z/TPF Modernization – Why and How

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IBM Distinguished Engineer

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IBM Z

IBM

Disclaimer

Any reference to future plans are for planning purposes only. IBM reserves the right to change those plans at its discretion. Any reliance on such a disclosure is solely at your own risk. IBM makes no commitment to provide additional information in the future.

Modernization

Why Modernize

- Many different opinions exist on what "modernization" means

- There is more consensus around the end goals of modernization. To explore that, let's look at a sample z/TPF user (note that the names and workloads have been changed to protect the not so innocent):

  Company **_The Music Never Stopped_** uses z/TPF and sells packages to concert events at stadiums, arenas, and concert halls in several countries. Besides ticket sales, they provide travel to the event, and optional VIP experiences. The company is looking to modernize and their senior leadership were asked what they expect to gain out of doing that.

Modernization Goals for z/TPF User

THE MUSIC NEVER STOPPED

"Make existing core services and data **available and easily consumable** by the rest of my enterprise and business partners"

Integration

"Create a hybrid cloud architecture that leverages the strengths of various platforms that **optimizes performance, scale, and costs**."

Eddie
Architecture

Modernization Goals for z/TPF User THE MUSIC NEVER STOPPED

"Make developers **more productive**"   "**Faster** time to market"

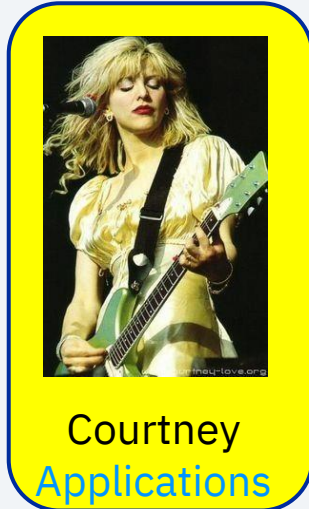"Create a **more maintainable** app code base"   "**Improve** code quality"

Agility   "**Reduce the costs** of development and test"

Eddie
Architecture

Courtney
Applications

Modernization Goals for z/TPF User **THE MUSIC NEVER STOPPED**

"Faster **detection and resolution** of application and system problems, thus **preventing** many situations from turning into problems that impact the business"
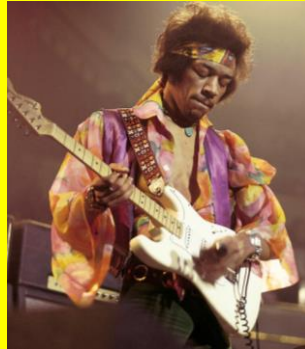
Stability and Observability

"Better **management and insights** into workloads that span multiple platforms, including z/TPF"

Eddie
Architecture

Courtney
Applications

Jimi
Operations

Modernization Goals for z/TPF User

THE MUSIC NEVER STOPPED

"I need to **reduce the risk of a data breach** and other **security incidents.**"

"Be able to **recover** from incidents like a cyber attack"

Security and Compliance

"Adhere to the growing and ever changing set of security requirements **without having to make major app changes**"

Eddie
Architecture

Courtney
Applications

Jimi
Operations

David
CISO

Modernization Goals for z/TPF User

THE MUSIC NEVER STOPPED

"Being able to **react to business requirements** quickly enough to **still exist as a company**, and of course **grow**"

"Leverage a **larger** developer skill base"

The Future

"Having an **architecture** that allows us to make acquisitions and go into new markets that **increase workload volumes by 2-10X**"
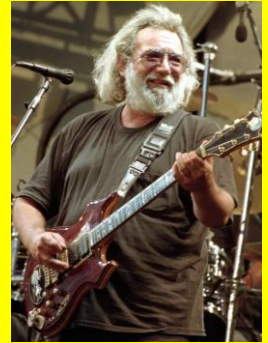

Eddie
Architecture

Courtney
Applications

Jimi
Operations

David
CISO

Jerry
CIO

Ask an Expert

- Many leaders at ***The Music Never Stopped*** are new to the company, and some are new to real-time transaction processing.

- They consult with a trusted industry analyst to get feedback on their modernization goals...

What the Analyst Said

Ozzy
Analyst

"mumble, mumble…

Hybrid Cloud is ***absolutely*** the right architecture for your environment. Like any other architecture, there are good implementations and bad implementations, so make sure to follow best practices and not repeat the mistakes others have made.

IBM z16 is a ***definitely*** a modern platform. That coupled with the capabilities z/TPF provides will allow you achieve your modernization goals. And don't forget about **server consolidation** and other advantages of Linux on IBM Z!

Have you read the IBM Redbook on *z/TPF Application Modernization*?"

IBM Redbook on z/TPF Application Modernization

- Entry points for z/TPF clients:
  - I. Optimizing cost/performance of existing z/TPF applications
  - II. Enhancing and modernizing applications
  - III. Integrating across hybrid cloud
  - IV. Simplifying information sharing and data access
  - V. Getting more agile with enterprise DevOps
  - VI. Making AI-driven decisions at scale

- Dozens of z/TPF modernization patterns
- Reference architectures
- Differentiating values of z/TPF

https://www.redbooks.ibm.com/abstracts/redp5714.html

In This Presentation

Most of the material is this presentation represents capabilities that exist **today** in z/TPF and are discussed in the **z/TPF Application Modernization** Redbook. In this presentation if you see the following symbol...
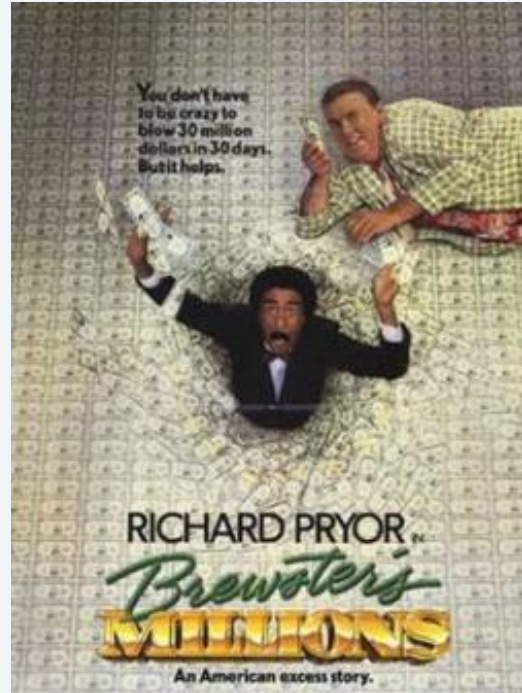

... that represents a new capability IBM is currently working on that you will hear more about in other presentations at this conference.

Hybrid Cloud Service Integration

What Do These Classic Movies Have in Common?

They are both all about z/TPF!

Classic End User Use Cases Handled by z/TPF

"I want to travel from point A to point B next Sunday and then back on the following Friday. While there I want to stay in the city center. "
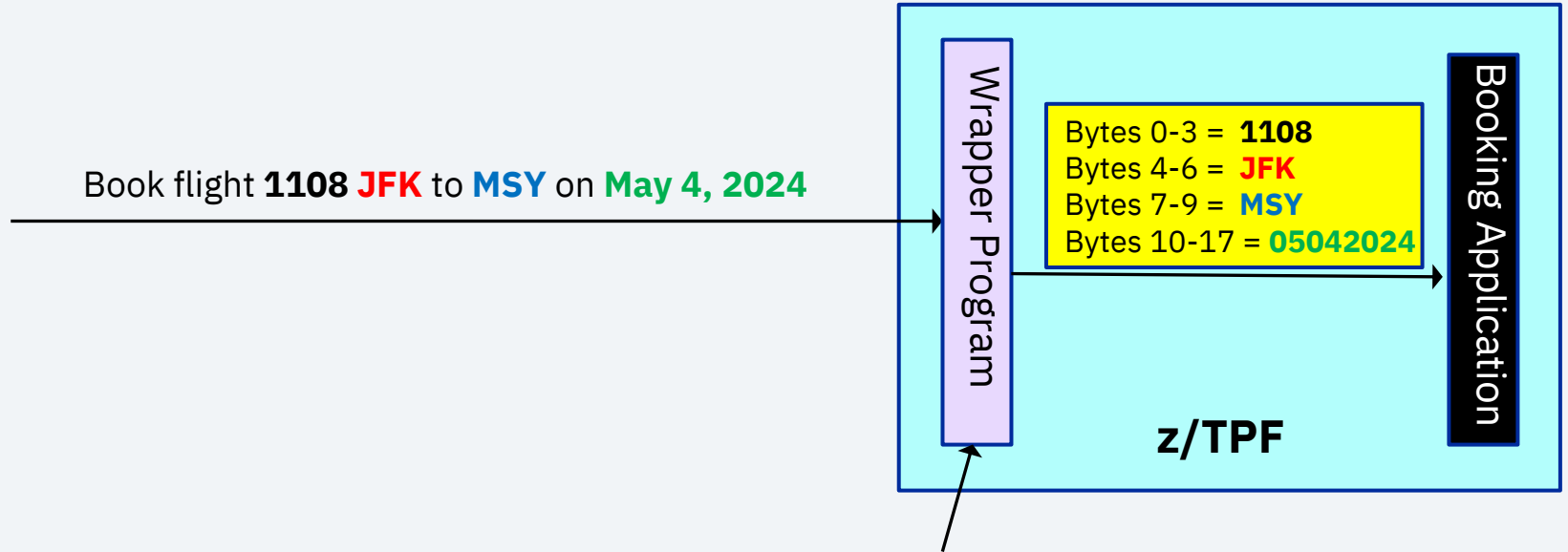
→ Arrange flights, trains, ground transportation, lodging, and so on, then manage the journey

