excellent redundancy in retaining the data and g
- It also provides a straightforward mechanism for achieving horiz



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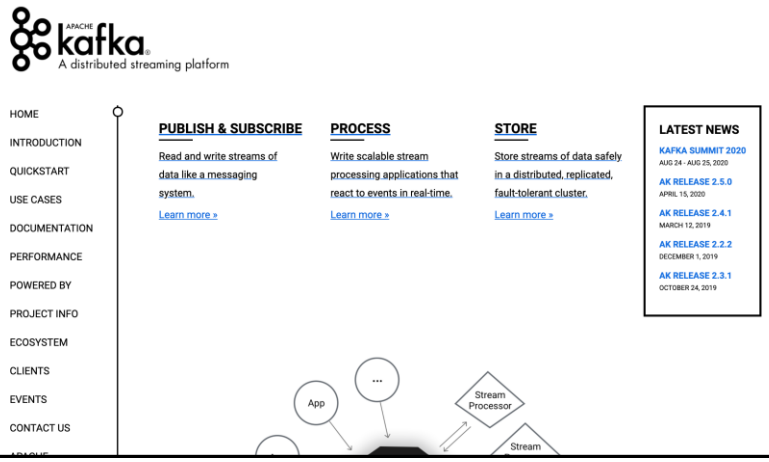
Obtaining Kafka

- Kafka is maintained and distributed from its top-level community home, https://kafka.apache.org:



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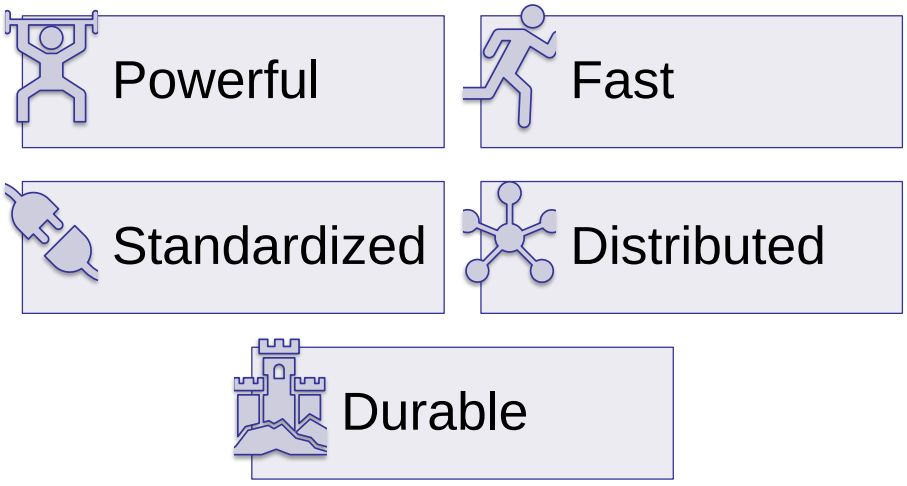
OK, but why is Kafka such a big deal?



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Use cases

- Artificial intelligence
- Infrastructure monitoring
- Transaction monitoring
- Real-time reporting
- Microservices
- Fraud/anomaly detection
- Heterogeneous applications

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OK, but how do I stream/consume data?

- https://ibmi-oss-docs.readthedocs.io/en/latest/kafka/README.html
- Db2 Triggers and Apache Camel: stream events in real-time
- Kafka Connect JDBC Source connector: Simple, polling-based technique
- InfoSphere Data Replication and the CDC Replication Engine for Kafka
- Native ILE Kafka client (unsupported): call Kafka functions directly from ILE programs.
- Confluent Platform
  - ksqlDB, which provides an SQL interface
  - Kafka REST APIs, which provide a REST interface

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Apache Camel

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What is Apache Camel

- A Java-based integration framework
- As Jesse says, "it can be used to connect anything to anything"
- Information about Camel with IBM i:
  - https://ibmi-oss-docs.readthedocs.io/en/latest/camel/README.html

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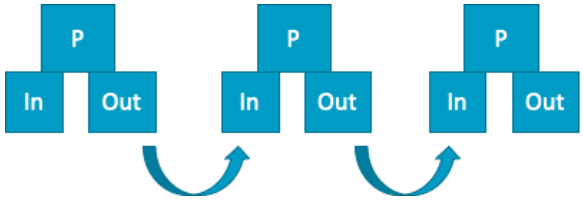
How Does It Work?

- Exchanges can be chained together – like piping commands through *NIX – to form a Camel Route
- The "Out" message of a previous Exchange becomes the "in" message of a new Exchange
- This defines the route



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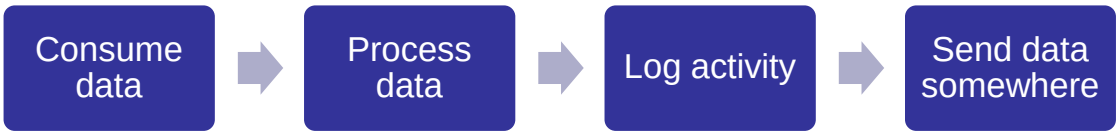

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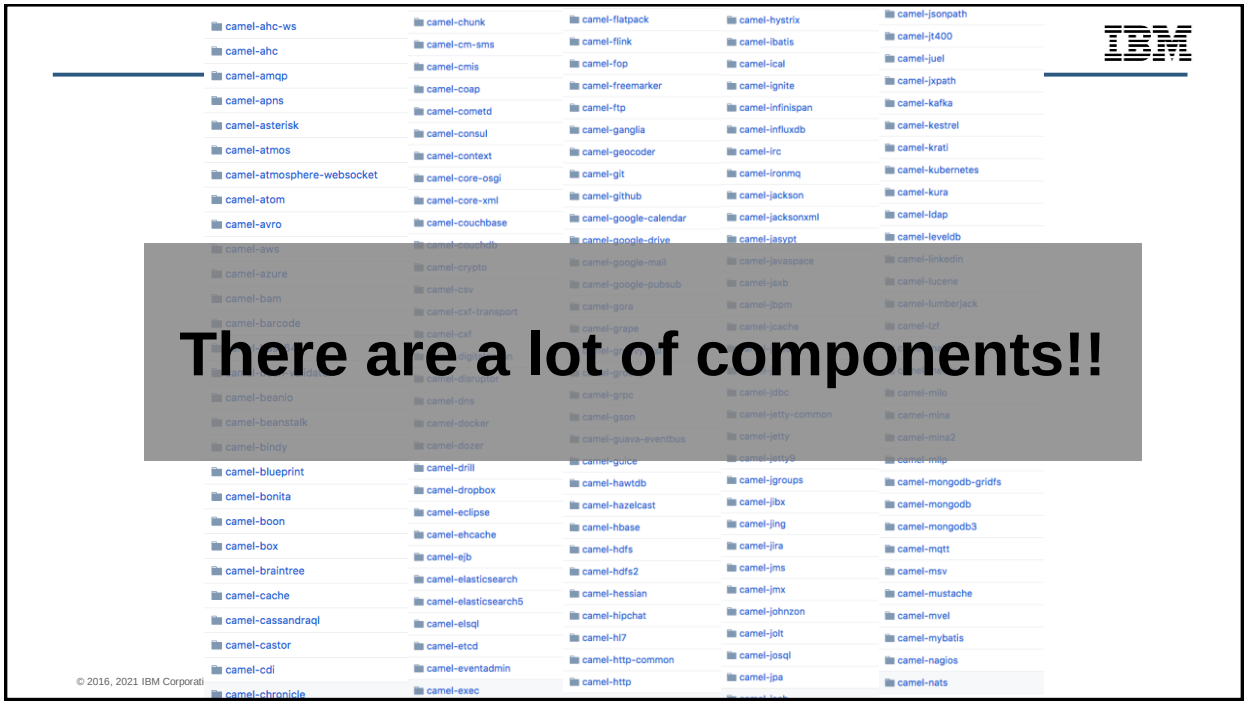

There are a lot of components!!

