監控中台AIOps
實現應用創新與IT價值的融合

Tony Liu (劉育誠)
Technical Solution Architect
IBM Cloud & Cognitive Software

演講內容

- 工業**4.0**時代維運及流程處理的挑戰
- **DevOps**系統發展及監控中台整合
- **AIOps**智慧化維運及自動流程處理
- **AIOps**雲服務價值的融合
- **AIOps**雲服務展示及案例分享

工業4.0時代維運及流程處理的挑戰

10x-100x 資訊速度時代

設備資料數位化->通訊協定複雜->整合資料繁瑣

老闆說：全面轉型工業4.0...

員工說：數位化流程有許多困難

Software Development
轉型數位化如何整合異質性資料

Hardware Engineer
廠區內通訊設備/協定過多，有通訊協定的整合及安全問題

Reliability Engineer
流程處理跟原來不一樣，如何問題分析處理驗證資料

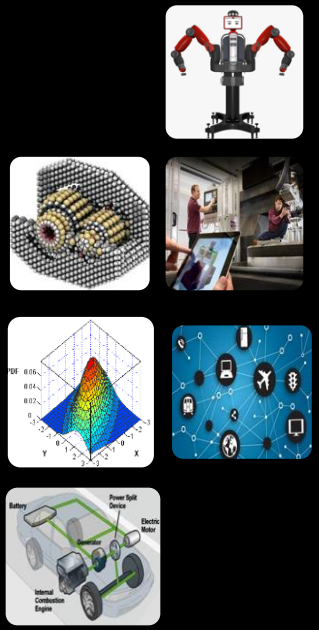
Operations Engineer
數位整合後如何即時監控IT/OT設備資料

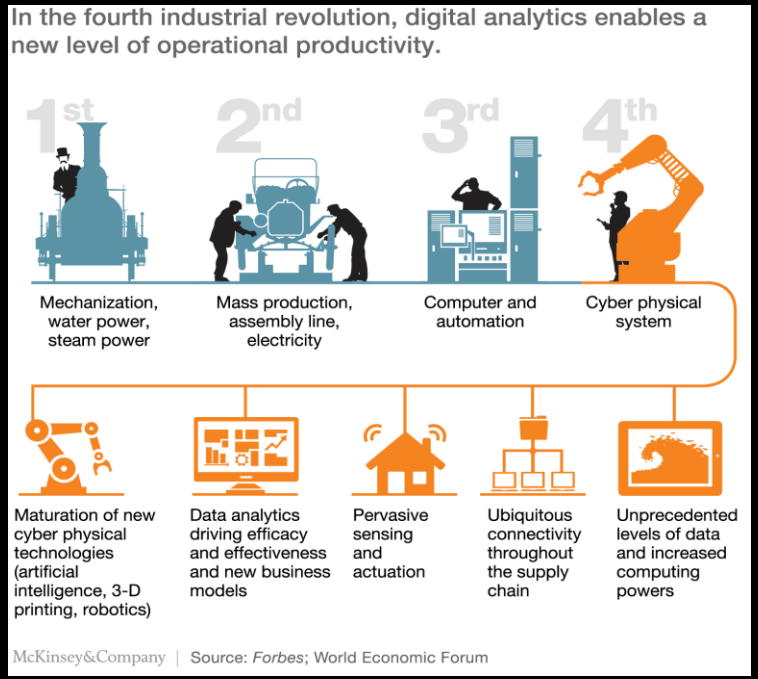
工業數位發展

工業 4.0將傳統線性數據和通訊轉化成即時處理查詢數據的智能化轉變
透過如工業物聯網 (IIoT)、數據分析、3D列印技術和人工智慧應用，加速資料與現實物體間的結合過程，應用IT/OT技術整合來提升優化製造的業務、技術、基礎設施和勞動力的執行流程

Selected Technologies

Hybrid, Electrified, and Autonomous Vehicles
Sensors, Controls, and Vision Systems
Nanotechnology
Alloys, Composites, and Adhesives
Model Based Enterprises
Multi-variant Simulations
Additive Manufacturing/3D Printing
Collaborative Robots
Integrated Supply Chain
Smart Maintenance/Manufacturing
Internet of Things and Real Time Data
Big Data and Decision Optimization





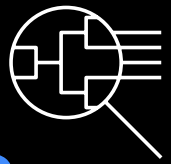
工業數位流程處理的轉變

1 應用資訊中台整合

優秀的中間件溝通及彙整各項設備資訊的通訊能力是資訊中台擔任重要的角色，而面對企業間已使用的各種資料庫該如何透過資訊中台來進行收集關聯各表單間的欄位

2 雲平台資料整合

Google, Amazon, Azure 不同雲平台的資料的整合及各種資源上的調度監控，也將會是一大挑戰。能夠快速地進行佈署建置，又可整合多雲架構下的各項資源及服務監控資源



3 問題發現即通知

更快速的事件反應方式，代表著更快速的解決問題，從機台的操作異常到供應鏈的設備供需數量預測，若能更精準快速的反應當前的狀態，將會大幅縮短時程提高產能及開發效益

4 流程再造方式

結合人員、流程、技術敏捷的效率來改善整體的企業文化價值，提升優化製造的業務、技術、基礎設施和勞動力的執行流程

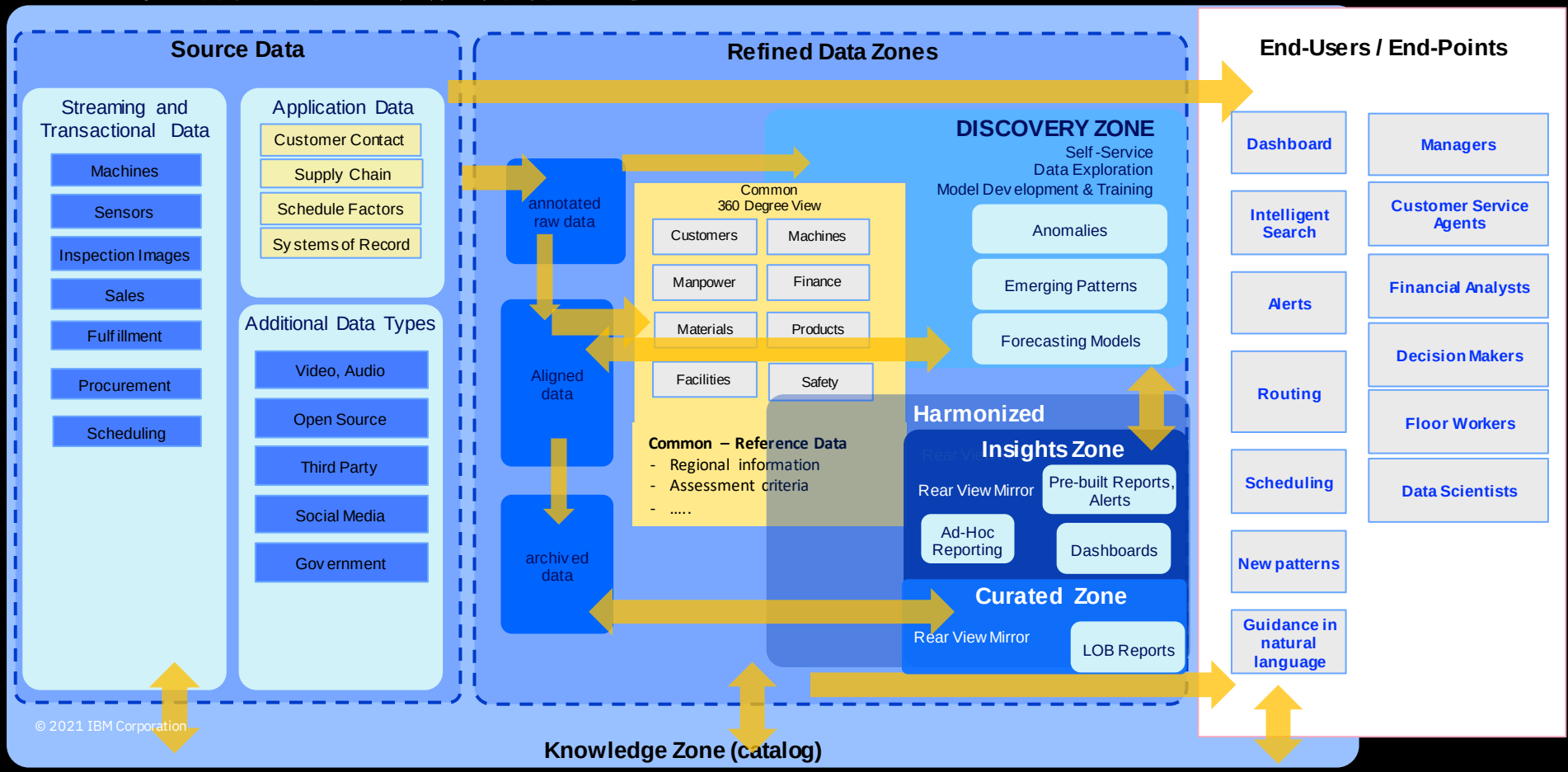
5 績效報告方式

IT/OT人處理異質性的資料，來給予資料科學分析人員透過人工智慧及機器學習的方式，提供Visualization報表或圖表呈現，都會花費許多的流程及時效，而更重要的是對於開發或操作人員的成本也會是個須考量的議題

Industry with Automation Middleware

工業 4.0 將從根本上改變他們開展業務的方式。來自許多不同來源和地點的數位資訊的集成(CI)可以在一個持續的循環中推動開展業務佈署(CD)的行為過程

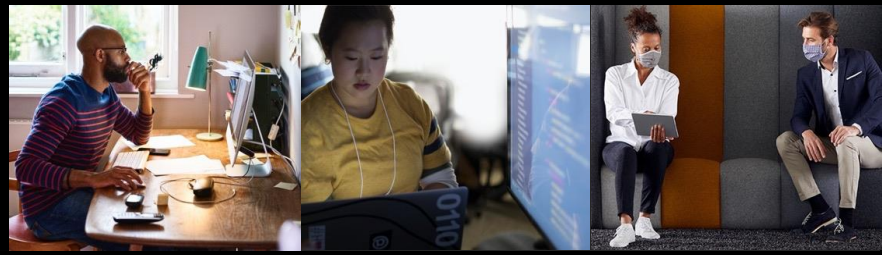
工業數位轉型及資料應用



DevOps系統發展及監控中台整合

Speed 開發及維運能夠有多快

整合三大環節 技術->人員->流程



老闆說：DevOps是什麼...