"I want to buy item X from merchant M using credit or debit card Y"

→ Validate the account, balance, make educated guess on whether this is fraud, authorize the purchase if all criteria are met

Input Data the Application Needs Has Not Changed Much Over Time

Book flight **1108** **JFK** to **MSY** on **May 4, 2024**

Wrapper Program

Bytes 0-3 = **1108**
Bytes 4-6 = **JFK**
Bytes 7-9 = **MSY**
Bytes 10-17 = 05042024

Booking Application

z/TPF

User written wrapper program parses input message and moves the data to the input structure required by the application program (and does the reverse for the output message)

Many Different Transport Protocols Have Been Used

Book flight **1108** **JFK** to **MSY** on **May 4, 0001**

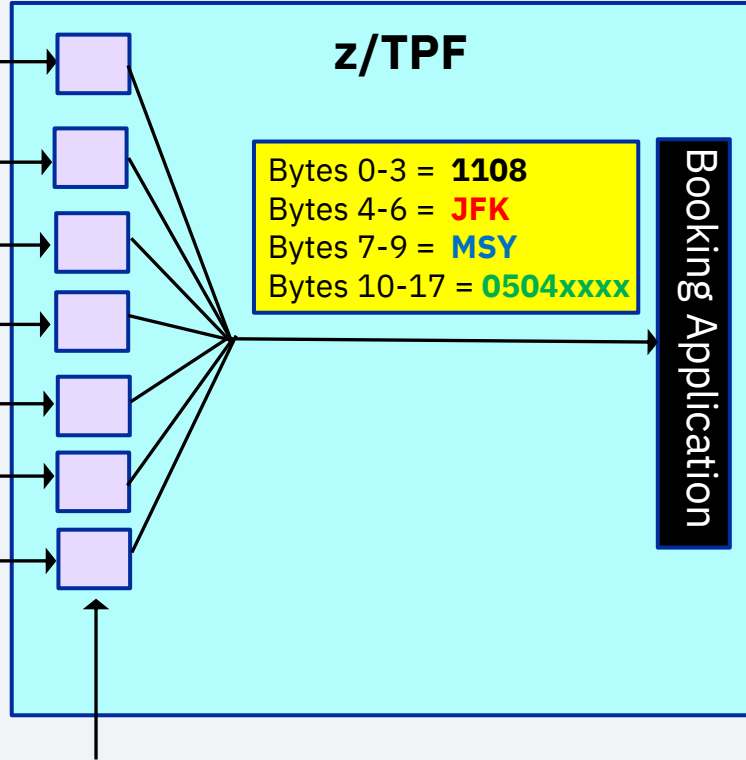Book flight **1108** **JFK** to **MSY** on **May 4, 1844**

SNA
Book flight **1108** **JFK** to **MSY** on **May 4, 1976**

TCP/IP
Book flight **1108** **JFK** to **MSY** on **May 4, 1999**

MQ
Book flight **1108** **JFK** to **MSY** on **May 4, 2001**

HTTP
Book flight **1108** **JFK** to **MSY** on **May 4, 2005**

SOAP
Book flight **1108** **JFK** to **MSY** on **May 4, 2012**

z/TPF

Bytes 0-3 = **1108**
Bytes 4-6 = **JFK**
Bytes 7-9 = **MSY**
Bytes 10-17 = **0504xxxx**

Booking Application

Separate user written wrapper program was needed for each new transport protocol

Why REST is Different... In a Good Way

Book flight **1108** **JFK** to **MSY** on **May 4, 0001**

Book flight **1108** **JFK** to **MSY** on **May 4, 1844**

SNA
Book flight **1108** **JFK** to **MSY** on **May 4, 1976**

TCP/IP
Book flight **1108** **JFK** to **MSY** on **May 4, 1999**

MQ
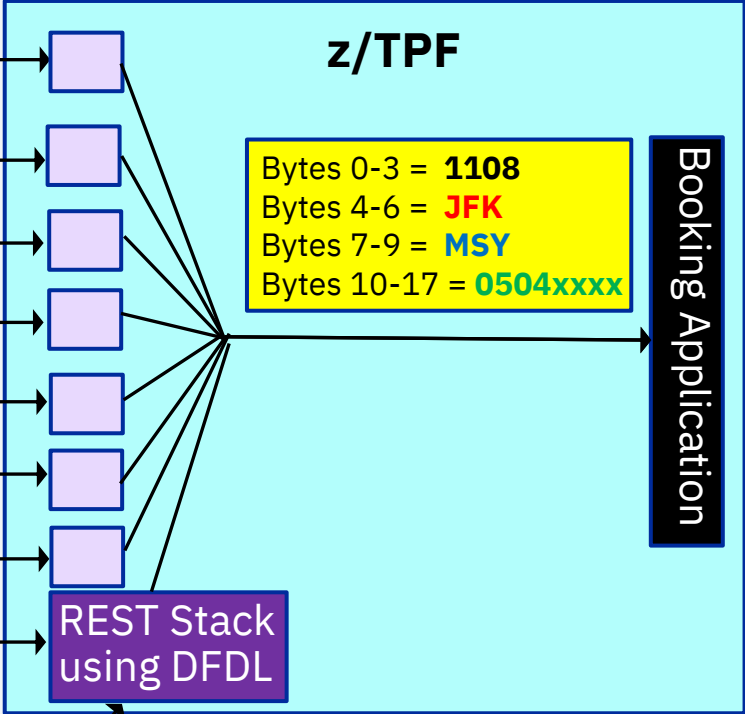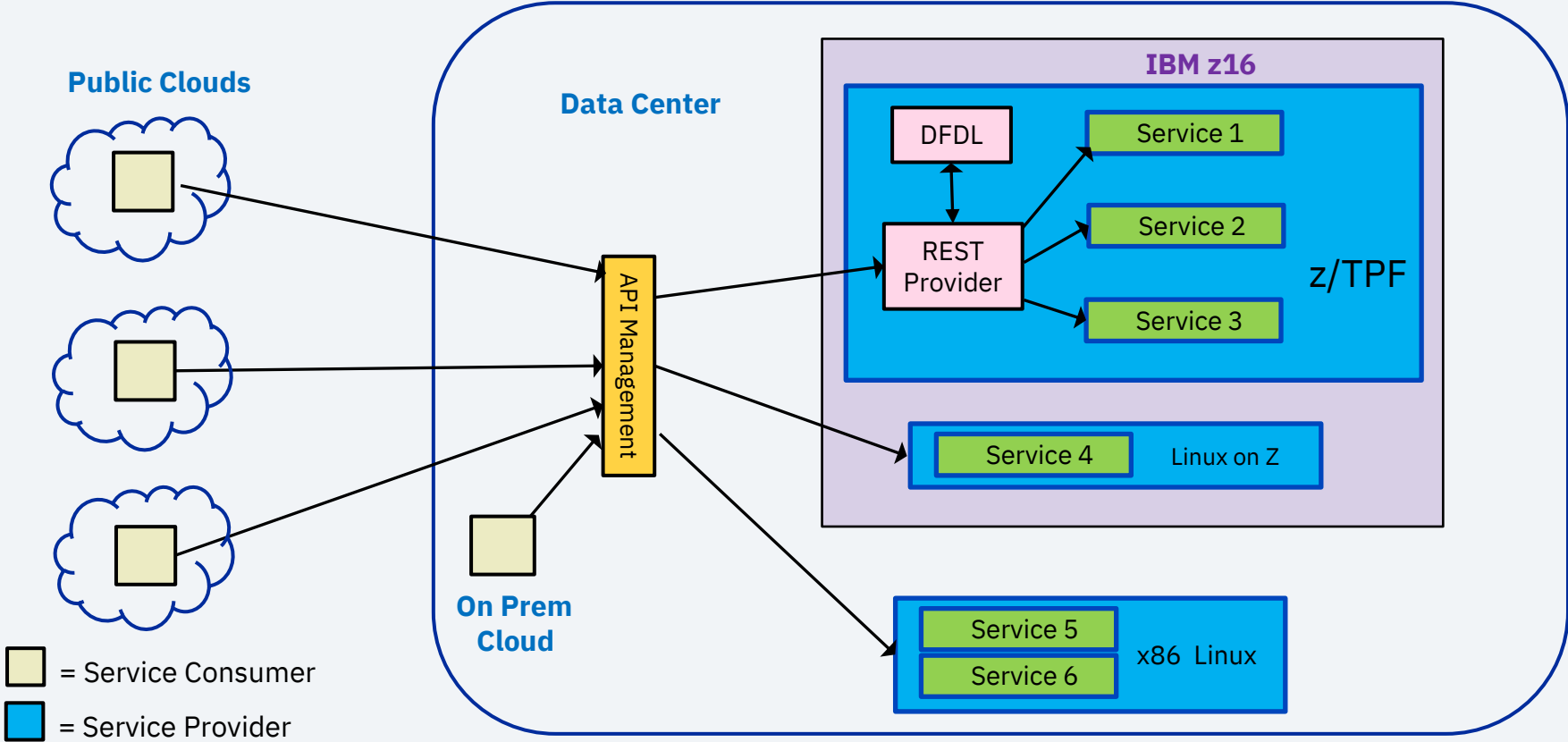Book flight **1108** **JFK** to **MSY** on **May 4, 2001**