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Synergy with the Operating System via Apache Camel

To send or receive data from a data queue

```
jt400://user:password@system/QSYS.LIB/LIBRARY.LIB/QUEUE.DTAQ[?options]
```

To send or receive messages from a message queue New!

```
jt400://user:password@system/QSYS.LIB/LIBRARY.LIB/QUEUE.MSGQ[?options]
```

To call remote program

```
jt400://user:password@system/QSYS.LIB/LIBRARY.LIB/program.PGM[?options]
```

You can append query options to the URI in the following format, `?option=value&option=value&…`

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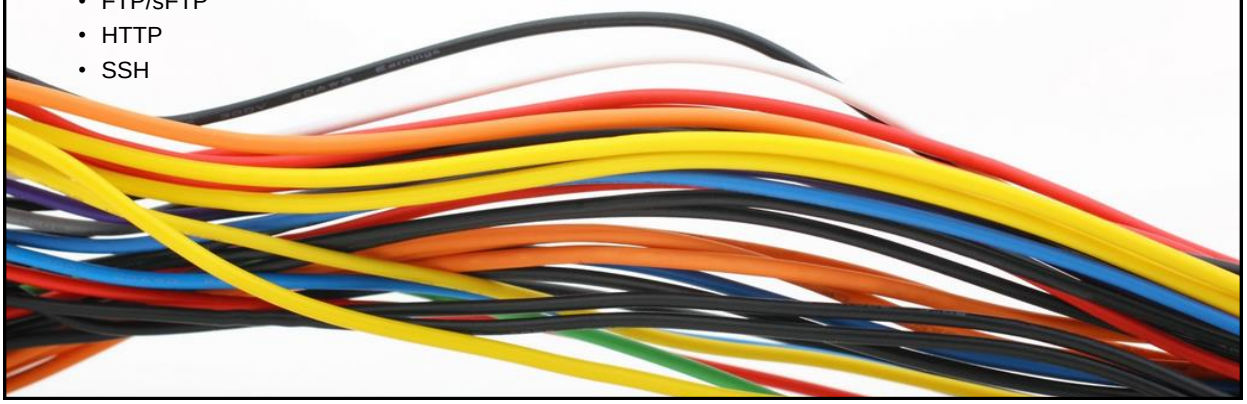
Many other components for interacting with IBM i, for instance…..

- JDBC/SQL
- Paho (mqtt/IoT)
- Exec (execute a command)
- File
- FTP/sFTP
- HTTP
- SSH



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Db2 Enhancements for Apache Camel

- JSON Publishing Functions provide data in a manner understood by Kafka/ActiveMQ consumers

```
SELECT JSON_OBJECT(
     KEY 'Department' VALUE
     JSON_ARRAYAGG(JSON_OBJECT(
               KEY 'Id' VALUE X.DEPTNO,
               KEY 'Name' VALUE X.DEPTNAME)))
               AS DEPT_JSON
  FROM TOYSTORE.DEPT X;
```

- Data Queue Functions allow integration with queues (and therefore Apache Camel) directly from the database

```
call qsys2.send_data_queue_utf8(
    message_data       => scottf.dq_json,
    data_queue         => 'HANDOFF_DQ',
    data_queue_library => 'BANKONOSS');
```


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Camel Source

- Camel routes can be coded in Java DSL

```
from("activemq:foo").filter().
  xquery("//foo").
  to("activemq:bar")
```

- Or by using Camel Spring DSL XML files

```
<route xmlns="http://camel.apache.org/schema/spring"
id="TimerClient">
        <from uri="activemq:topic:broadcastData"/>
        <setBody>
            <constant>This is a test JMS message.</constant>
        </setBody>
        <to uri="activemq:Test_ActiveMQ_Route.inQueue"/>
</route>
```


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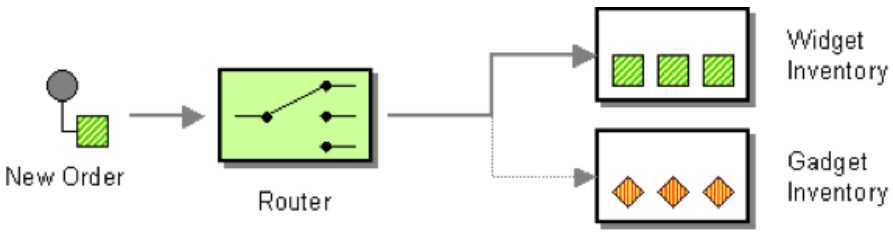
Integration Patterns – Content Based Router

- Message routing based on message criteria



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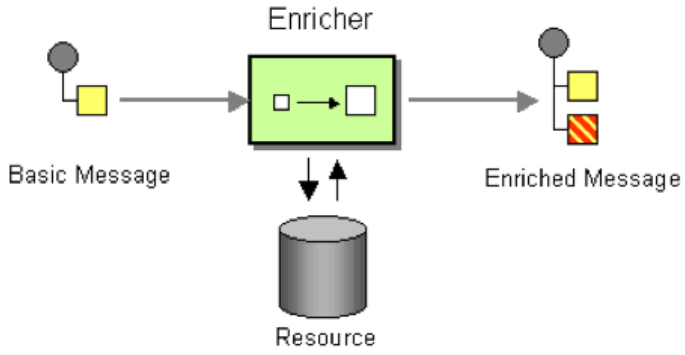
Integration Patterns – Content Enricher

- Pattern adds data to message from another source



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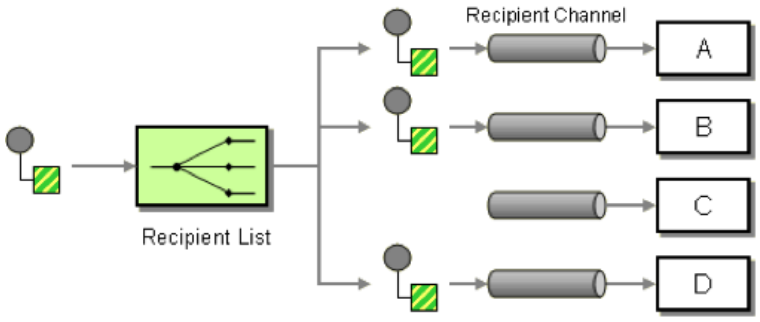
Integration Patterns – Recipient List

- Message broadcast to *n* channels based on message criteria
- Broadcast to all channels == Multicast Pattern



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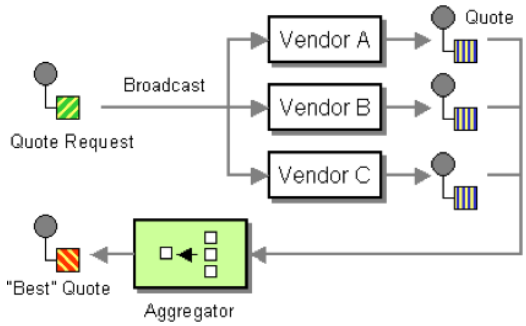
Integration Patterns – Scatter-Gather