維運說：**它是加速專案流程**

工廠化生產的方式

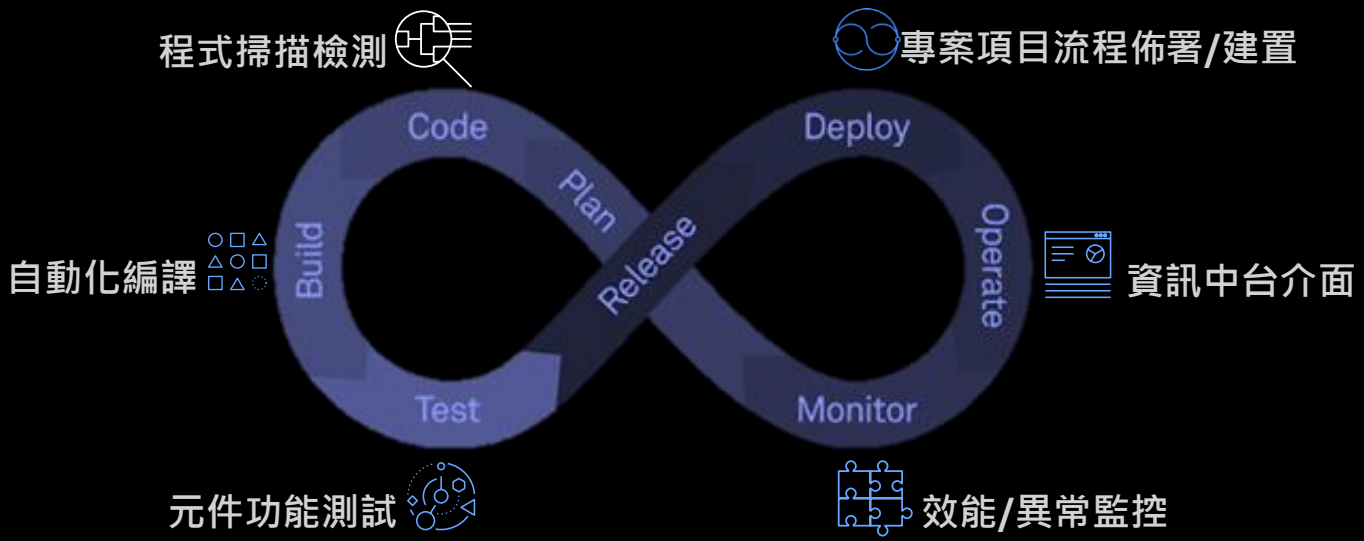
before

after

- Shorter time to diagnose and resolve
- Less effort and skills required
- Reduced risk as (earlier) detected anomalies evolve into client impacting outages

IBM

DevOps自動化維運系統發展與組織文化



客戶需求/研發 → 自動化編譯/測試 → 工程/項目產出 → 數字績效 → 組織文化

隨著專案數量增長，更需要的是隨即而來發生錯誤時，異常問題的反應管道，以及反應各項工程/項目佈署建置及執行時的狀態是否正常。

DevOps專案管理流程的轉型

IBM Cloud Pak for **Watson AIOps**

單一服務 → 多元服務

SPEED

決策制定
獲取建議的補救措施，應用ChatOps結合通訊軟體集中CI/CD流程與異常制定

行動處理
跨工具關聯、整理和突出顯示最相關的數據，無需手動調查

發現問題
結構化和非結構化來源中提取和分析數據，包括日誌、指標、事件和紀錄

自動最佳化
根據過去的事件操作相關性自動執行維運流程

DevOps及監控中台整合

Break the IT Ops Silos

跨結構化和非結構化數據源的洞察力和智能全面了解業務應用程序，以識別異常。

1. 基礎設施 (可視覺化的監測及操控各項服務及容器、服務流量分流、自動化負載平衡HA)

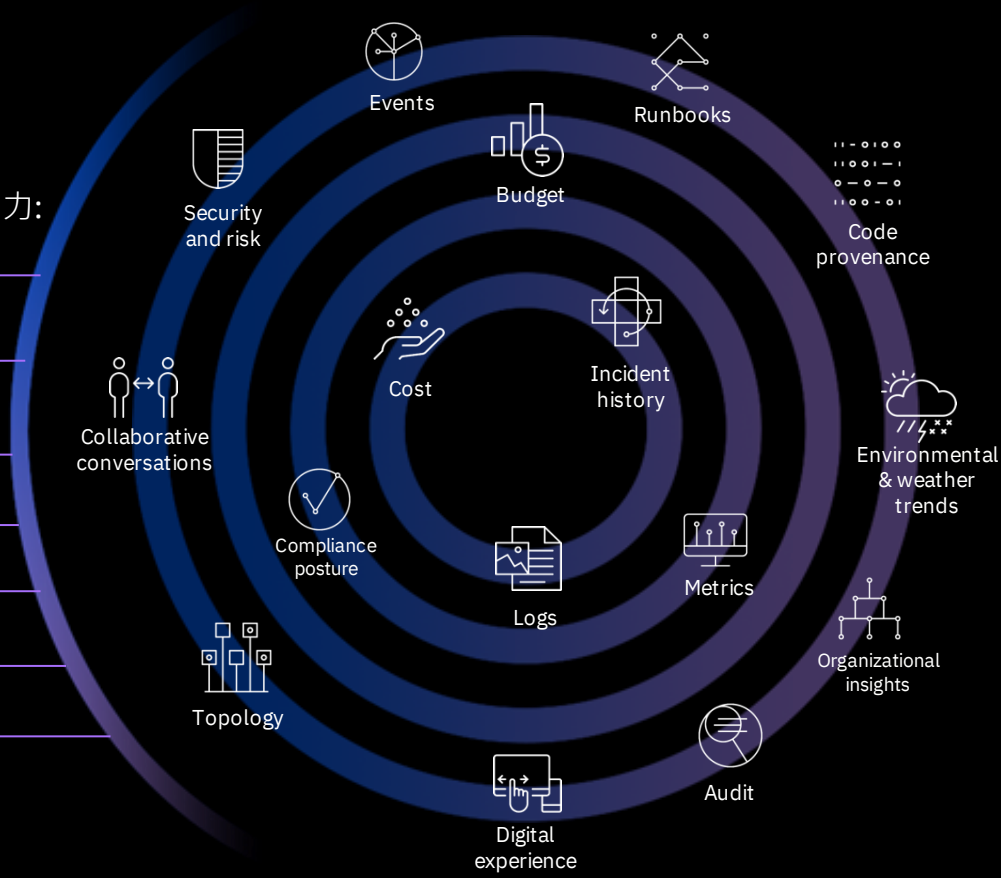
2. 共用服務 (異質資料庫的連接、雲平台間資料共享、即時串流資料介接、系統事件偵測及回報)

3. 應用平台 (流程引擎、資料分析、監控設備及服務狀態、資源調度管理)

4. 領域服務 (金融、醫療、電商、資料科學領域)

監控中台具備能力:

- DevOps CI/CD
- Tickets, Logs, Metrics, Events, Topology
- 數位領域服務
- 應用解決方案
- 數據應用平台
- 共用服務
- 基礎設施



AIOps智慧化維運及自動流程處理

APM & ARM+AI 服務資源監控

1. APM: 以應用服務內通訊為中心監控
2. ARM: 以應用服務內資源為中心監控

維運說：小朋友才做選擇、我全都要

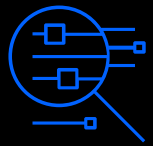
Software Development
即時資料得進行取得，但設備端服務怎麼沒有回應 ...

Operations Engineer
廠區監控查看到異常事件紀錄，但找不到問題點，只好找OT/IT解決

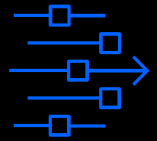
OT Engineer
憑著經驗去檢查設備看看好了 ...

IT Engineer
服務數量太多需要重新啟動，難道沒有自動的方式 ...