HTTP
Book flight **1108** **JFK** to **MSY** on **May 4, 2005**

SOAP
Book flight **1108** **JFK** to **MSY** on **May 4, 2012**

REST
Book flight **1108** **JFK** to **MSY** on **May 4, 2024**

♪ HTTP 2.0

z/TPF

Bytes 0-3 = **1108**
Bytes 4-6 = **JFK**
Bytes 7-9 = **MSY**
Bytes 10-17 = **0504xxxx**
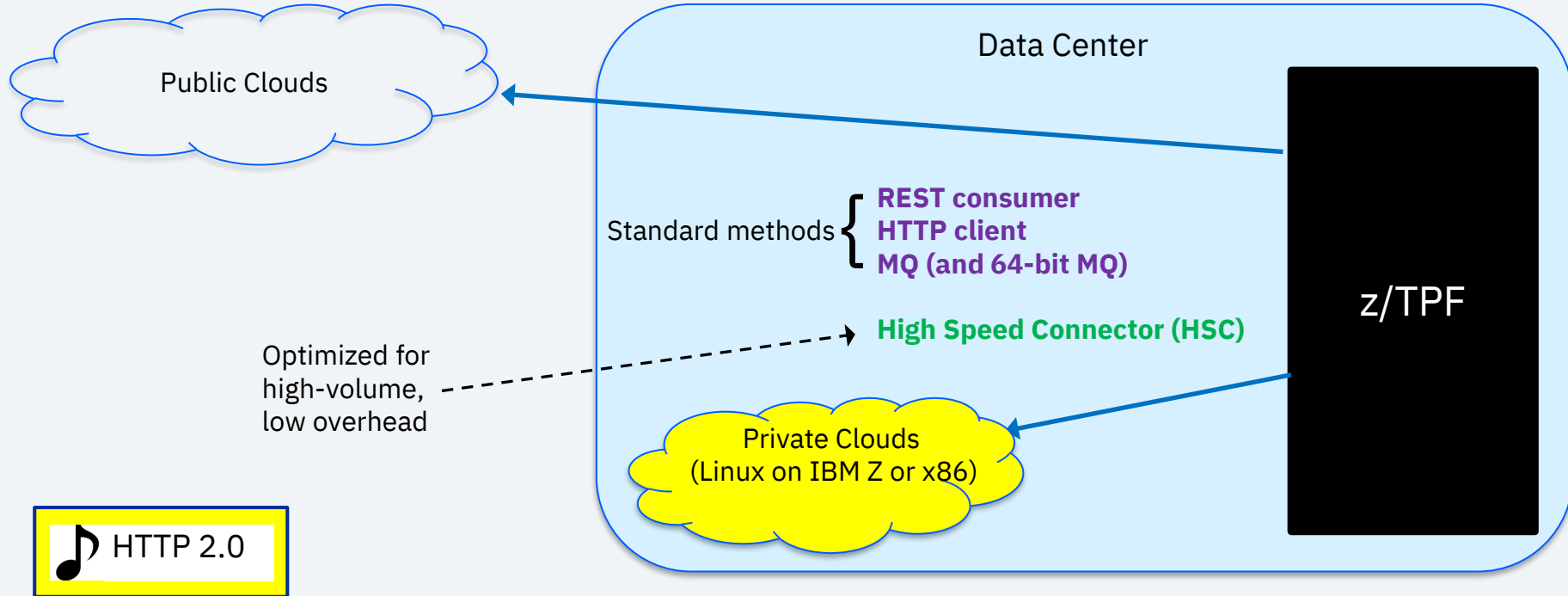
Booking Application

REST Stack using DFDL

z/TPF system code parses the input message and transforms the data (and builds the REST response)

Leverage Centralized API Management (APIM) for All Services

z/TPF Applications Can Also Consume External Services

Public Clouds

Data Center

z/TPF

Standard methods {
REST consumer
HTTP client
MQ (and 64-bit MQ)

High Speed Connector (HSC)

Optimized for
high-volume,
low overhead

Private Clouds
(Linux on IBM Z or x86)

♪ HTTP 2.0

What the Stakeholders Are Saying

Eddie
Architecture

"Externally, you made z/TPF look like **any other platform,** making it very **easy** for cloud applications to **consume core z/TPF services**"

Courtney
Applications

"No more having to write **tedious and error prone** wrapper programs for **every** new and existing service... Halleluiah!

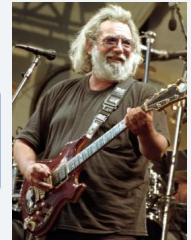"Being able to **manage access to all services**, even those on z/TPF, in a **consistent manner** in one place is heavenly"