- Messages broadcast to disparate endpoints and results aggregated into a single message



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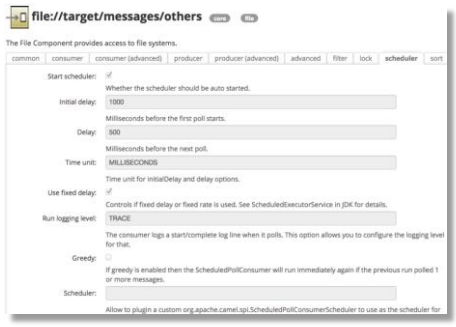
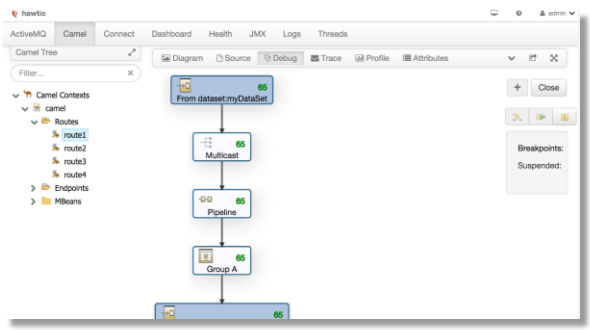
Camel Development

- **Major IDEs** like Eclipse and IntelliJ can **ease Camel development** by allowing routes to execute within the IDE
- As of Camel 2.16, **comprehensive in-line tools are available** which allow auto-completion and even list every parameter of an available component
- HawtIO allows for **visual debugging of routes**, tracing of message lifecycle, diagram driven development, as well as monitoring





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Creating/Configuring Endpoints

- Camel documentation is at : https://camel.apache.org/manual/latest/faq/how-do-i-configure-endpoints.html
- Several techniques
  - Explicit Java code (uses URIs)
  - Spring XML (uses URIs)
  - Java DSL (uses URIs)

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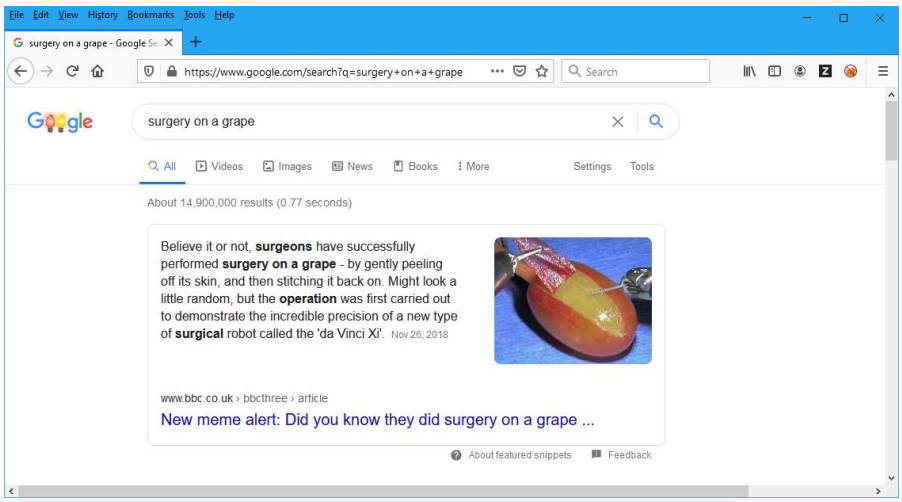
URI Example (URL is a type of URI)



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URI Example

Protocol

Location

Path Parameter

https://www.google.com/search?q=surgery+on+a+grape

Query Parameter
(name is "q", value is "surgery on a grape")

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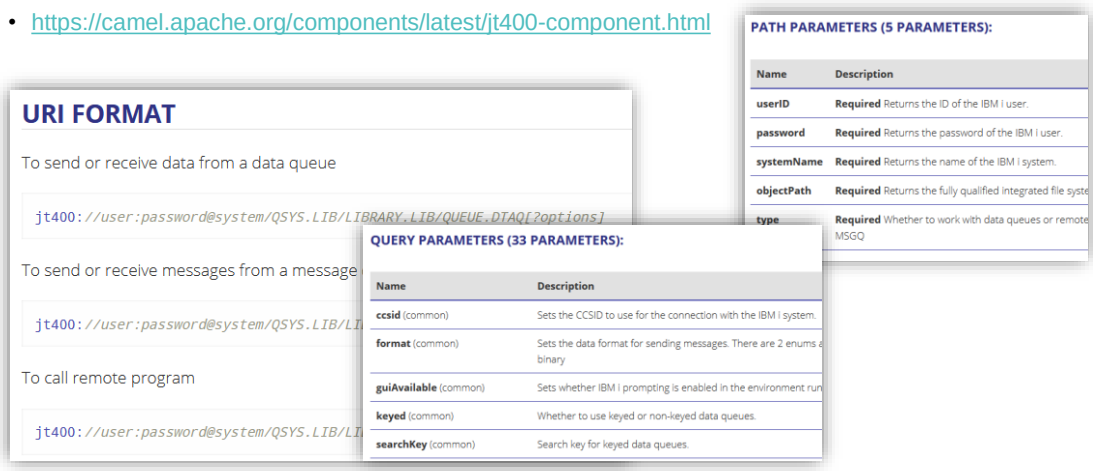
Apache Camel Component Documentation

- https://camel.apache.org/components/latest/jt400-component.html



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Simplest Camel Route

- Specify a simple route with a source URI and a target URI
- Camel will implicitly create the endpoint objects and tie them together

- Camel doc on Routes is very useful for starters: https://camel.apache.org/manual/latest/routes.html

```
final String sourceUri = // some URI of an endpoint that produces data
final String targetUri = // some URI of an endpoint to receive data
context.addRoutes(new RouteBuilder() {
    @Override
    public void configure() {
        from(sourceUri)
        .to(targetUri);
    }
});
```


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Message Queue to Email Bridge

- This sample code uses a helper object to generate the URI (parsed from a config file)

- Introduced the "Wire Tap" EIP

```
final String msgqUri = conf.getMsgQUri(); //something like -> jt400://username:password@localhost/qsys.lib/mylib.lib/myq.MSGQ?format=binary&guiAvailable=false
final String smtpUri = conf.getSmtpUri(); //something like -> smtp://my.smtp.server.com?from=jgorzins@us.ibm.com&to=jgorzins@us.ibm.com&subject=Camel is Really Amazing!
context.addRoutes(new RouteBuilder() {
    @Override
    public void configure() {
        from(msgqUri)
        .wireTap("log:msgq_to_email?showAll=true&level=INFO") // This is just for debug data flowing through the route
        .to(smtpUri);
    }
});
```


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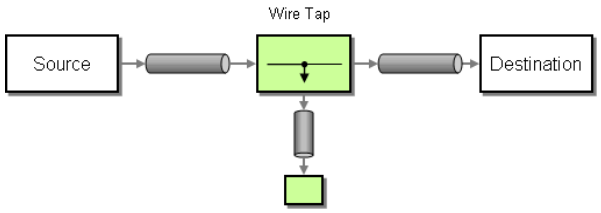
Wire Tap EIP

- https://camel.apache.org/components/latest/eips/wireTap-eip.html
- Used here because:
  - Demo/starter program, visual feedback is nice :)