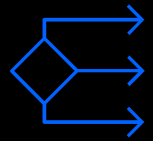
Instana + Turbonomic - 介紹及應用



程式監控
Full-Stack Code Trace
Code-focused
支援各種前端及後端應用服務



基礎設施
Dynamic resource management
infrastructure-focused
監控支援智能分析各項基礎設施及雲服務資源



自動化分析
Automation
Event-Focused
事件處理及預測

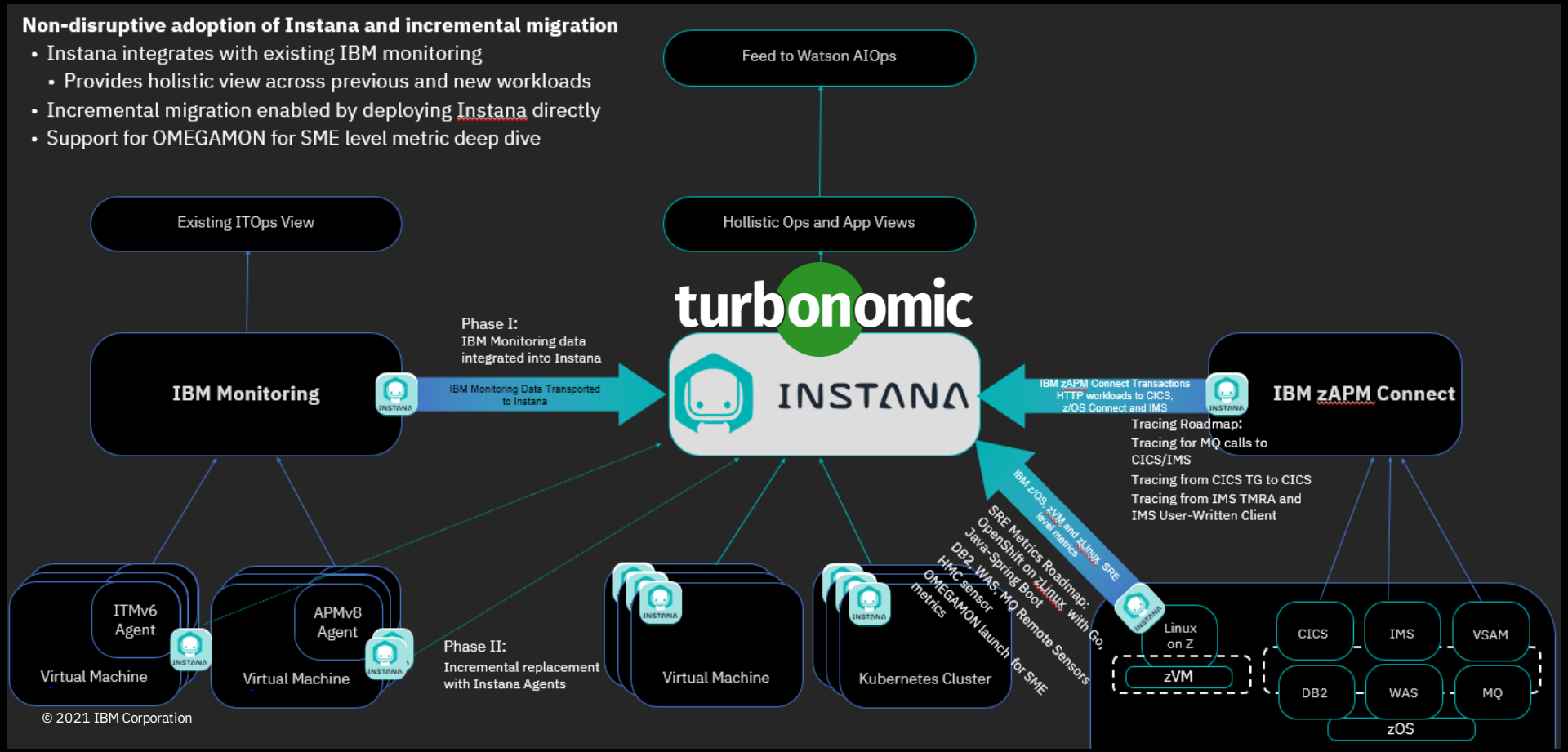
INSTANA ⟷ 發現事件 turbonomic ⟷ 最佳化處理 Watson AIOps

- 監控各項Metrics效能指標
- 跟蹤各種HTTP請求狀態
- 圖示各類連結組件/服務
- 分析各類效能可行性最佳化
- 分析事件顯示介接 (ELK)
- 通知事件顯示介接 (Slack)

- 監控分析使用API連結通訊(No Agent)
- 智能分析各項基礎設施及雲服務資源需求建議
- 制定監控各項標準服務資源符合業務使用需求建議
- 自動化調配各項服務資源的調配 (減少/增加)
- 整合各項通訊協定端點資源監控 (Cloud/Storage/VM/API)