David
CISO

"I can take on **more business partners** and **quickly onboard** them using **standard** interoperability options."
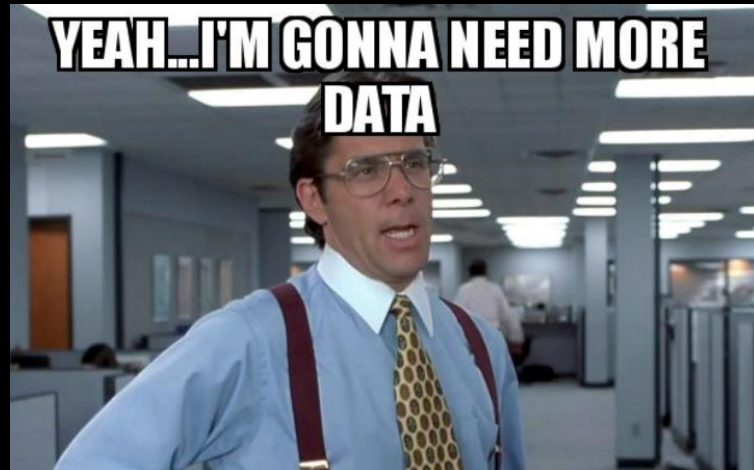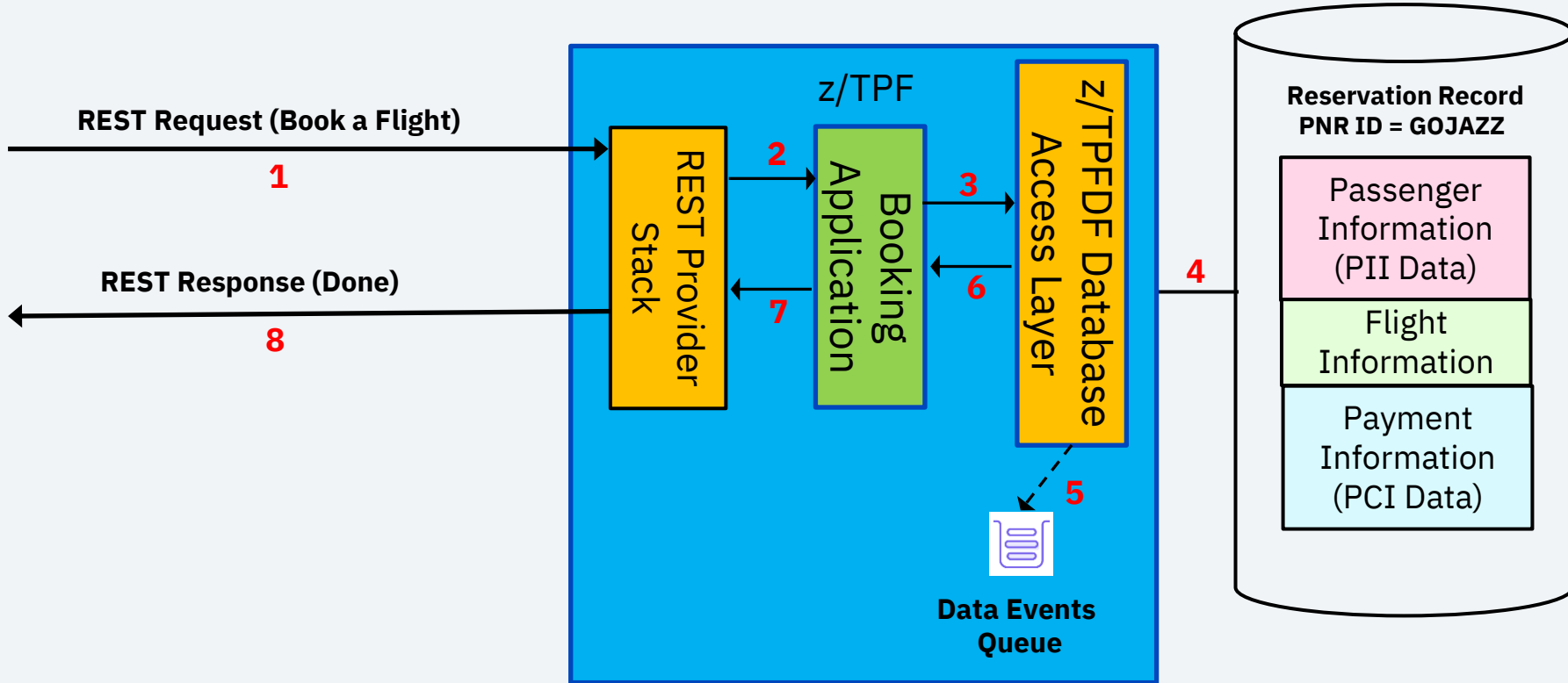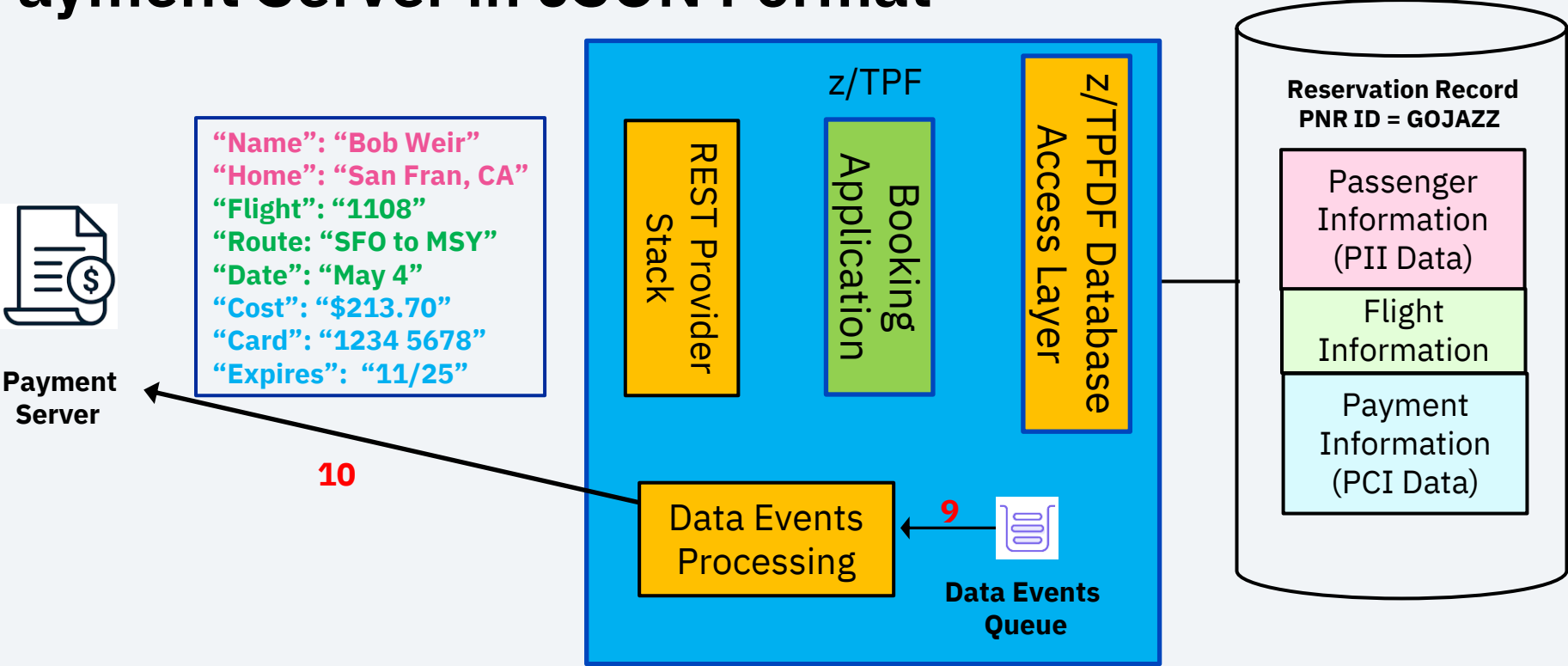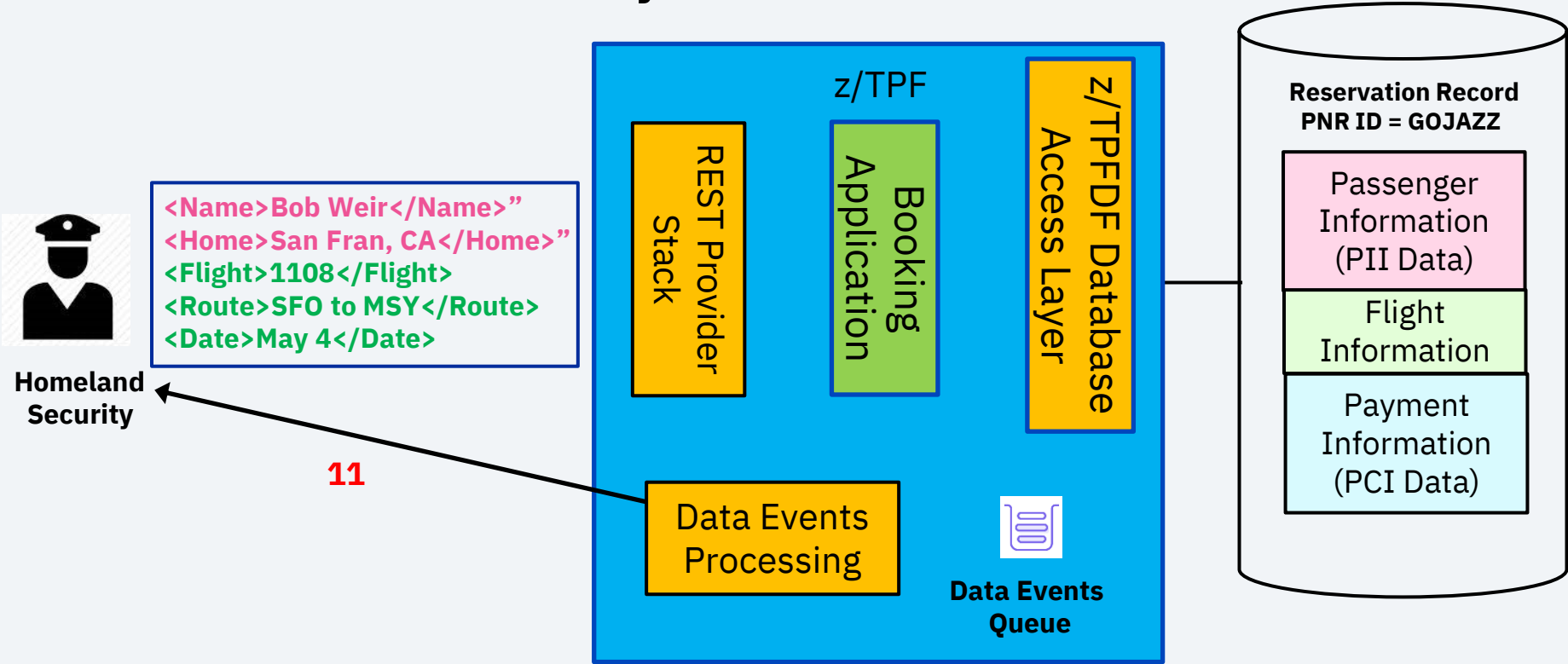

Jerry
CIO

Hybrid Cloud
Data Integration

Transaction Creates a Reservation Record

Copy of Entire Reservation Record Sent to Payment Server in JSON Format

"Name": "Bob Weir"
"Home": "San Fran, CA"
"Flight": "1108"
"Route: "SFO to MSY"
"Date": "May 4"
"Cost": "$213.70"
"Card": "1234 5678"
"Expires": "11/25"

Payment Server

z/TPF

REST Provider Stack

Booking Application

z/TPFDF Database Access Layer

Data Events Processing

Data Events Queue

10

9

Reservation Record PNR ID = GOJAZZ

Passenger Information (PII Data)

Flight Information

Payment Information (PCI Data)

Copy of Reservation Record without Payment Information Sent to Homeland Security in XML Format

Homeland Security

```
<Name>Bob Weir</Name>"
<Home>San Fran, CA</Home>"
<Flight>1108</Flight>
<Route>SFO to MSY</Route>
<Date>May 4</Date>
```

11

z/TPF

- REST Provider Stack
- Booking Application
- z/TPFDF Database Access Layer

Data Events Processing

Data Events Queue

Reservation Record PNR ID = GOJAZZ

- Passenger Information (PII Data)
- Flight Information
- Payment Information (PCI Data)

Copy of Reservation Record with No PII or Credit Card Information Sent to Analytics Server in JSON Format

"Flight": "1108"
"Route: "SFO to MSY"
"Date": "May 4"
"Cost": "$213.70"

"Sales Campaign":
"Free Hurricanes"

Analytics Server

z/TPF

REST Provider Stack

Booking Application

z/TPFDF Database Access Layer

12

Data Events Processing

Data Events Queue

Reservation Record PNR ID = GOJAZZ

Passenger Information (PII Data)