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Data Queue to Kafka Bridge

- Same concept, different URIs
- Applied case: stream Db2 transactions to Apache Kafka

```
final String dtaqUri = conf.getDtaQUri(); //something like -> jt400://username:password@localhost/qsys.lib/mylib.lib/myq.DTAQ?keyed=false&format=binary&guiAvailable=false
final String kafkaUri = conf.getKafkaUri(); //something like -> kafka:mytopic?brokers=mybroker:9092
context.addRoutes(new RouteBuilder() {
    @Override
    public void configure() {
        from(dtaqUri)
        .wireTap("log:msgq_to_email?showAll=true&level=INFO") // This is just for debugging data flowing through the route
        .to(kafkaUri);
    }
});
```


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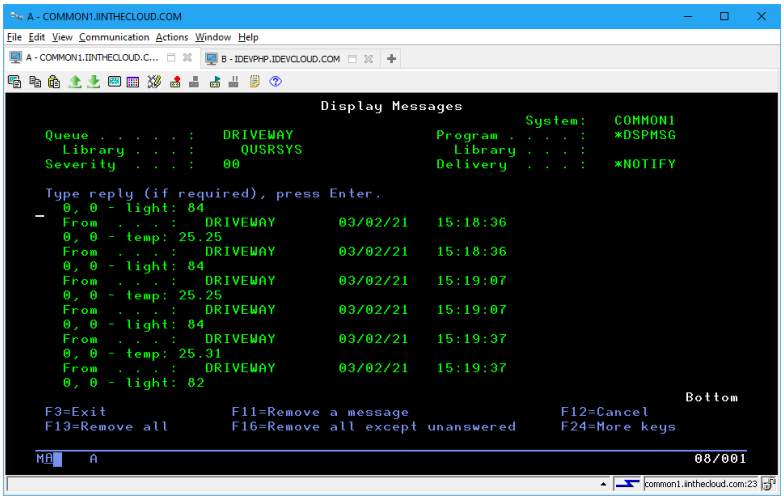
Consume IoT Data? No Problem!



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Consume IoT Data? No Problem!

```
context.addRoutes(new RouteBuilder() {
    @Override
    public void configure() {
        from("paho:factory/1/light?brokerUrl=ssl://localhost")
        .to("jt400://driveway:xxxxxx@localhost/qsys.lib/QUSRSYS.lib/DRIVEWAY.MSGQ?guiAvailable=false");
    }
});
context.addRoutes(new RouteBuilder() {
    @Override
    public void configure() {
        from("paho:factory/1/temp?brokerUrl=ssl://localhost")
        .to("jt400://driveway:xxxxxx@localhost/qsys.lib/QUSRSYS.lib/DRIVEWAY.MSGQ?&guiAvailable=false");
    }
});
```


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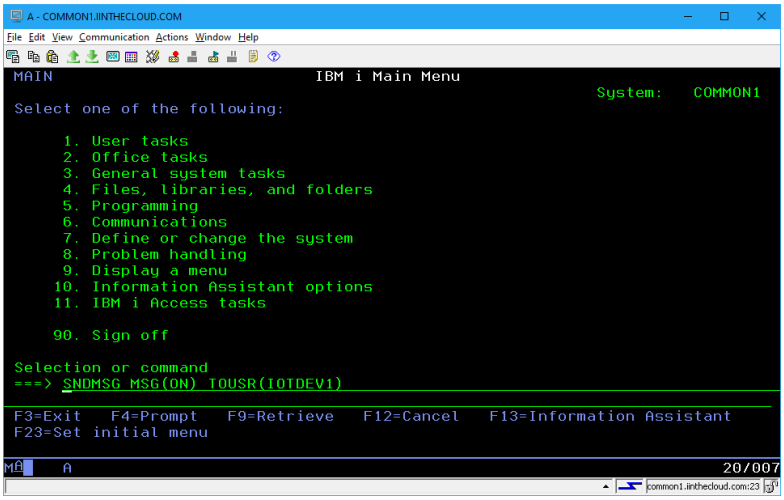
Control IoT Devices? No Problem!



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A More Complex Example…

- This example is a simple disk usage monitor
  - Continually checks average disk usage
  - If disk usage is >90%, send an email
  - Send an email every hour until disk usage is freed back up
- Will use several techniques and EIPs

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Timer Endpoint

Often used to kick off tasks on some form of periodic basis (in this case, polling disk usage)

https://camel.apache.org/components/latest/timer-component.html

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JDBC Endpoint

Used to query the database (using QSYS2.SYSDISKSTAT)

https://camel.apache.org/components/latest/jdbc-component.html

Supports both queries (SELECT) and operations (INSERT, UPDATE, etc.).

SQL is sent in the message body

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Disk Monitor Example

```
context.getRegistry().bind("jt400", new AS400JDBCDataSource("localhost", "*CURRENT", ""));
context.addRoutes(new RouteBuilder() {
    @Override
    public void configure() {
        from("timer://foo?period=5000").routeId("diskmon")
            .setBody(constant("SELECT AVG(PERCENT_USED)FROM QSYS2.SYSDISKSTAT A"))
            .to("jdbc:jt400")
            .process((exchange) -> {
                    Object diskUsageValue = ((ArrayList<HashMap<String, Object>>)exchange.getIn().getBody()).remove(0).values().iterator().next();
                    exchange.getIn().setBody(diskUsageValue);
                })
            .choice()
                .when(body().isGreaterThan(90))
                    .process((exchange) -> {exchange.getIn().setBody("Average utilization of your disks is "+ exchange.getIn().getBody() + "%");})
                    .to("log:disk_space_mon?showAll=true&level=ERROR")
                    .to("smtp://mysmtpserver:1025?from=me@gmail.com&to=me@gmail.com&subject=Disk getting full!!")
                    .process((exchange) -> { pauseContext(exchange.getContext(), 1000*60*60); })
                .otherwise()
                    .wireTap("log:disk_space_mon?showAll=true&level=INFO");
    }
});
```


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Disk Monitor Example

Instantiate Timer to kick off the route

```
context.addRoutes(new RouteBuilder() {
    @Override
    public void configure() {
        from("timer://foo?period=5000").routeId("diskmon")
            .setBody(constant("SELECT AVG(PERCENT_USED)FROM QSYS2.SYSDISKSTAT A"))
            .to("jdbc:jt400")
            .process((exchange) -> {
                    Object diskUsageValue = ((ArrayList<HashMap<String, Object>>)exchange.getIn().getBody()).remove(0).values().iterator().next();
                    exchange.getIn().setBody(diskUsageValue);
                })
            .choice()
                .when(body().isGreaterThan(90))
                    .process((exchange) -> {exchange.getIn().setBody("Average utilization of your disks is "+ exchange.getIn().getBody() + "%");})
                    .to("log:disk_space_mon?showAll=true&level=ERROR")
                    .to("smtp://mysmtpserver:1025?from=me@gmail.com&to=me@gmail.com&subject=Disk getting full!!")
                    .process((exchange) -> { pauseContext(exchange.getContext(), 1000*60*60); })
                .otherwise()
                    .wireTap("log:disk_space_mon?showAll=true&level=INFO");
    }
});
```

```
from("timer://foo?period=5000").routeId("diskmon")
```