- 異質性資料處理
- AI Manager整合資源管理

Instana + Turbonomic - Architecture



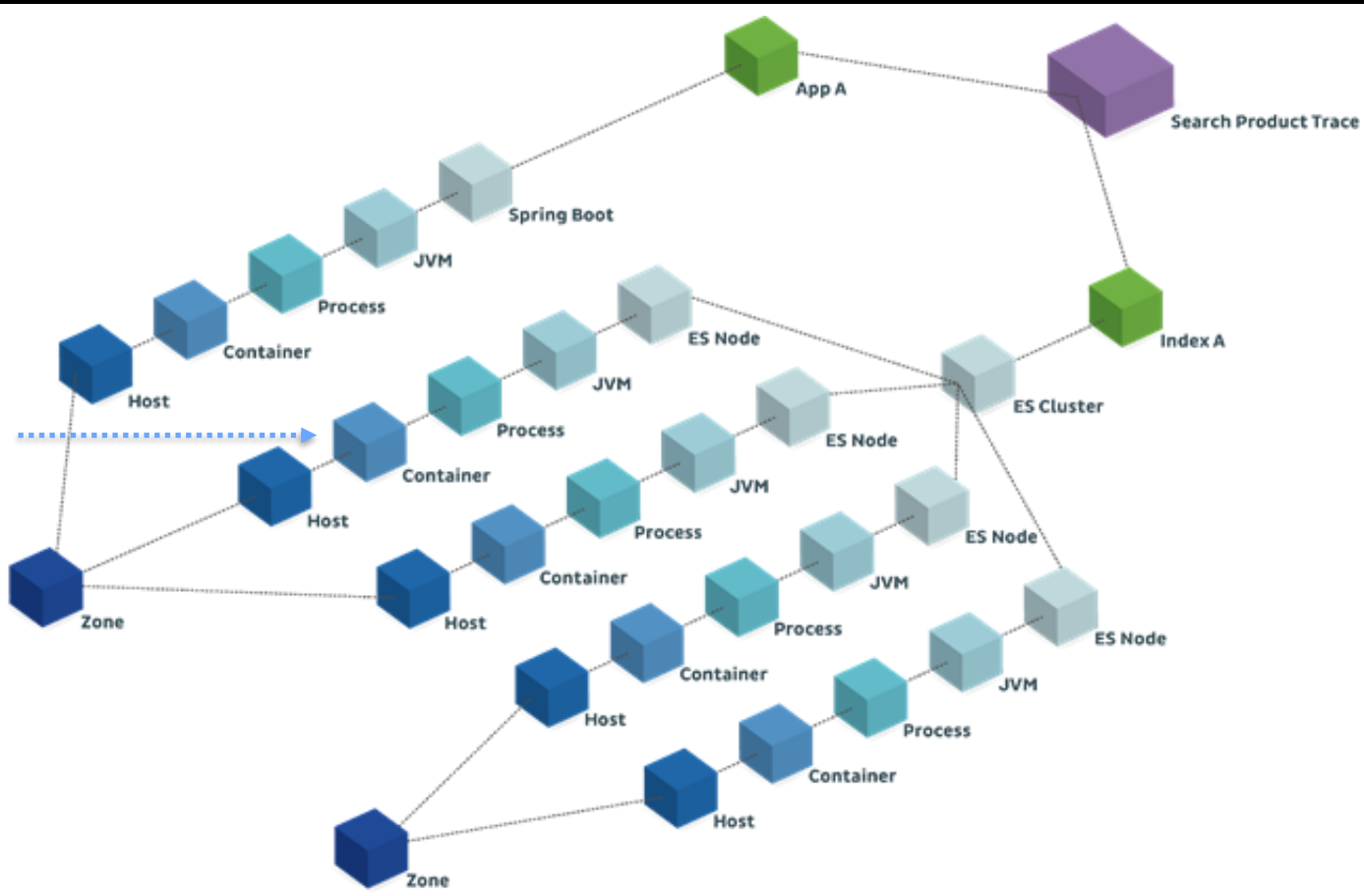
Instana - 圖示各類連結組件/服務

1. 圖示各類連結組件/服務

應用間的連結組件/服務使用圖像方式呈現，包含可監控類型的服務如(Containers, Microservice, JVM)一體化的於介面點選瀏覽細節資訊

2. 導覽連結組件資訊

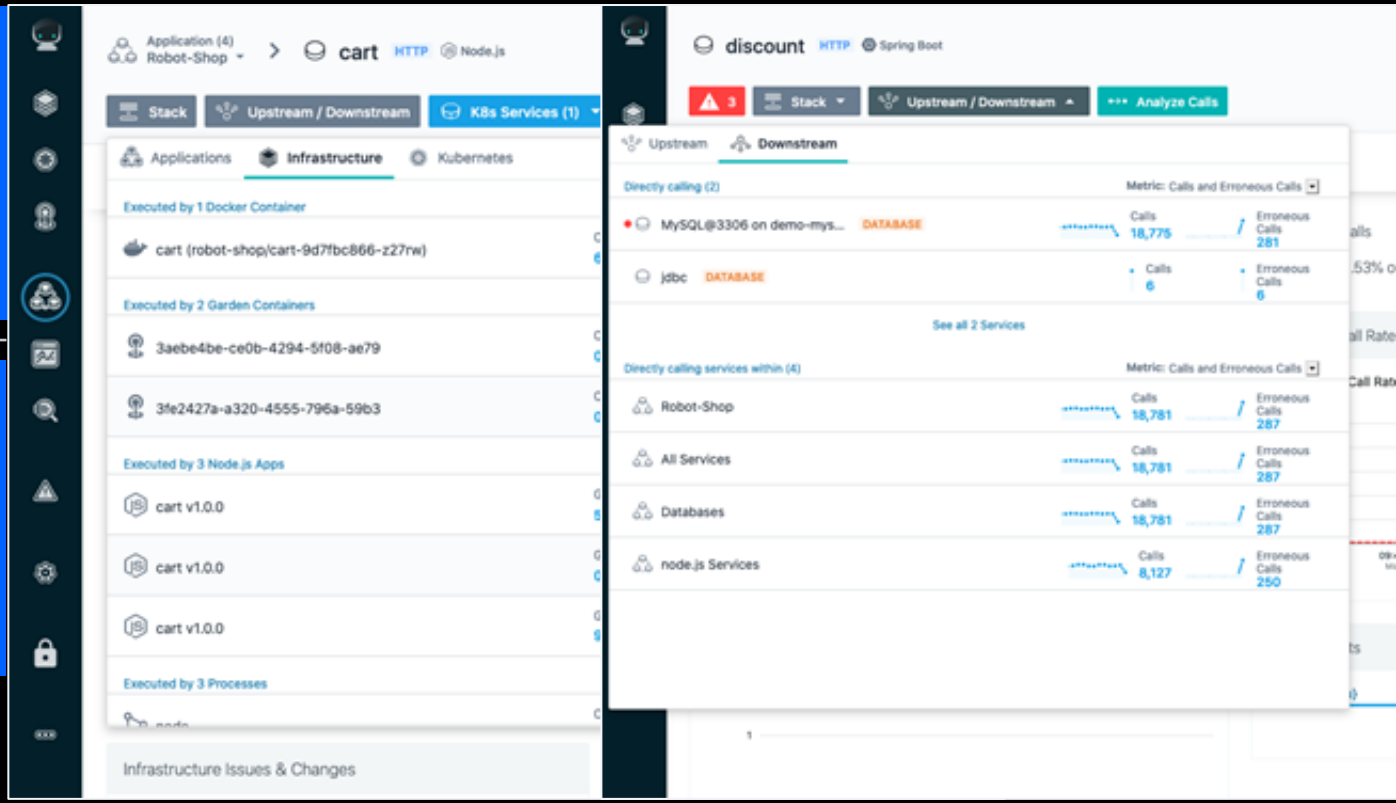
對於需要查看狀態的組件/服務點選即可進入確認當前監控狀態



Instana - 監控各項效能指標

1. Metrics組件/服務資訊
監控各服務內包含CPU, Memory, GC, RSS等狀態，也列出容器內執行的各項服務

2. 組件/服務異常顯示
當專案內執行有異常如，如資料庫連線流量過高時會呈現紅色警告，方便維運人員立即通報

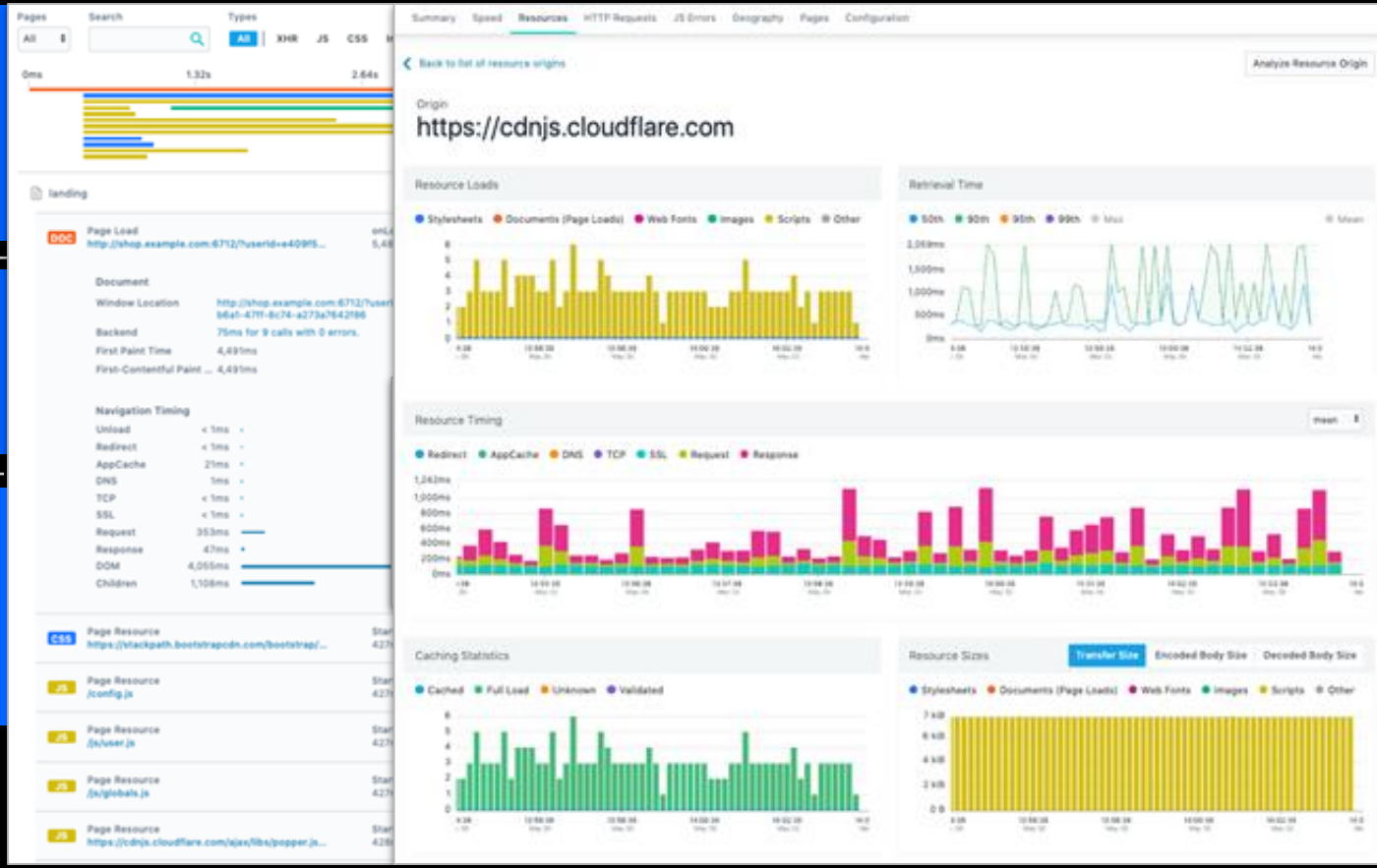


Instana - 監控HTTP請求狀態

1. 監控HTTP請求狀態
對於維運人員有詳細的HTTP status code (Request/Response)回應，更可以確實的開發人員當前發生的異常錯誤代碼