Flight Information

Payment Information (PCI Data)
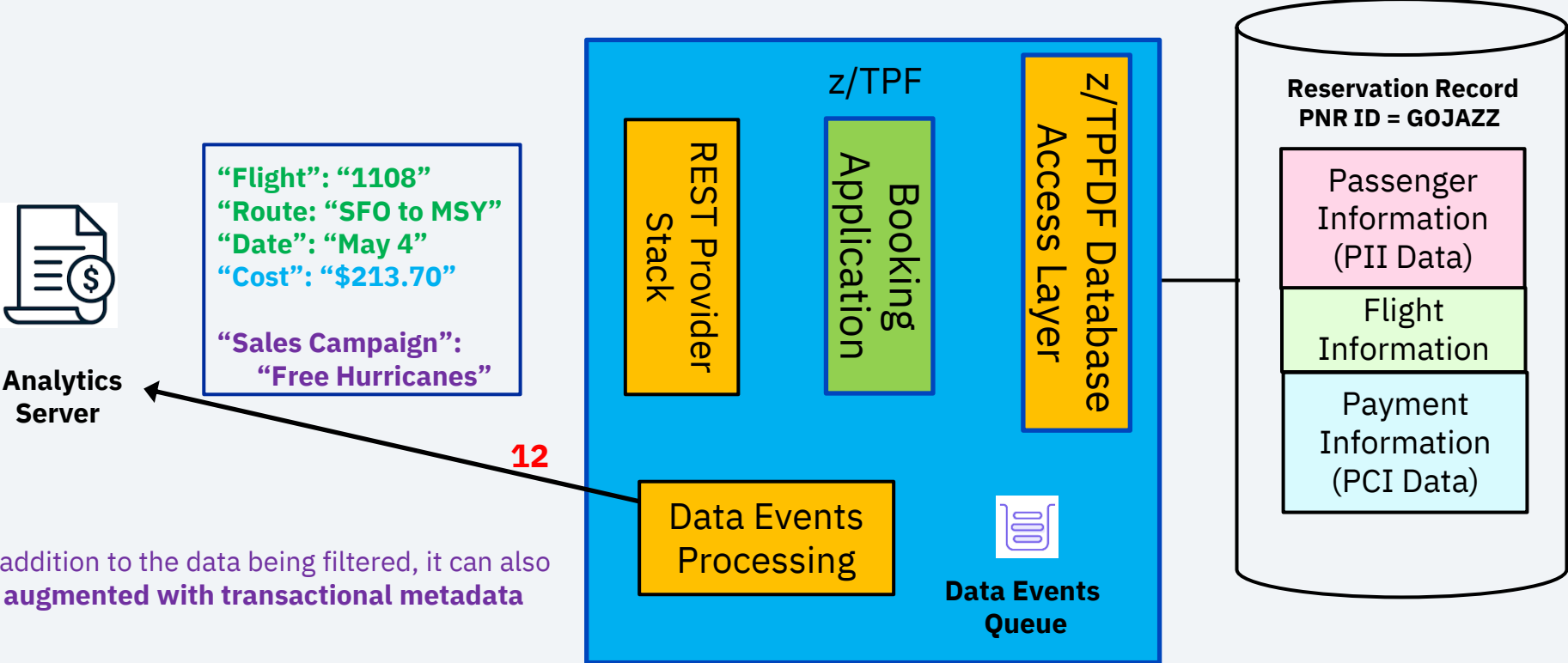
In addition to the data being filtered, it can also be **augmented with transactional metadata**

Remote Access to z/TPF Data – Pull Model
Gate Agent Reads the Reservation Record Using MongoDB

MongoDB Request (Read PNR "GOJAZZ")

Standard
mongoDB
Client

MongoDB Response

z/TPF

MongoDB Support for z/TPF

z/TPFDF Database Access Layer

Reservation Record PNR ID = GOJAZZ

Passenger Information (PII Data)

Flight Information

Payment Information (PCI Data)

"ReservationRecord": [
  "Name": "Bob Weir"
  "Home": "San Fran, CA"
  "Flight": "1108"
  "Route: "SFO to MSY"
  "Date": "May 4"
], "_id" : "GOJAZZ"
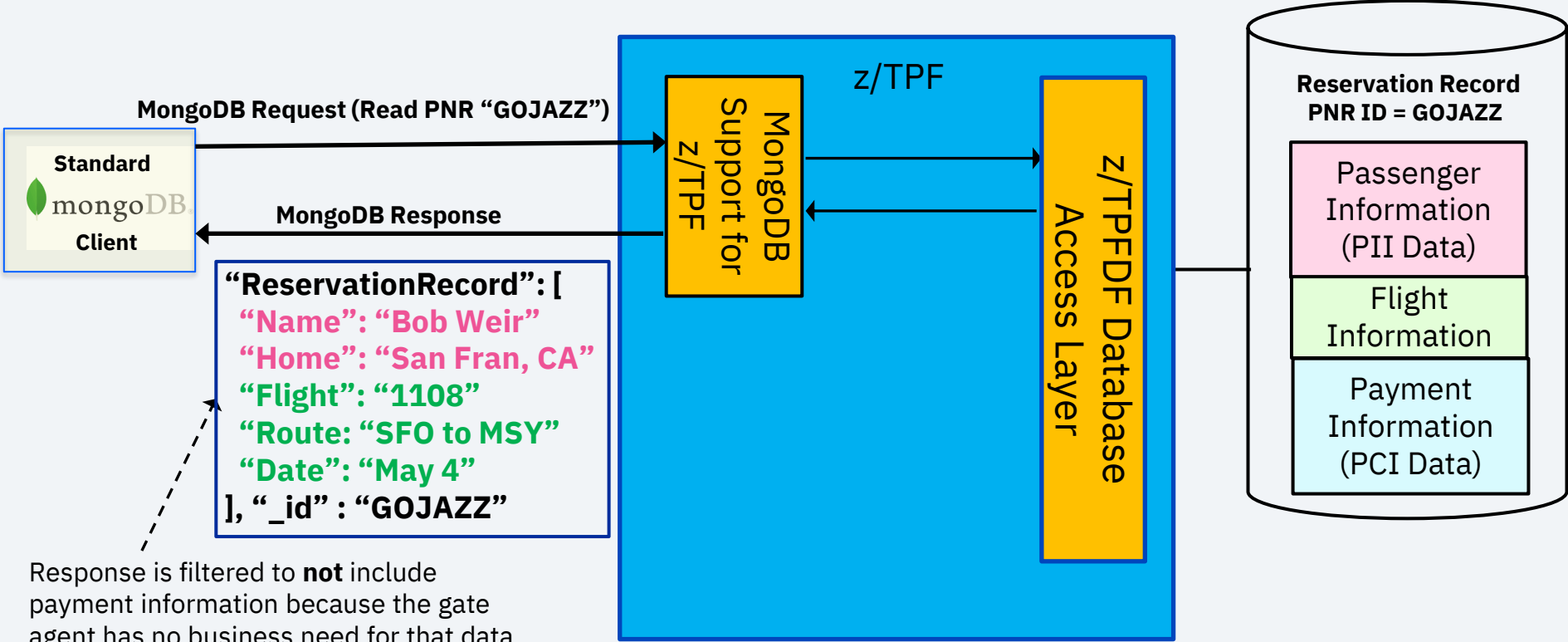
Response is filtered to **not** include payment information because the gate agent has no business need for that data

What the Stakeholders Are Saying

Eddie
Architecture

"All my systems **can access the z/TPF data they need** in a **standard consumable format**!"

"z/TPF data is available to remote systems **without having to change my z/TPF application programs -** Miss World is on top of the world now!"

Courtney
Applications

David
CISO

"Being able to **exclude sensitive data** for users that have no business need for that data **reduces my security risk**"

"Being able to control who can see what data through **configuration options makes it easy to manage.**"

Jimi
Operations

DevSecOps

We're gonna need a bigger boat

Developing a Tier 1 Server Application Service

- These are your **most critical** business services

- The **right design** is of paramount importance

  - You might build it to satisfy one use case, but once others find out it exists, the **transaction rate might increase 10x or more**

  - Excessive database lock contention, network latency, or both can **prevent workloads from scaling**

  - Inability to keep up with security requirements can **prevent you from entering or continuing to operate** in certain markets

- Often requires **modifying/extending an existing application**

- Whenever possible **leverage existing** lower level (micro and macro) **services**

- So what can z/TPF user ***The Music Never Stopped*** do to get it right…

Do Market Research on Industry Trends and New Technology

Free Online z/TPF Education
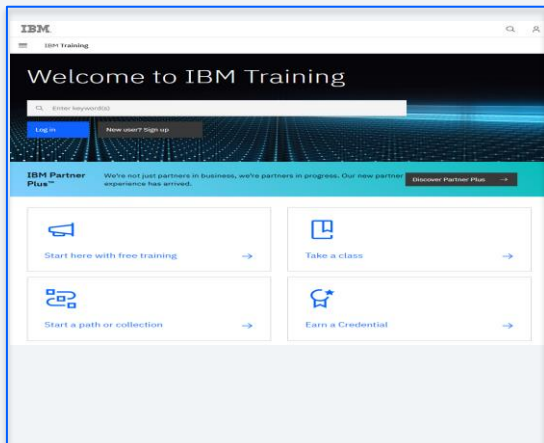
IBM Training