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Disk Monitor Example

```
context.addRoutes(new RouteBuilder() {
    @Override
    public void configure() {
        from("timer://foo?period=5000").routeId("diskmon")
          .setBody(constant("SELECT AVG(PERCENT_USED)FROM QSYS2.SYSDISKSTAT A"))
          .to("jdbc:jt400")
          .process((exchange) -> {
                Object diskUsageValue = ((ArrayList<HashMap<String, Object>>)exchange.getIn().getBody()).remove(0).values().iterator().next();
                exchange.getIn().setBody(diskUsageValue);
            })
          .choice()
              .when(body().isGreaterThan(90))
                  .process((exchange) -> {exchange.getIn().setBody("Average utilization of your disks is "+ exchange.getIn().getBody() + "%");})
                  .to("log:disk_space_mon?showAll=true&level=ERROR")
                  .to("smtp://mysmtpserver:1025?from=me@gmail.com&to=me@gmail.com&subject=Disk getting full!!")
                  .process((exchange) -> { pauseContext(exchange.getContext(), 1000*60*60); })
              .otherwise()
                  .wireTap("log:disk_space_mon?showAll=true&level=INFO");
    }
});
```

Set the body of the message (SQL)

```
.setBody(constant("SELECT AVG(PERCENT_USED)FROM QSYS2.SYSDISKSTAT A"))
```


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Disk Monitor Example

```
context.addRoutes(new RouteBuilder() {
    @Override
    public void configure() {
        from("timer://foo?period=5000").routeId("diskmon")
          .setBody(constant("SELECT AVG(PERCENT_USED)FROM QSYS2.SYSDISKSTAT A"))
          .to("jdbc:jt400")
          .process((exchange) -> {
                Object diskUsageValue = ((ArrayList<HashMap<String, Object>>)exchange.getIn().getBody()).remove(0).values().iterator().next();
                exchange.getIn().setBody(diskUsageValue);
            })
          .choice()
              .when(body().isGreaterThan(90))
                  .process((exchange) -> {exchange.getIn().setBody("Average utilization of your disks is "+ exchange.getIn().getBody() + "%");})
                  .to("log:disk_space_mon?showAll=true&level=ERROR")
                  .to("smtp://mysmtpserver:1025?from=me@gmail.com&to=me@gmail.com&subject=Disk getting full!!")
                  .process((exchange) -> { pauseContext(exchange.getContext(), 1000*60*60); })
              .otherwise()
                  .wireTap("log:disk_space_mon?showAll=true&level=INFO");
    }
});
```

Route the message to the JDBC component (note the "jt400" datasource)

```
.to("jdbc:jt400")
```


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Disk Monitor Example

Translate the results to a simple number (Message Translator EIP)

```
context.addRoutes(new RouteBuilder() {
    @Override
    public void configure() {
        from("timer://foo?period=5000").routeId("diskmon")
            .setBody(constant("SELECT AVG(PERCENT_USED)FROM QSYS2.SYSDISKSTAT A"))
            .to("jdbc:jt400")
            .process((exchange) -> {
                    Object diskUsageValue = ((ArrayList<HashMap<String, Object>>)exchange.getIn().getBody()).remove(0).values().iterator().next();
                    exchange.getIn().setBody(diskUsageValue);
                })
            .choice()
                .when(body().isGreaterThan(90))
                    .process((exchange) -> {exchange.getIn().setBody("Average utilization of your disks is "+ exchange.getIn().getBody() + "%");})
                    .to("log:disk_space_mon?showAll=true&level=ERROR")
                    .to("smtp://mysmtpserver:1025?from=me@gmail.com&to=me@gmail.com&subject=Disk getting full!!")
                    .process((exchange) -> { pauseContext(exchange.getContext(), 1000*60*60); })
                .otherwise()
                    .wireTap("log:disk_space_mon?showAll=true&level=INFO");
    }
});
```

```
process((exchange) -> {
        Object diskUsageValue = ((ArrayList<HashMap<String, Object>>)exchange.getIn().getE
        exchange.getIn().setBody(diskUsageValue);
    })
```


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Disk Monitor Example

Make a decision (Content Based Router EIP)

```
context.addRoutes(new RouteBuilder() {
    @Override
    public void configure() {
        from("timer://foo?period=5000").routeId("diskmon")
            .setBody(constant("SELECT AVG(PERCENT_USED)FROM QSYS2.SYSDISKSTAT A"))
            .to("jdbc:jt400")
            .process((exchange) -> {
                    Object diskUsageValue = ((ArrayList<HashMap<String, Object>>)exchange.getIn().getBody()).remove(0).values().iterator().next();
                    exchange.getIn().setBody(diskUsageValue);
                })
            .choice()
                .when(body().isGreaterThan(90))
                    .process((exchange) -> {exchange.getIn().setBody("Average utilization of your disks is "+ exchange.getIn().getBody() + "%");})
                    .to("log:disk_space_mon?showAll=true&level=ERROR")
                    .to("smtp://mysmtpserver:1025?from=me@gmail.com&to=me@gmail.com&subject=Disk getting full!!")
                    .process((exchange) -> { pauseContext(exchange.getContext(), 1000*60*60); })
                .otherwise()
                    .wireTap("log:disk_space_mon?showAll=true&level=INFO");
    }
});
```

```
choice()
    .when(body().isGreaterThan(90))
    .otherwise()
```


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Disk Monitor Example

Reformat the message (Content Enricher EIP)

```
context.addRoutes(new RouteBuilder() {
    @Override
    public void configure() {
        from("timer://foo?period=5000").routeId("diskmon")
            .setBody(constant("SELECT AVG(PERCENT_USED)FROM QSYS2.SYSDISKSTAT A"))
            .to("jdbc:jt400")
            .process((exchange) -> {
                    Object diskUsageValue = ((ArrayList<HashMap<String, Object>>)exchange.getIn().getBody()).remove(0).values().iterator().next();
                    exchange.getIn().setBody(diskUsageValue);
                })
            .choice()
                .when(body().isGreaterThan(90))
                    .process((exchange) -> {exchange.getIn().setBody("Average utilization of your disks is "+ exchange.getIn().getBody() + "%");})
                    .to("log:disk_space_mon?showAll=true&level=ERROR")
                    .to("smtp://mysmtpserver:1025?from=me@gmail.com&to=me@gmail.com&subject=Disk getting full!!")
                    .process((exchange) -> { pauseContext(exchange.getContext(), 1000*60*60); })
                .otherwise()
                    .wireTap("log:disk_space_mon?showAll=true&level=INFO");
    }
});
```

```
.process((exchange) -> {exchange.getIn().setBody("Average utilization of your disks is "+ exchange.getIn().g
```


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Disk Monitor Example

Route to logging and email

```
context.addRoutes(new RouteBuilder() {
    @Override
    public void configure() {
        from("timer://foo?period=5000").routeId("diskmon")
            .setBody(constant("SELECT AVG(PERCENT_USED)FROM QSYS2.SYSDISKSTAT A"))
            .to("jdbc:jt400")
            .process((exchange) -> {
                    Object diskUsageValue = ((ArrayList<HashMap<String, Object>>)exchange.getIn().getBody()).remove(0).values().iterator().next();
                    exchange.getIn().setBody(diskUsageValue);
                })
            .choice()
                .when(body().isGreaterThan(90))
                    .process((exchange) -> {exchange.getIn().setBody("Average utilization of your disks is "+ exchange.getIn().getBody() + "%");})
                    .to("log:disk_space_mon?showAll=true&level=ERROR")
                    .to("smtp://mysmtpserver:1025?from=me@gmail.com&to=me@gmail.com&subject=Disk getting full!!")
                    .process((exchange) -> { pauseContext(exchange.getContext(), 1000*60*60); })
                .otherwise()
                    .wireTap("log:disk_space_mon?showAll=true&level=INFO");
    }
});
```

```
.to("log:disk_space_mon?showAll=true&level=ERROR")
.to("smtp://mysmtpserver:1025?from=me@gmail.com&to=me@gmail.com&subject=Disk getting full!!")
```