2. 監控請求的時間軸
採用時間軸的方式來顯示各類型通訊目前的回應時效及請求數量

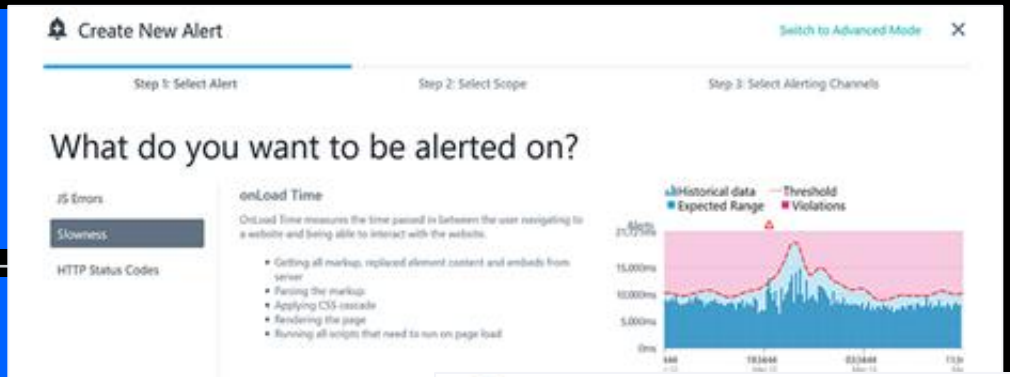
3. 多點組件/服務同時監控
對於節點或容器內不同程序可集中監控即時狀態

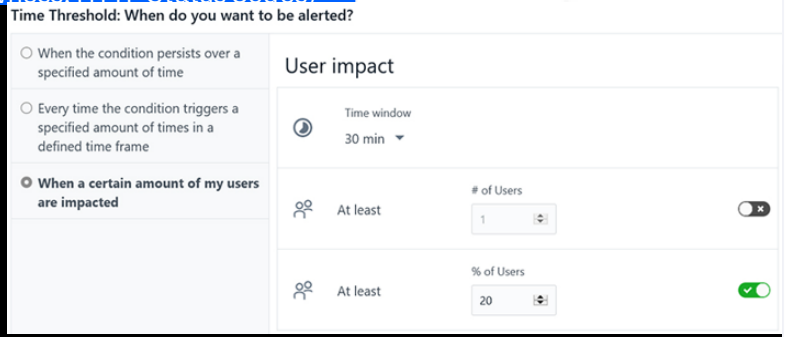


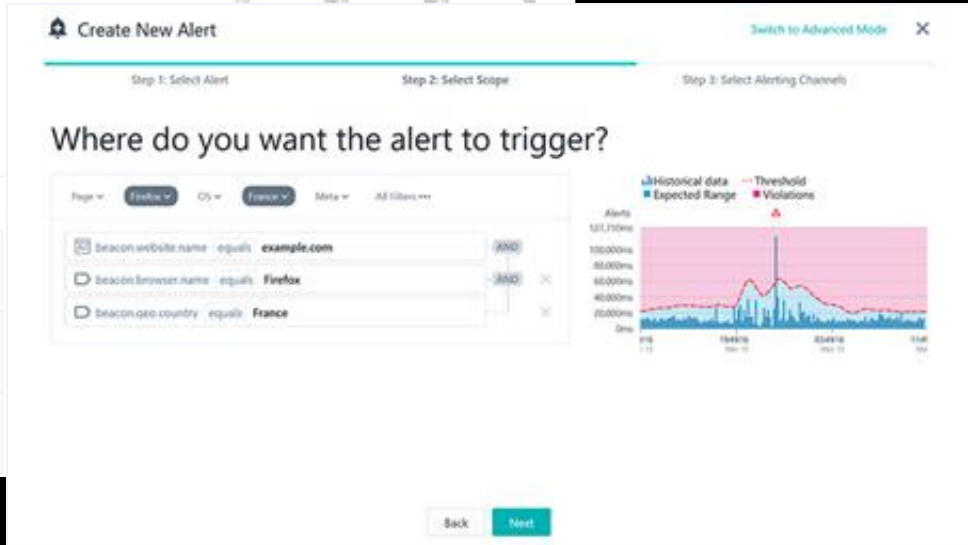
Instana – 最佳化分析及智能警示

1. 最佳化分析支援
對於程式執行時異常提供偵測事件
Code Trace Support:
Java(JVM), .Net, Node.js, Python, Ruby, PHP, Go

2. 智能警示
支援警示項目如下
- 效能及可用性
- 異常及可能的程式Bug
- 流量偵測異常
- 可制定的警示管理
(JS, Slowness, HTTP Status Codes)





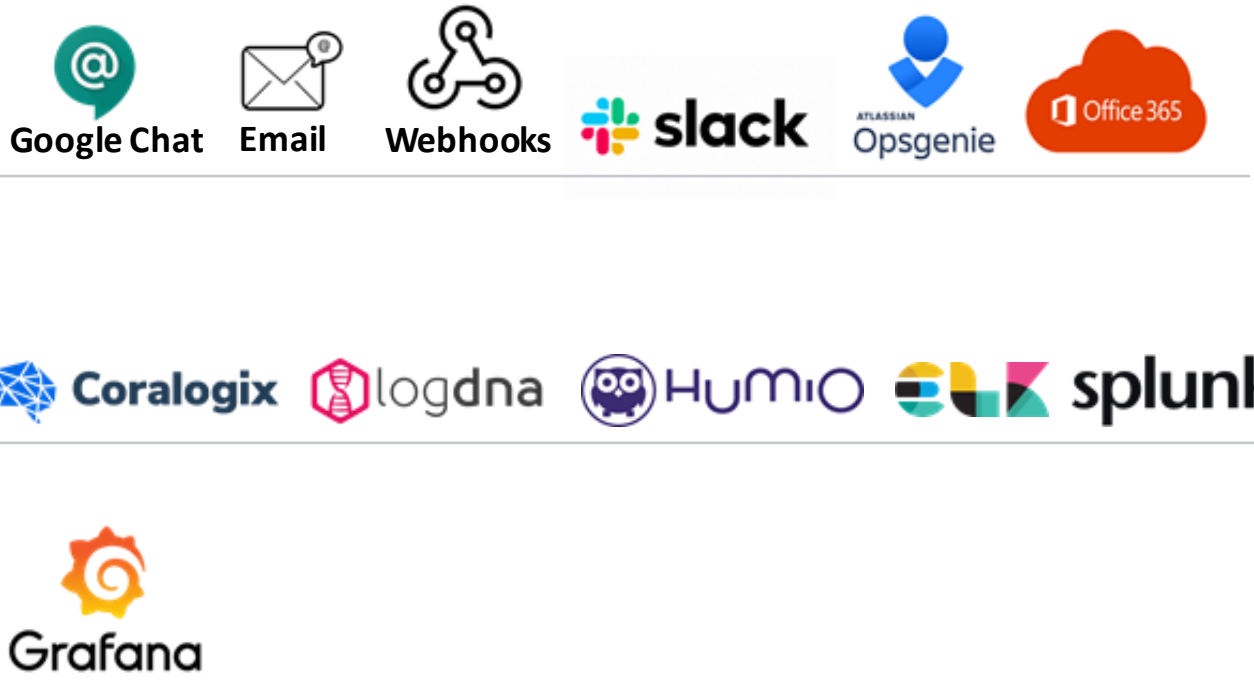


Instana - 開源軟體介接

1. 通知服務介接支援
Slack, Google Chat, Email, Webhooks

2. 事件服務介接支援
ELK, splunk, Coralogix, logdna

3. 報表/圖表服務介接
Grafana

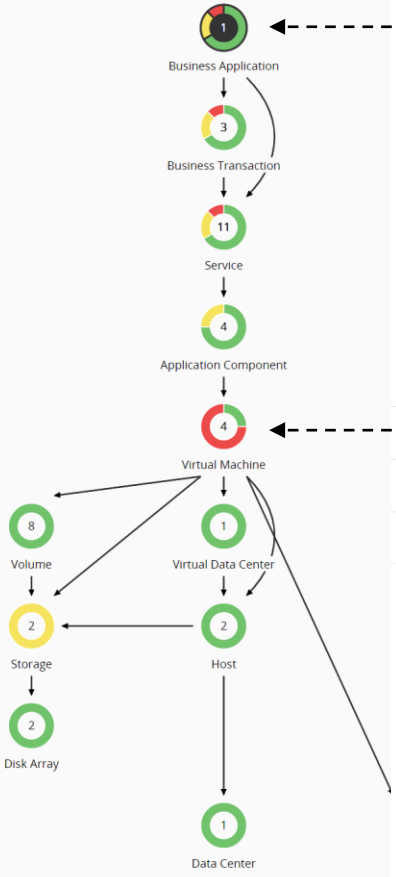


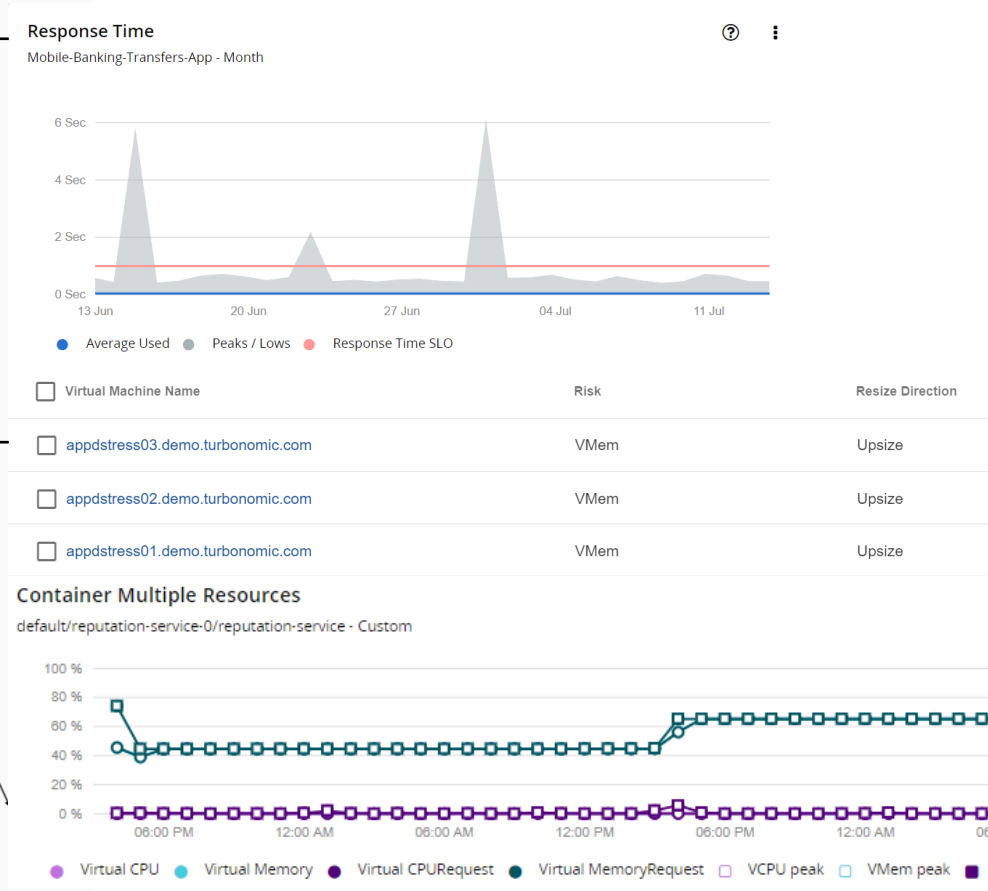
Turbonomic - 圖像化視覺操作

1. 圖像化視覺操作
直覺地透過結構圖示進行點選，即可查看每一個組件/服務中的資源狀態

2. 階層式概念
將應用程序和基礎架構級別結合在一起，智能產生應用程序感知資源決策，通過預防策略來減少響應時間延遲。

說明：我們的業務應用程序在響應時間延遲方面遇到了巨大的峰值。 底層基礎設施大多是綠色(健康)，黃色(資源過大)，紅色與 3 個容量不足的VM相關。很容易就知道應用服務延遲可能得問題點為何，並判斷如何修復狀況