- Graphical videos to teach intermediate and advanced z/TPF concepts, including examples
- Quiz for each section to confirm understanding
- Pointers to additional documentation

- **z/TPF Programming Models**
  - https://www.ibm.com/training/course/ztpf-programming-models-DL007240G

- **z/TPF Task Management**
  - https://www.ibm.com/training/course/ztpf-task-management-DL007241G

- Being developed now:
  - **z/TPF Task Management for Non-Transactional Work**

Free Online z/TPF Training
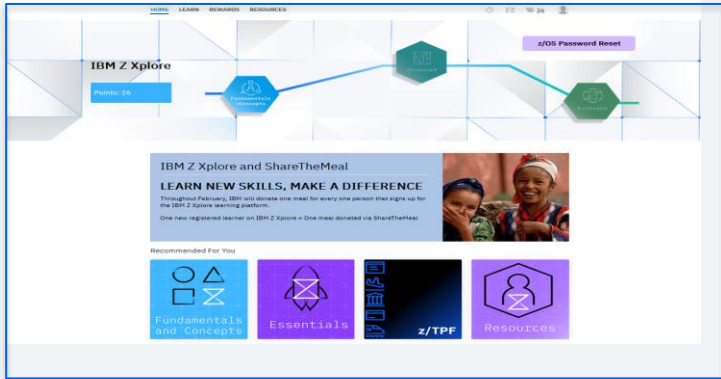
z/TPF Learning Platform (Z Xplore)

- Learn z/TPF technologies by doing
- Hands on exercises on a real z/TPF test system
- Challenges delivered
  - REST
  - Business Events
  - z/TPF Automated Test Framework
  - Data Format Description Language (DFDL)

https://ibmzxplore.influitive.com/users/sign_up?join-code=ztpf

Prototype Various Technologies and Design Options

The z/TPF Dev/Test Experience (The "Dev" part of DevSecOps)

1. Develop code using **TPF Toolkit** (or vendor equivalent IDE)

2. Push button build and deploy to your z/TPF test system

3. Automated testing leveraging **z/TPF Automated Test Framework**:

   – Unit test new and changed code

   – Regression test existing code

4. Use **z/TPF Debugger** to identify and fix code bugs

5. Use **Scriptable Code Coverage** to determine how much new/changed code was tested and identify testing gaps

6. **Real-time Runtime Metrics Collection (RTMC)** :

   – Determine resources impacts of new/changed code prior to deploy to production

   – Identify early in development cycle **if** performance issues exist

7. Use **z/TPF Message Analysis Tool** to identify **where** the performance problems are

   – Also use to train new developers on what your applications do

Security (The "Sec" part of DevSecOps)

- Should **not** be an afterthought

- Internal policies and external regulations are the **minimum** requirements

- Don't wait until after there's an incident to secure your environment
  - Implement proactive approaches like **100% encryption** and **zero-trust**
  - Position yourself to be **compliant with future security requirements**

- So what can z/TPF user *The Music Never Stopped* do to stay safe...

Securing Data in Flight
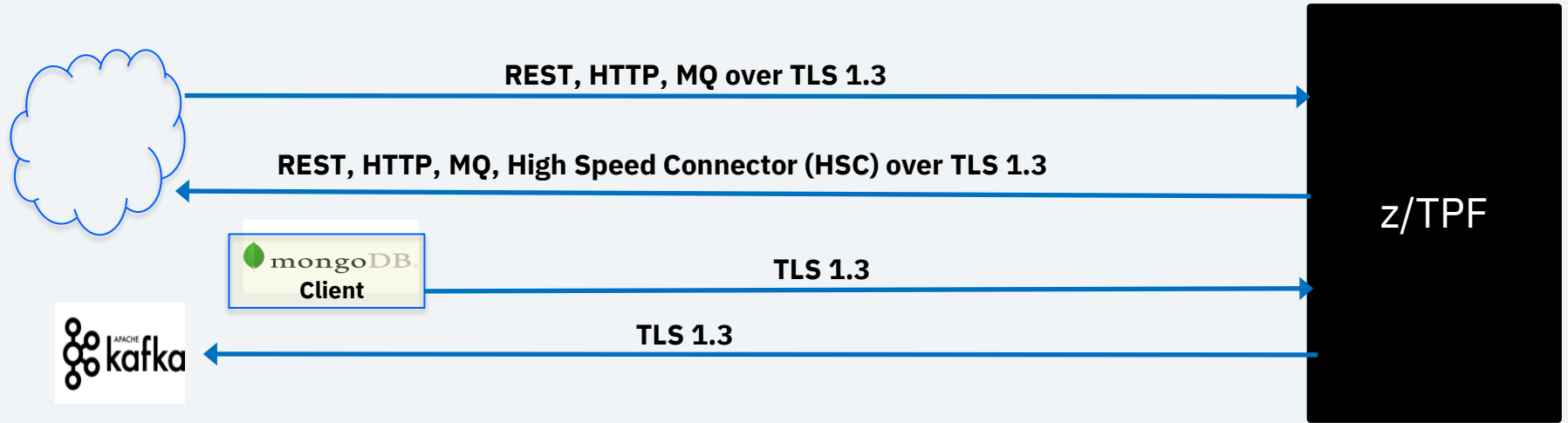
Enough HW crypto capacity to **encrypt all traffic** in and out of z/TPF:
- Transactional requests coming into z/TPF
- Transactional requests to remote systems made by z/TPF applications
- Data accessed by remote users (pull model)
- Data pushed to remote consumers (data events, Kafka)

Securing Data at Rest

Enough HW crypto capacity on IBM Z to **encrypt all data at rest** using **quantum safe cryptography** with **no application changes required**

Data is protected across all exposure points:

1. In z/TPF database memory cache
2. Across the link flowing to the DASD control unit (CU)
3. In the DASD CU cache
4. On disk (prime and dupe copies, only one copy shown here)
5. Across the link between the primary data center and D/R site
6. On disk in D/R site
7. In the data vault (IBM DASD Safeguarded Copy volumes)

♪ Automatic encryption of traditional Find/File DBs
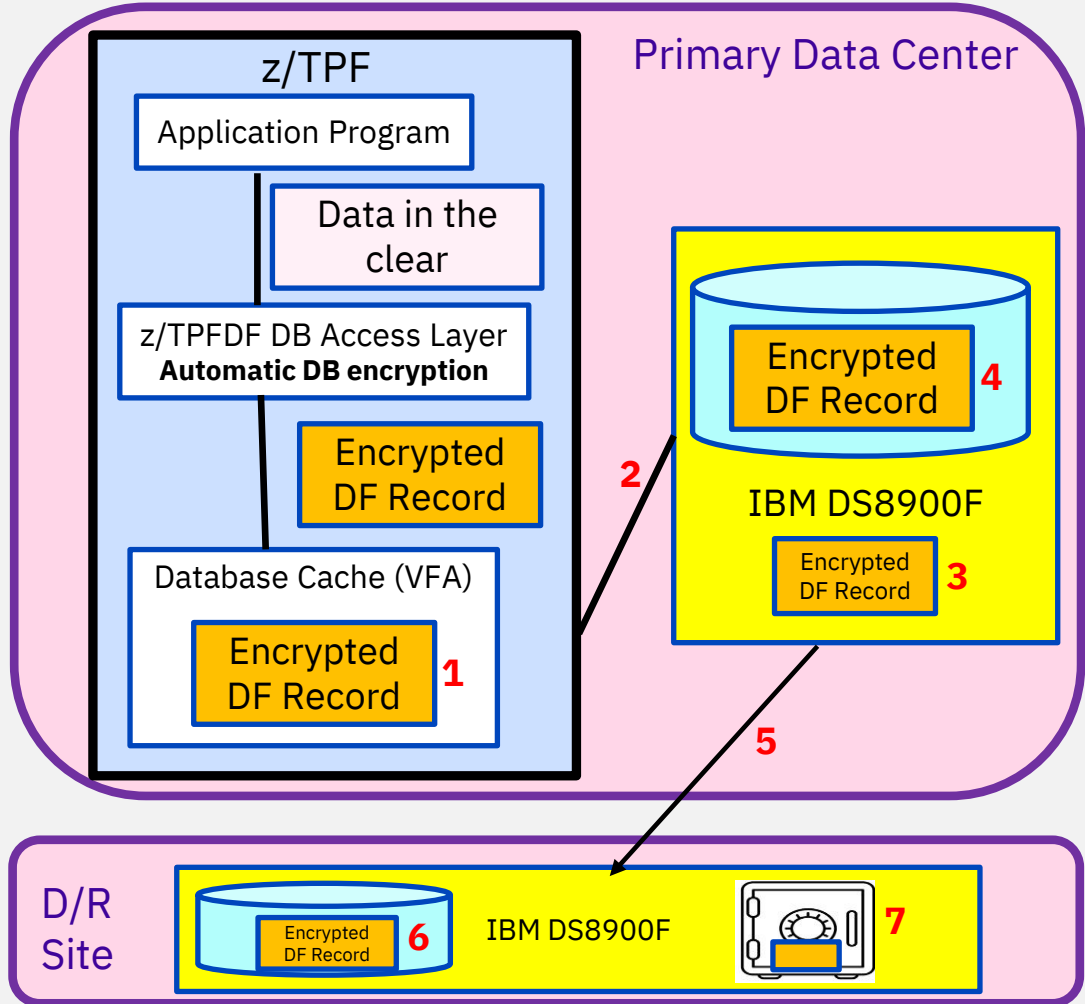
More z/TPF Security