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Disk Monitor Example

Suspend the context for 1 hour

```
context.addRoutes(new RouteBuilder() {
    @Override
    public void configure() {
        from("timer://foo?period=5000").routeId("diskmon")
            .setBody(constant("SELECT AVG(PERCENT_USED)FROM QSYS2.SYSDISKSTAT A"))
            .to("jdbc:jt400")
            .process((exchange) -> {
                    Object diskUsageValue = ((ArrayList<HashMap<String, Object>>)exchange.getIn().getBody()).remove(0).values().iterator().next();
                    exchange.getIn().setBody(diskUsageValue);
                })
            .choice()
                .when(body().isGreaterThan(90))
                    .process((exchange) -> {exchange.getIn().setBody("Average utilization of your disks is "+ exchange.getIn().getBody() + "%");})
                    .to("log:disk_space_mon?showAll=true&level=ERROR")
                    .to("smtp://mysmtpserver:1025?from=me@gmail.com&to=me@gmail.com&subject=Disk getting full!!")
                    .process((exchange) -> { pauseContext(exchange.getContext(), 1000*60*60); })
                .otherwise()
                    .wireTap("log:disk_space_mon?showAll=true&level=INFO");
    }
});
```

```
.process((exchange) -> { pauseContext(exchange.getContext(), 1000*60*60); })
```


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Deploying Your First Simple Routes

- Can visit the "IBM i OSS Examples" repo at https://github.com/IBM/ibmi-oss-examples/
  - Note the "camel" subdirectory: https://github.com/IBM/ibmi-oss-examples/tree/master/camel
- Also check out Kameleon: https://kameleon.dev
- Examples use Java and Maven
  - Maven has a central repository of packages
  - Configuration of project in 'pom.xml' file
  - Feel free to dig in the examples to learn more
- How do I install Camel?
  - When doing a standalone Java route, just let Maven download Camel as a dependency!

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Deploying Your First Simple Routes

- Examples currently include
  - A data queue to Kafka bridge (with information about using this as a Db2->Kafka bridge)
    - Requires you to have Kafka somewhere
  - A message queue to email bridge
    - Requires you to have an SMTP server
  - Disk monitor email example
    - Requires you to have an SMTP server
  - Disk monitor message queue example (send messages to *SYSOPR message queue)
    - Should work "out of the box"
  - Message Queue to Slack bridge (listens on the *SYSOPR message queue and posts a message to slack when the severity of the message is greater than 45)
    - Requires Slack
  - db2_bash: allows you to call PASE commands in bash via an SQL table function.
    - Can be made to work "out of the box"

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Running a Standalone Java Camel Application/Route as a Service

CL	Submit to batch
PASE/SSH	Install coreutils-gnu and use "nohup"
PASE/SSH	Use ServiceCommander • https://github.com/ThePrez/ServiceCommander-IBMi • Define the program in a .yaml file (or use "scinit" utility") • TIP: For POJO camel applications, submit to batch with a custom job name

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Community Portals

IBM i OSS Ryver chat

http://ibm.biz/ibmioss-chat (join at http://ibm.biz/ibmioss-chat-join)

ZulipChat

https://camel.zulipchat.com/

Mailing Lists

https://camel.apache.org/manual/latest/mailing-lists.html

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Kafka vs Camel

	Camel	Kafka
What is it?	A framework	A high-performing message bus
Interfaces with	Just about anything, including IBM i	Anything that knows Kafka, including Apache Camel
Distributed?	No	Yes
Protocol	Many	Kafka

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Can this perform well?

- https://techchannel.com/SMB/09/2021/power10-ai-event-streaming
- Power 10 demo doing real-time stock price prediction (stock exchange running on IBM i)

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HTTP Functions

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New HTTP Functions for SQL (QSYS2)

- HTTP_GET, HTTP_POST, HTTP_PUT, HTTP_DELETE
- Two part blog series:
  - https://techchannel.com/SMB/09/2021/new-sql-http-functions-part-1
    - Overview of the new services
  - https://techchannel.com/Trends/09/2021/sql-http-part-2
    - Integrating with OSS

```
values QSYS2.HTTP_POST(
    'https://api.twilio.com/2010-04-01/Accounts/AC8f1fd0e6d288b6252f7d664e2cfb40a2/Messages.json',
    cast('To=15075559963' concat
    '&From=15556697987' concat
    '&Body=Order is ready' as varchar(855)),
    '{"basicAuth":"AC8f1fd0e6d288b6252f7d664e2cfb40a2,2a6f5a798b2803be2042ab4825d02570",
     "header":"content-type,application/x-www-form-urlencoded"}'
  );
```


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Function	Description
HTTP_DELETE	Make an HTTP DELETE request and return CLOB data.
HTTP_DELETE_VERBOSE	Make an HTTP DELETE request and return CLOB data and response header.
HTTP_GET	Make an HTTP GET request and return CLOB data.
HTTP_GET_VERBOSE	Make an HTTP GET request and return CLOB data and response header.
HTTP_POST	Make an HTTP POST request and return CLOB data.
HTTP_POST_VERBOSE	Make an HTTP POST request and return CLOB data and response header.
HTTP_PUT	Make an HTTP PUT request and return CLOB data.
HTTP_PUT_VERBOSE	Make an HTTP PUT request and return CLOB data and response header.

Function	Description
BASE64_DECODE	Returns a bit data string that has been Base64 decoded.
BASE64_ENCODE	Returns the Base64 encoded version of a character string.
URL_DECODE	Decodes a URL encoded string.
URL_ENCODE	Encodes a string using URL encoding.

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Contrasted with SYSTOOLS predecessors

```
select *
  from json_table(
       SYSTOOLS.HTTPGETCLOB('https://official-joke-api.appspot.com/jokes/ten
       'lax $'
       columns(
         "id" integer,
         "type" varchar(100),
         "setup" varchar(100),
         "punchline" varchar(100)
       )
    ) x;
-- Statement ran successfully   (6,693 ms  =  6.693 sec)

--
-- Count all threads in my job
--
select count(distinct(THREAD_ID))
  from table (
       QSYS2.STACK_INFO('*', 'ALL')
    ) as x;
-- ======================================================
-- 49 threads
-- ======================================================
```

```
select *
  from json_table(
       QSYS2.HTTP_GET('https://official-joke-api.appspot.com/j
       'lax $'
       columns(
         "id" integer,
         "type" varchar(100),
         "setup" varchar(100),
         "punchline" varchar(100)
       )
    ) x;
-- Statement ran successfully   (2,539 ms  =  2.539 sec)

--
-- Count all threads in my job
--
select count(distinct(THREAD_ID))
  from table (
       QSYS2.STACK_INFO('*', 'ALL')
    ) as x;
-- ======================================================
-- 1 thread
-- ======================================================
```