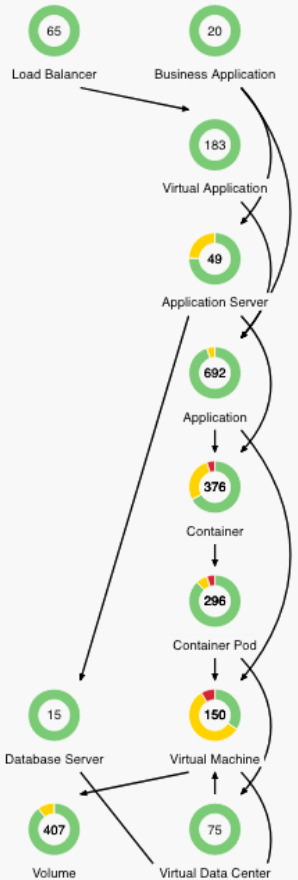


Turbonomic - 智能分析基礎設施及雲服務資源

1. 智能分析基礎設施及雲服務資源
對於各項應用/服務使用資源自動給予相
對應該實施的策略分析如下
- 降低過度配置的虛擬機器(VM)
VCPU/Vmem/Volume/Heap以降低成本
- 磁碟空間過小影響效能
- 資料庫容量配置轉移

2. 拓譜圖顯示應用資源
- 結構方式呈現容器/應用及虛擬機關係
- 清楚的顏色標示正常、異常、錯誤

3. 監控類型支援
- 支援服務、基礎設施及儲存設備
- 支援(Containers, K8S Pod, VM, DB)
- 支援(Cloud, Storage, VM, API)



Overprovisioned VM VCPU/VMem can be sized down to reduce costs

- Scale up VCPU for Container default/music-xhd78/web-app from 34.49841 MHz to 134.49841 ...
  VCPU congestion in Container 'default/music-xhd78/web-app'
- Scale up VMem for Container default/turbotest-mem-rc-29rlk/memory-load from 200 MB to 2...
  VMem congestion in Container 'default/turbotest-mem-rc-29rlk/memory-load'

Overprovisioned volume can be sized down to reduce costs

- Move Volume vol-074975105670f7e02 of Virtual Machine spcnapi097-worker-2 from aws-us-west-2a-gp2 to aw
  Improve overall performance

Overprovisioned heap can be sized down to reduce costs

- Move ContainerPod default/router-1-ks74z from osp-node-1 to osp-node-2
  VMem congestion
- Move ContainerPod default/max-api-45hgh-c from osp-node-4 to osp-node-2
  Improve overall performance

Undersized disk can lead to app performance issues

- Scale Database Server alanstestinstance-please-dont-delete from db.t2.large to db.t2.small
  Matching Database Server needs: CPU 1 Core, Virtual Memory 1.84 GB

Resourcing Actions for Virtual Machines

- Resize down VMem for Virtual Machine mo1-035a-ixb-bp from 16 GB to 7 GB
  Underutilized VMem in Virtual Machine mo1-035a-ixb-bp
- Resize down VCPU for Virtual Machine mo1-035a-ixb-bp from 4 to 2
  Underutilized VCPU in Virtual Machine mo1-035a-ixb-bp

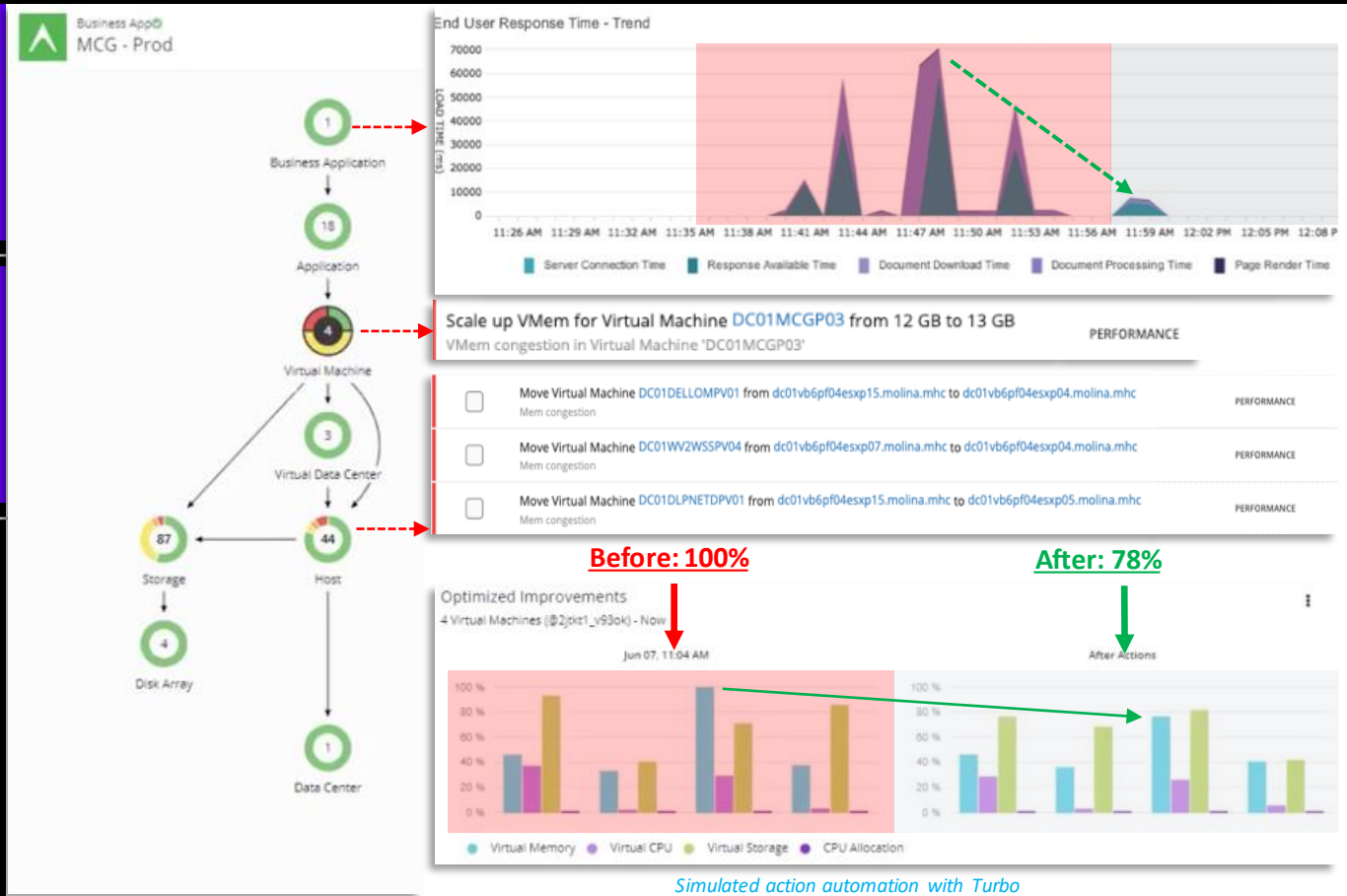
Resouring Actions for Storage Datastores

- Move Volume Vol-mo1-031a-ixb-bp-389_S_016 of Virtual Machine mo1-031a-ixb-bp from 389_S_016
  Storage Amount Congestion

Turbonomic - 決策自動化調配服務及成效

1. 決策自動化調配服務資源
- Compute move and storage move
- Compute sizing (on-prem/cloud)
- Storage volume sizing (cloud)
- Database scaling (cloud)

2. 智能分析建議成效
- 通過執行Turbo的決策，主機利用率提高了22%，將100%的利用率下降到78%。Turbonomic 持續確保應用回應時間保持在服務水準內