- Protecting **data in use**

- How to design z/TPF applications with **crypto agility** where **encryption usage is transparent**, or if the application uses encryption directly how to design it where the **application does not have to change** when encryption keys or algorithms are upgraded

- **Secure code load** procedures for both z/TPF system code and applications, including Java

- All these topics and more will be covered in a new **IBM Redbook on z/TPF Security** coming soon to download theater near you 🎵

Operations (The "Ops" part of DevSecOps)

- **Deploys** and **manages** application updates

- Needs **observability data** for the end-to-end environment to know whether workloads, networks, and servers are behaving properly

  - You need to collect the **relevant** data

- Should be able to **detect** and **react** to problems in a **timely manner**

- Leverage **automation** as much as possible

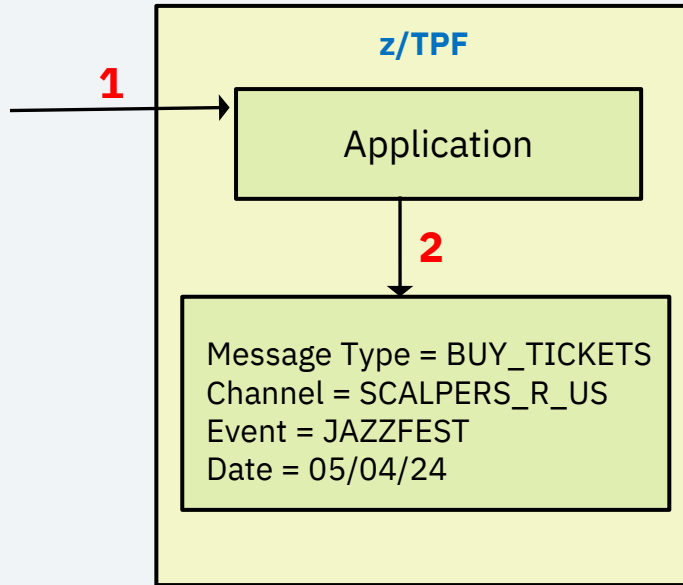- So what can z/TPF user ***The Music Never Stopped*** do keep its business up and running...

Deploy to Production for Limited Use

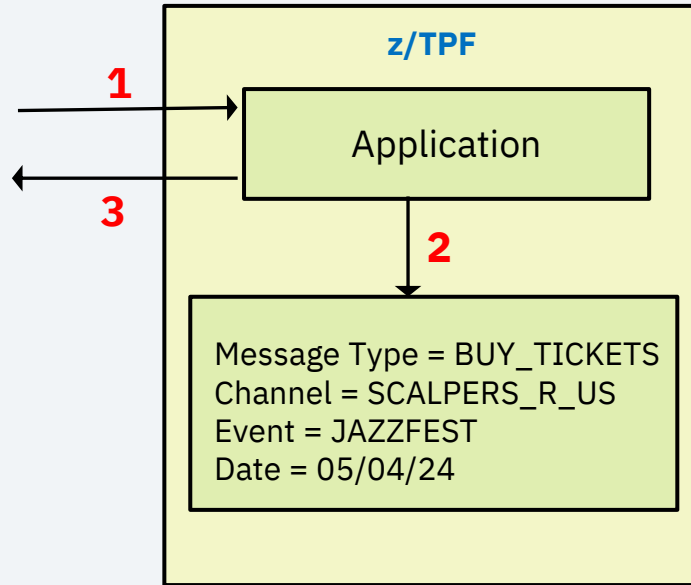# Monitoring Example Part 1: Transaction Arrives from the Network
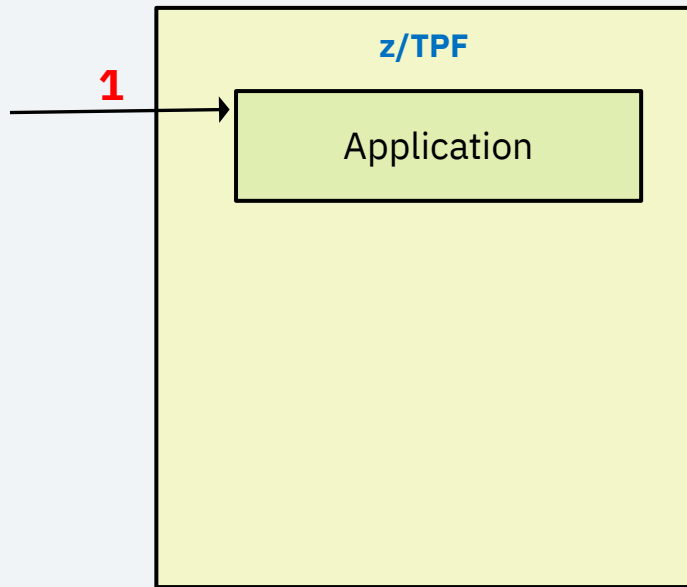
Monitoring Example Part 2: Application Instrumentation Data is Created and Collected while Processing the Transaction
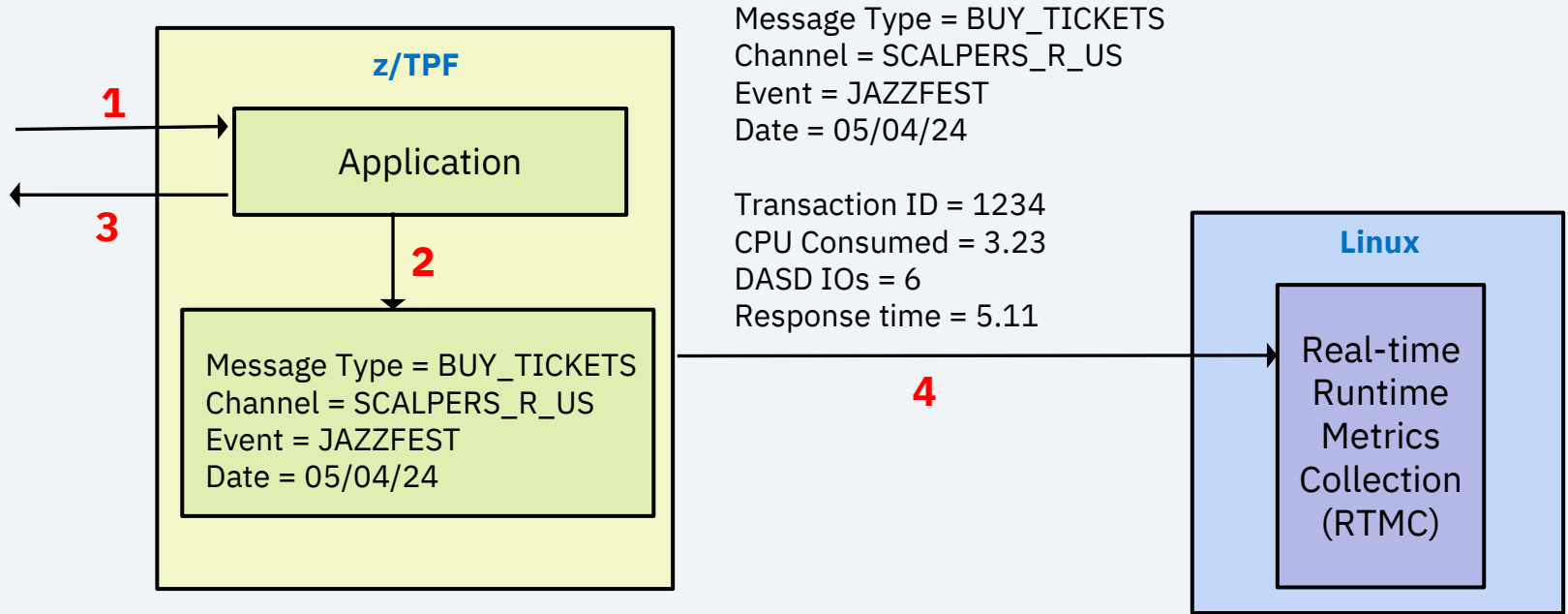

Application creates Name Value Pairs (NVPs) containing relevant data for this transaction. Note that if this is a REST message, some NVPs can be created automatically.