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Another example: DNS Lookup

- Discussed in more detail in blog entry referenced earlier
- Simple DNS lookup can be done in a Node.js HTTP API:

```
fastify.get('/dns/:name', (request, reply) => {
  let name = request.params.name;
  dns.lookup(name, (err, address) => {
    if (err || address === undefined) {
      reply.code(404).header('Content-Type', 'application/text; charset=utf-8').send(err);
    } else {
      reply.code(200).header('Content-Type', 'application/text; charset=utf-8').send(address);
    }
  });
})
```

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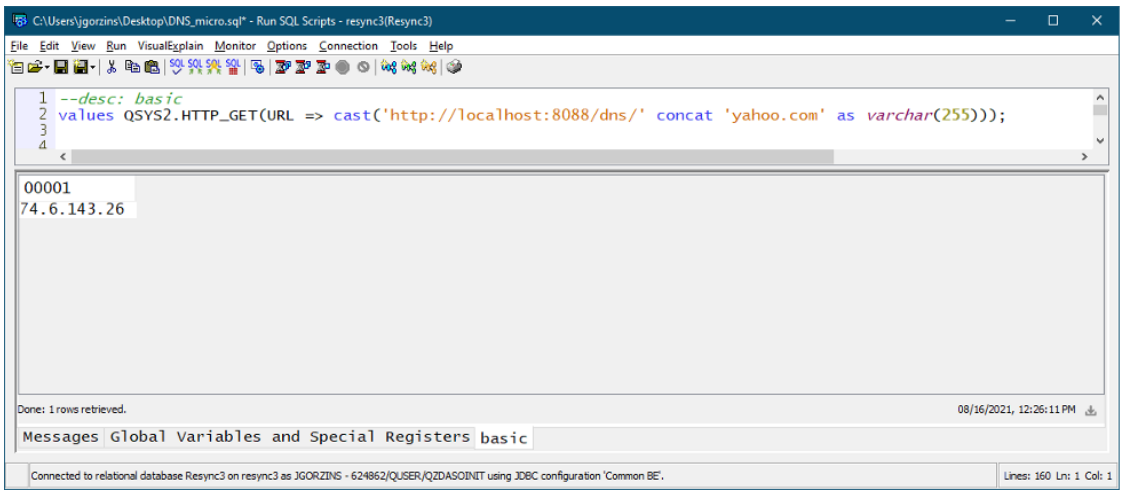
Simple DNS



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Advanced DNS sample

- Retrieve detailed DNS records
- Allow DNS server to be specified

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```
fastify.get('/dns_adv/:name', (request, reply) => {
  let reso = new Resolver();
  let name = request.params.name;
  let dns_server = request.query.dns_server;
  if (dns_server === undefined || dns_server === null) {
    reso.setServers(['8.8.8.8']);
  } else {
    reso.setServers([dns_server]);
  }
  reso.resolveAny(name, (err, addresses) => {
    if (err || addresses === undefined) {
      reply.code(404).header('Content-Type', 'application/text; charset=utf-8').send(err);
    } else {
      let i;
      for (i = 0; i < addresses.length; i++) {
        if (addresses[i].address === undefined) {
          addresses[i].address = addresses[i].value;
        }
      }
      reply.code(200).header('Content-Type', 'application/json; charset=utf-8').send(addresses);
    }
  });
})
```


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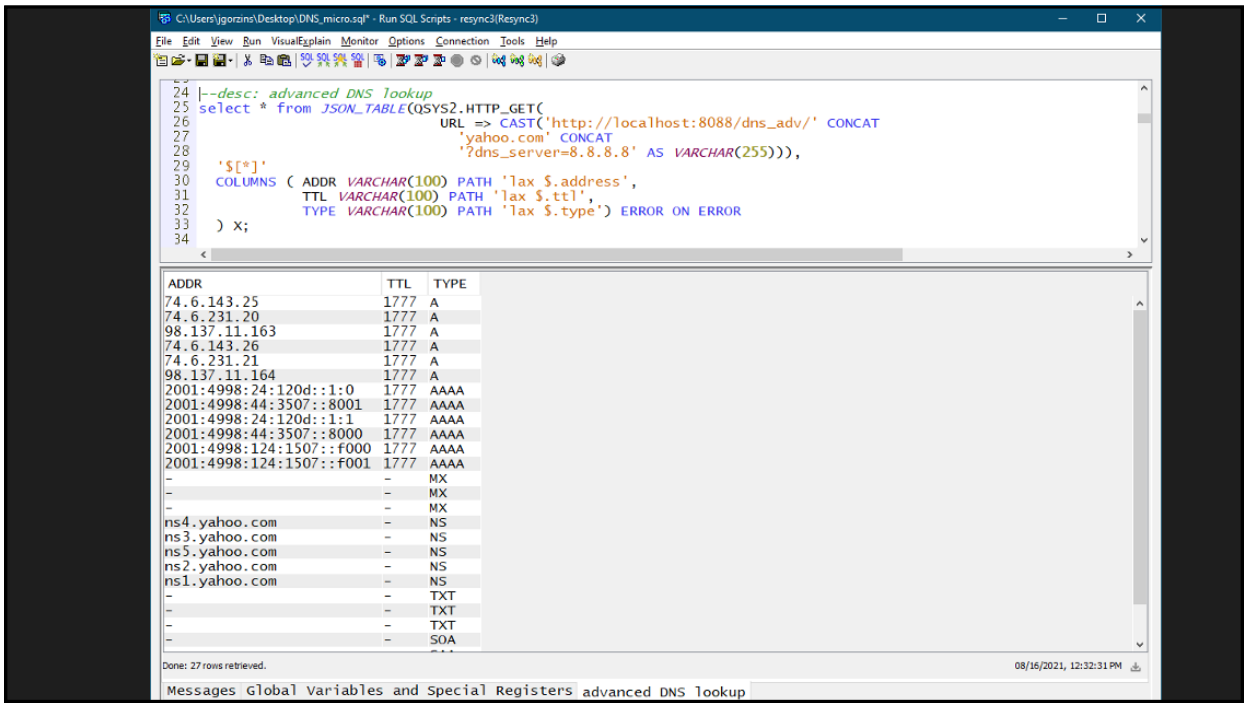

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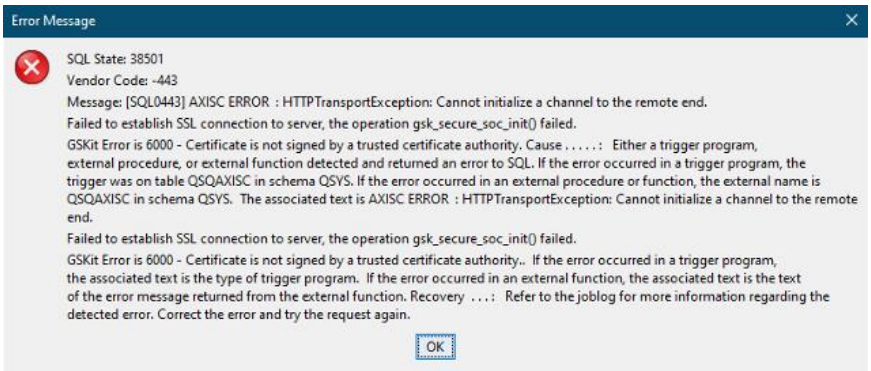
TLS Setup

- If the certificate isn't trusted, you may get an error



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Trusting the certificate

- Option 1: Import into DCM (or click "Populate CA Certificates" in DCM GUI if it's a common cert)
- Option 2: Use DCM-Tools open source toolset
  https://github.com/ThePrez/DCM-tools/

  To trust the certificate from localhost port 8089:
  `dcmimport --fetch-from=localhost:8089`

  To trust the certificates installed into PASE OSS environment:
  `dcmimport --installed-certs`

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One last example: publishing to Kafka…