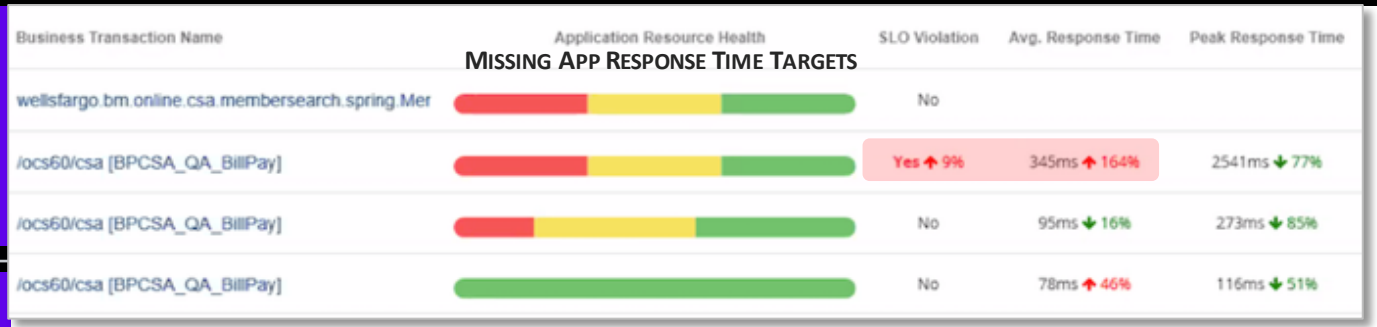
Simulated action automation with Turbo

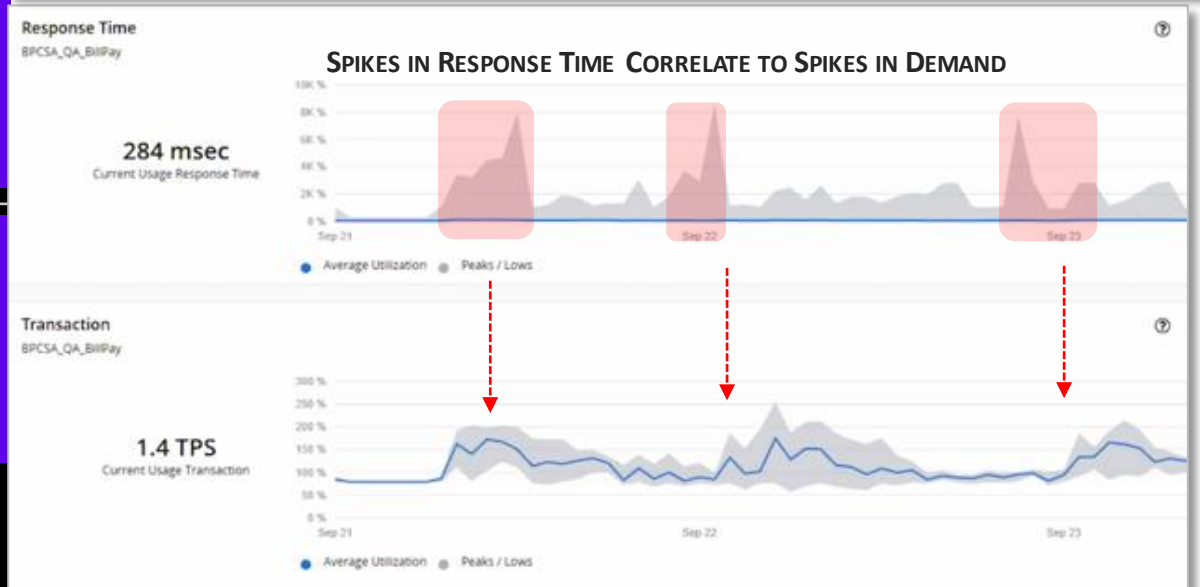
Turbonomic - 監視連線數量與資源負載

1. 監視連線數量的高峰數值

2. 預估可能性的資源負載

3. 調整資源負載提升或減低





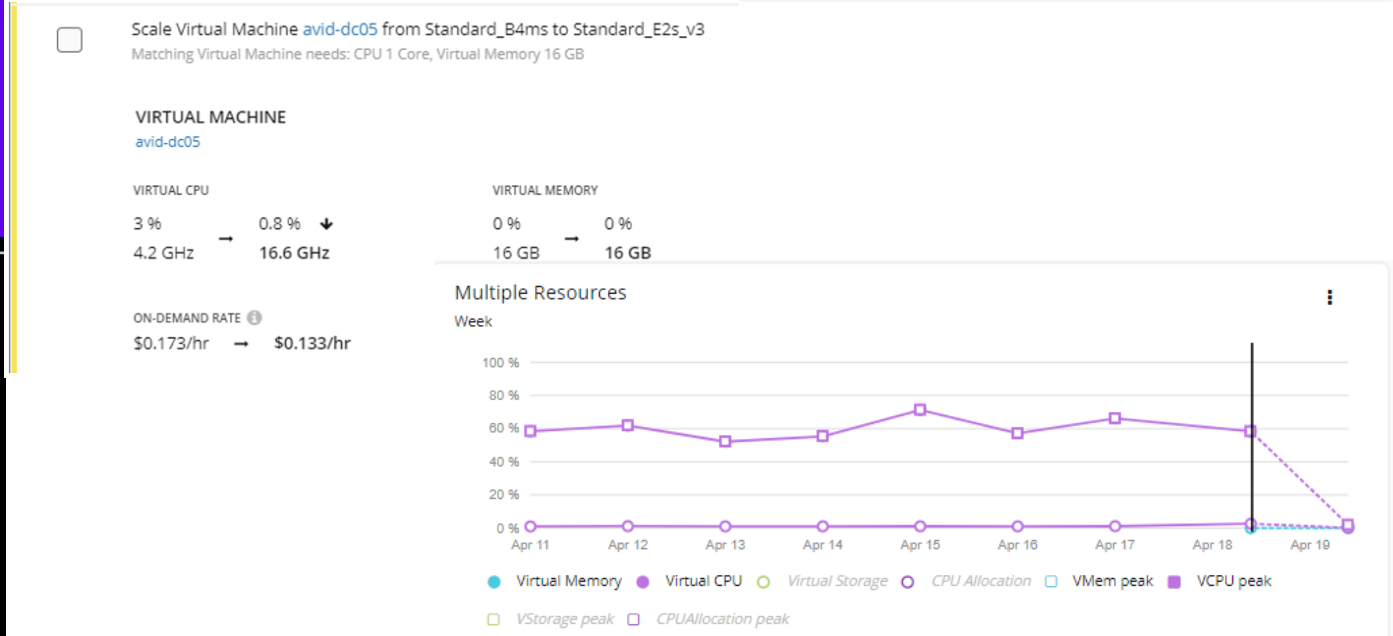
Turbonomic - 降載基礎設施資源效益

1. 發現虛擬機VM狀態負載降低
- 建議將CPU/Mem資源減低
- 減低虛擬機資源後的金額試算

2. 減低虛擬機資源後成本
經由減少各項基礎設施使用資源後，對於維護及營運成本大幅的減少。
過往經驗協助客戶在169個VM, 671個Volumes於AWS, Azure，節省每月$46216/每年$554,592元

Turbo recommended scaling down to improve efficiency of the azure-dc05 VM.
Result: cost savings $30/mo
from $129/mo→ $99/mo

Observing CPU consumption below 71% at **peak**, Turbonomic recommended & took action to downsize from a Standard_B4ms to Standard_E2s_v3



Turbonomic - 監控分析使用API連結通訊

1. 監控分析使用API連結通訊
經由API通訊協定介接各項容器服務，包含各家雲端及虛擬機器，資料庫及網路設備介面連線

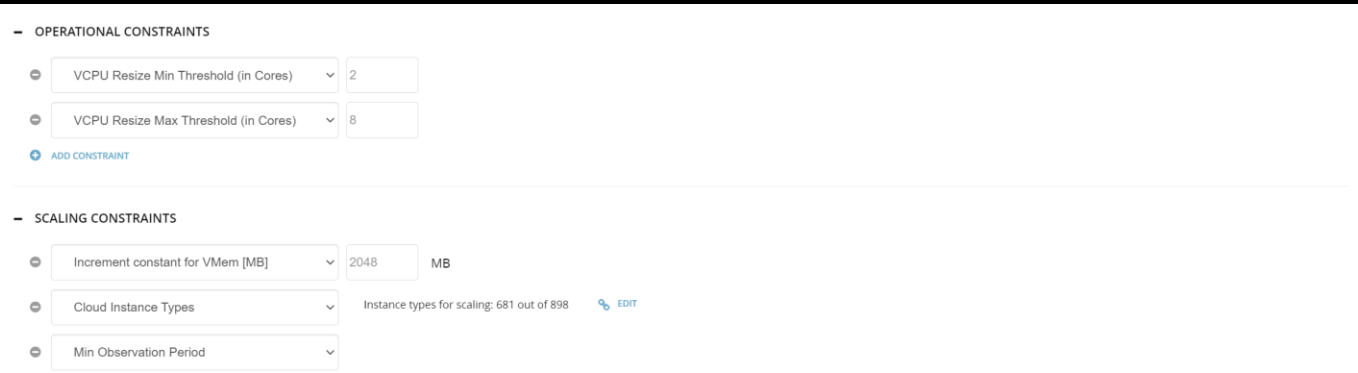
2. 整合通訊協定端點資源監控

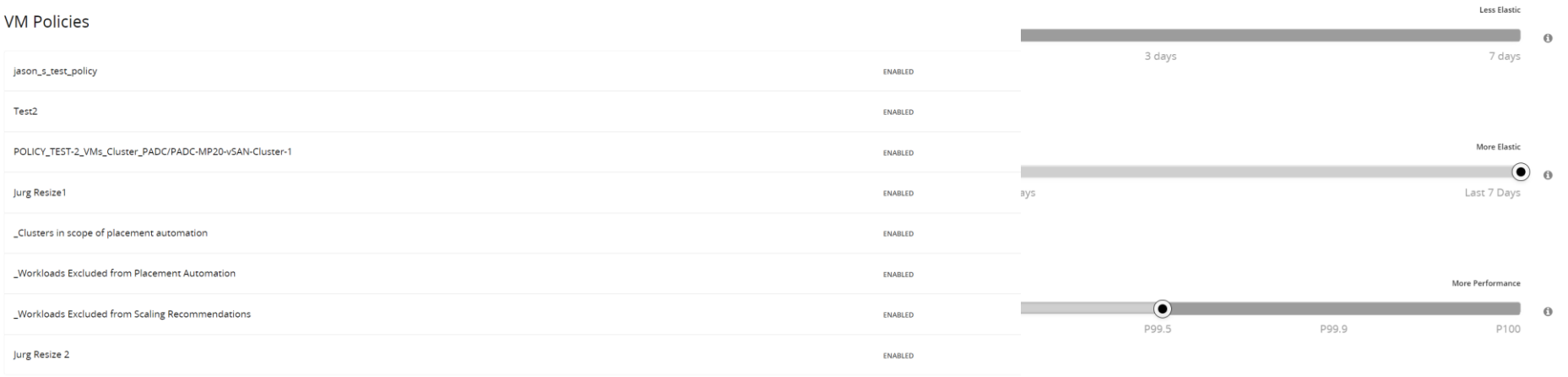
3. 自訂通訊協定連接埠介接
- 介接過程不需要安裝Agent
- 介接種類設備資源較多
- 自訂開發通訊端連接回應參數