Monitoring Example Part 3: Application Responds to the End User

z/TPF

1

Application

3

2

Message Type = BUY_TICKETS
Channel = SCALPERS_R_US
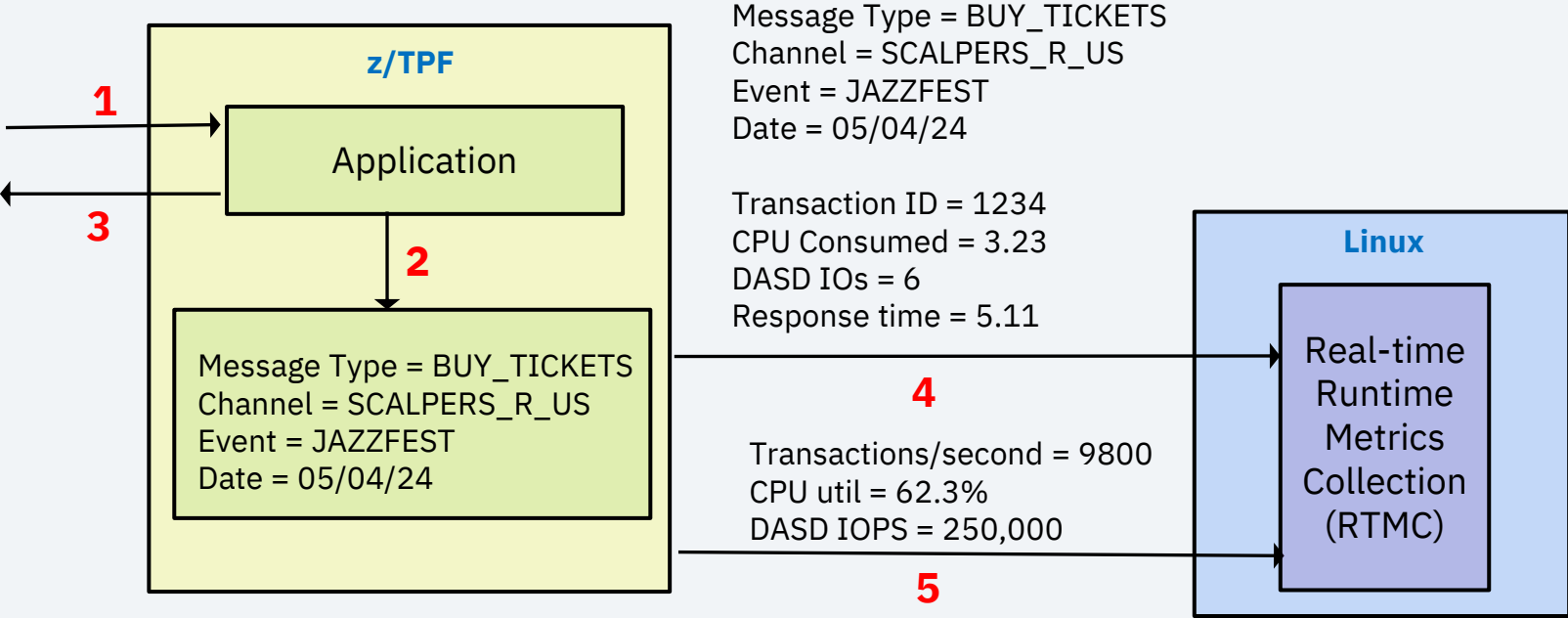Event = JAZZFEST
Date = 05/04/24

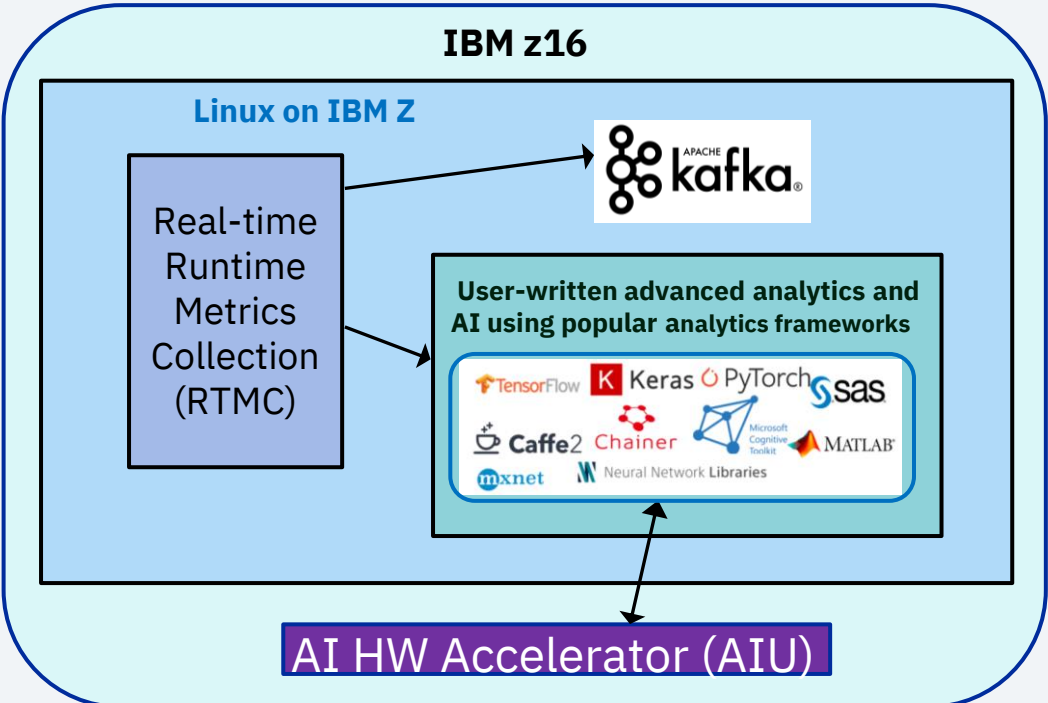# Monitoring Example Part 4: Transaction Data is Fed to RTMC

Includes unique transaction identifier, NVP data, and resources consumed processing this transaction.

Monitoring Example Part 5: System Metrics Data is Fed to RTMC

z/TPF

1

Application

3

2

Message Type = BUY_TICKETS
Channel = SCALPERS_R_US
Event = JAZZFEST
Date = 05/04/24

Message Type = BUY_TICKETS
Channel = SCALPERS_R_US
Event = JAZZFEST
Date = 05/04/24

Transaction ID = 1234
CPU Consumed = 3.23
DASD IOs = 6
Response time = 5.11

4

Transactions/second = 9800
CPU util = 62.3%
DASD IOPS = 250,000

5

Linux

Real-time
Runtime
Metrics
Collection
(RTMC)

Feed overall system usage and health data to RTMC once a second

Monitoring Example Part 6: Real-Time Operational and Business Analytics

IBM z16

Linux on IBM Z

Real-time Runtime Metrics Collection (RTMC)

User-written advanced analytics and AI using popular analytics frameworks

TensorFlow · Keras · PyTorch · SAS · Caffe2 · Chainer · Microsoft Cognitive Toolkit · MATLAB · mxnet · Neural Network Libraries

AI HW Accelerator (AIU)

Real-time insights **at scale** on z16

Grafana Dashboards

MsgType	Coef-Lt	Coef-Rt	MatDelta
Avail	-0.45	0.91	0.28
Shopping	-0.09	0.17	0.00
Booking	-0.02	-0.25	0.00

Avg CPU per Message Correlated

Actual System CPU and CPU Model Based Upon Point in Time Message Mix
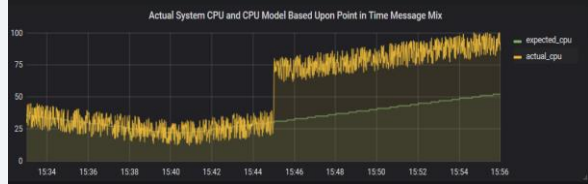
Quickly identify unexpected changes in behavior and whether an issue is **system wide** versus **isolated** to a particular application or end user

♪ OpenTelemetry (OTEL)

Full Scale Deployment Communicating with Over 40,000 End Users Concurrently

What the Stakeholders Are Saying

Courtney
Applications

"With these tools I can **improve developer productivity, code quality,** and leverage **automated testing**."

David
CISO

"Leveraging your **pervasive encryption** capabilities, I can **protect all my z/TPF data** and am no longer feeling *Comfortably Numb*"

"I can do **much better capacity planning** for application changes and can **solve production problems in a fraction of the time it used to take**."

Jimi
Operations

Eddie
Architecture

"My organization can shift from *Runnin' With The Devil* to **true DevSecOps practices** for all future enhancements"

Encore!

Overall Impressions on Art of the Possible

- The leaders for z/TPF user ***The Music Never Stopped*** read **the z/TPF Application Modernization** Redbook

- They instruct their teams to read it as well and have follow up deeper dive meetings with IBM, then report their findings and plans

- Senior leadership's reactions are …

Summary Stakeholder Reactions

Eddie
Architecture

"I can create an **integrated hybrid cloud** architecture where services and data are **available and easily consumable** by all."

Courtney
Applications

"I can achieve **developer agility, improve time to market and quality**, and benefit from **shift left savings** throughout the dev/test cycle."

Jimi
Operations

"No more *Manic Depression* as I now have **real-time insights** to **efficiently manage my workloads and systems** unleashing the full potential of **AIOps**"

David
CISO

"I can **protect everything** affordably, **remain compliant** without having to make application changes, and **reduce risk** by **intelligently replicating data**."
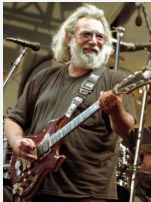
Jerry
CIO

"I can **progressively modernize my applications and workforce** to transform and **grow my business** where we can keep on *Truckin'* "

Thank you