```
VALUES QSYS2.HTTP_POST('http://myrestserver:8082/topics/fromrest',
                       '{"records":[{"key":"my_key","value":"Just some data to stream to Kafka"}]}',
                       '{"header":"Content-Type,application/vnd.kafka.json.v2+json" ,
                         "header":"Accept,application/vnd.kafka.v2+json"
                         }');
```


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Etcetera

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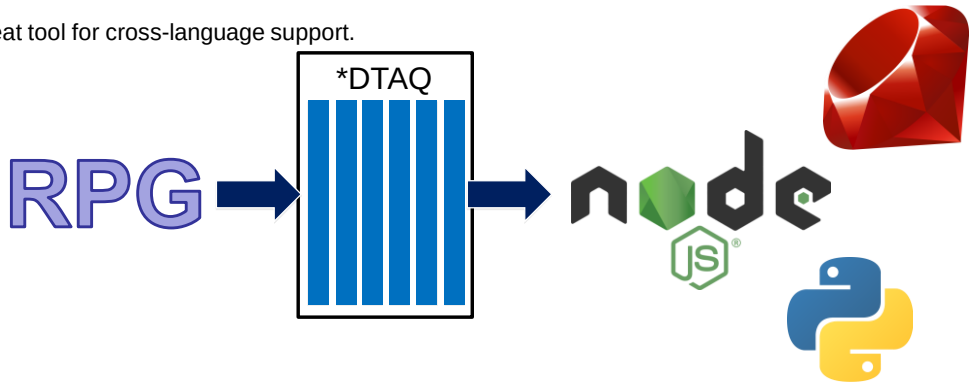
Data Queues

- Data Queues are great tools for general IPC.
- Also a great tool for cross-language support.



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Data queues

RPG could form JSON that looks like this:

```
{"body":"Hello World", "to":"+123456789", "from":"+123456789"}
```

Sends it like this:

```
dcl-pr snddtaq      extpgm('QSNDDTAQ');
   ##dtqname   like(d#dtqname)   const;
   ##dtqlib    like(d#dtqlib)    const;
   ##dtqlength like(d#dtqlength) const;
   ##dtqdata   char(32766)       const options(*varsize);
end-pr;
```


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```
async function getFromQ() {
  try {
    while(true) {
      let results =
        await pool.prepareExecute(`SELECT MESSAGE_DATA_UTF8
                                   FROM TABLE(QSYS2.RECEIVE_DATA_QUEUE(
                                     DATA_QUEUE => 'SNDSMSQ',
                                     WAIT_TIME => 1,
                                     DATA_QUEUE_LIBRARY => 'JESSEG'))`);
      if(results != undefined) {
        let data = JSON.parse(results.resultSet[0].MESSAGE_DATA_UTF8);
        sendSMS(data.to, data.from, data.body);
      }
    }
  }catch(err) {
      console.log('error: '+err.stack);
  }
}
```

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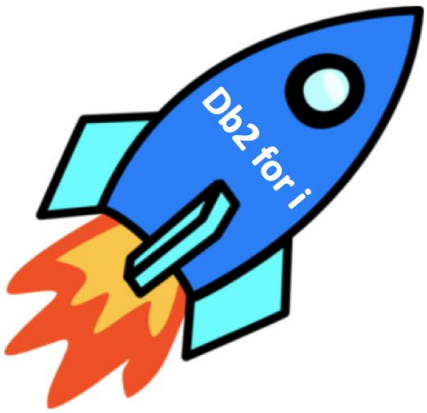
Connectivity libraries

- All major languages come with IBM i integration!!
- OSS programs can interact with:
  - Db2
  - Data Queues
  - CL commands
  - Data Areas
  - RPG Programs
  - QSH scripts
  - … and pretty much anything else!!



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UNIXCMD

- https://www.scottklement.com/unixcmd/
- https://www.common.org/blogs/temporary-admin1/2018/01/22/a-powerful-way-to-run-unix-and-open-source-tools-f
- This is a tool to help simplify the process of running QShell or PASE commands from RPG or CL.
- Implements a SPECIAL file
- When you read the file, you're reading the output of the command.
- When you write to the file, you're writing data to the command. For CL, it provides OPNPIPE, RCVPIPE, SNDPIPE and CLOPIPE commands that open the Unix and send/receive data from it, very similar to the way you use files in CL.

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```
**free

dcl-f UNIX disk(1000) usage(*input:*output) handler('UNIXCMDOA': cmd) usropn;
dcl-s cmd char(5000);
dcl-s lat packed(11: 7);
dcl-s lon packed(11: 7);
dcl-ds record len(1000) end-ds;

cmd = 'PATH=$PATH:/usr/local/ZendSvr6/bin && +
       iconv -f 0 -t 819 | +
       php-cli /www/zendsvr/htdocs/geocode.php';

open UNIX;

record = '1600 W Pennsylvania Av, Washington DC';
write UNIX record;

read UNIX record;
lat = %dec(record: 11: 7);

read UNIX record;
lon = %dec(record: 11: 7);

close UNIX;

dsply ('lat=' + %char(lat));
dsply ('lon=' + %char(lon));
*inlr = *on;
```

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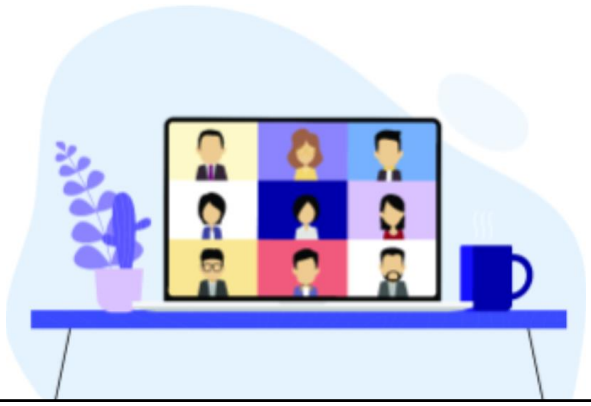
What else?

- More ways than I can list!!
- Today's presentation are just a few of Jesse's favorites
- Collaboration and open-mindedness is key (the real "skills gap"?)
- With open source, you're never alone



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IBM OSS Support! Example "Supportables" for IBM i

Git
Jenkins
Rsync
Ansible
Node.js
PHP
Apache Tomcat
WordPress
Python
R
Apache ActiveMQ
Apache Camel
Apache Kafka
Apache Zookeeper

For more resources, see: http://ibm.biz/ibmi-oss-support

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Resources

- IBM i RPMs (RedHat Technology we use for building/distributing)
  - http://ibm.biz/ibmi-rpms
- IBM i Open Source Support
  - http://ibm.biz/ibmi-oss-support
- Jesse Gorzinski's blog
  - http://ibm.biz/open-your-i
  - https://ibmsystemsmag.com/Power-Systems/06/2020/common-open-source-questions-answered
- Open Source Examples
  - http://github.com/IBM/ibmi-oss-examples
- IBM i customer stories
  - http://ibm.biz/ibmistories
- Community chat
  - http://ibm.biz/ibmioss-chat (join at http://ibm.biz/ibmioss-chat-join)
- Jesse
  - jgorzins@us.ibm.com
  - http://twitter.com/IBMJesseG

Brand new landing page:
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