Turbonomic - 建立自動化調配決策

1. 建立自動化調配決策
- VCPU, VMem Resize
- 依據天數/影響評級來建立策略

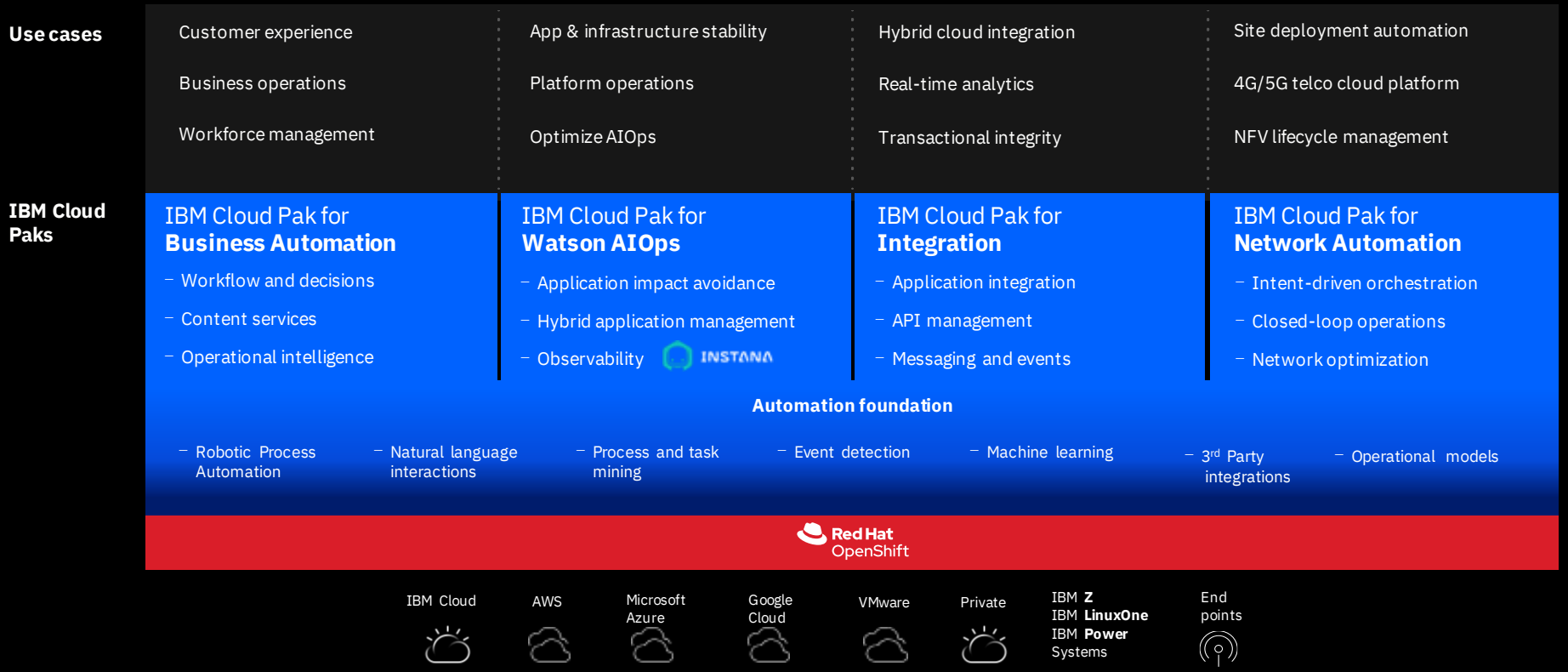
2. 監控決策清單
- 透過介面進行操作決策啟停



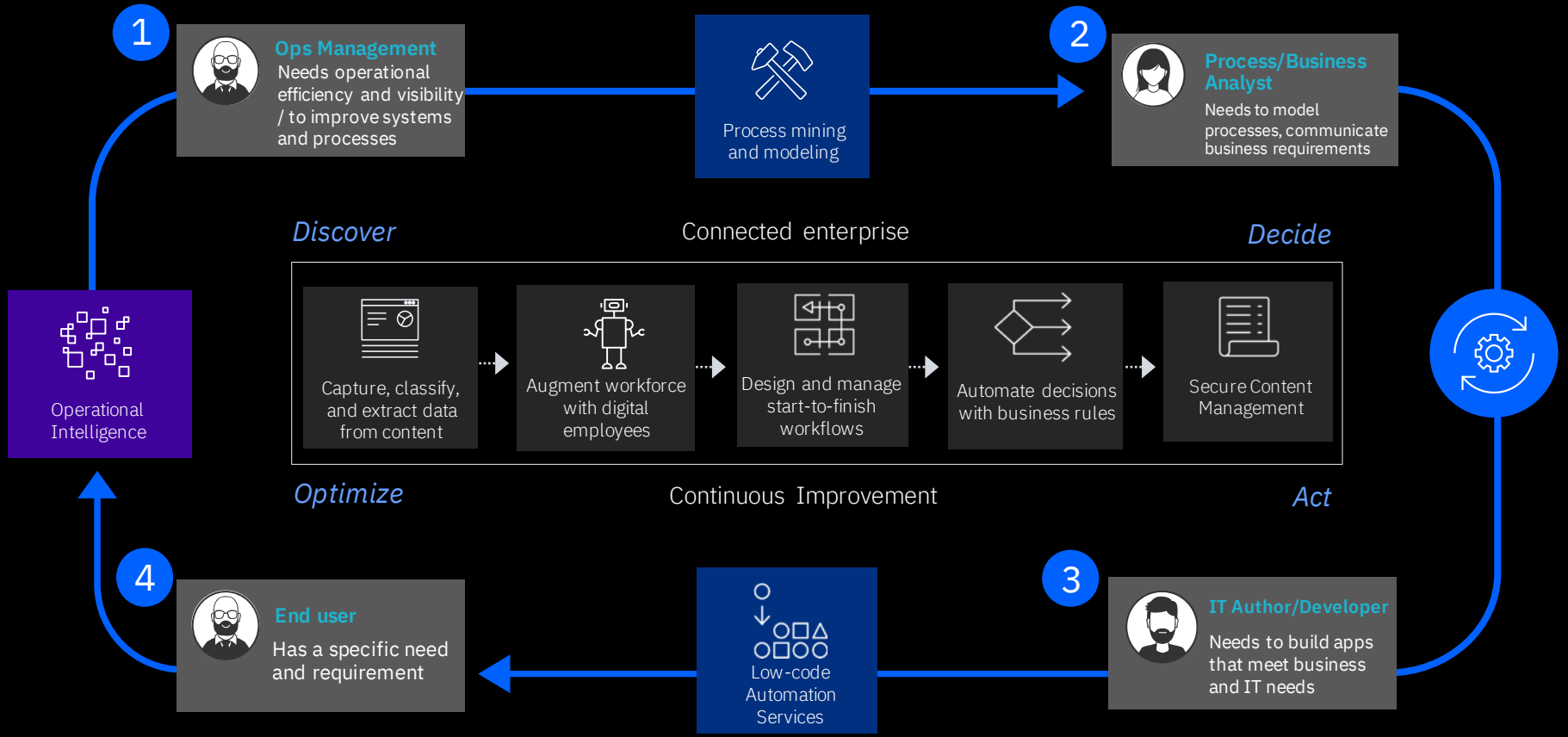


Automation - 自動化整合平台介紹

The most complete set of business and IT Automation services, powered by AI



Automation - 自動化交付流程處理

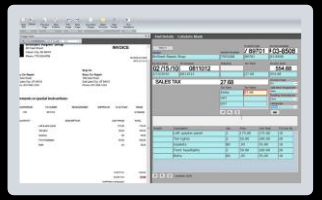


Automation - 介紹及應用
Key capabilities

Capture

Capture, classify, and extract data from content

- Speed extraction of data
- Reduce data entry errors
- Gain insights from unstructured documents

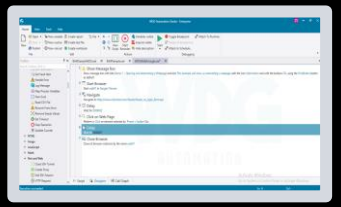


Datacap

Tasks

Use bots to automate routine human tasks

- Automate repetitive activities
- Eliminate copy-and-paste and data-entry errors
- Free employees for higher-value work

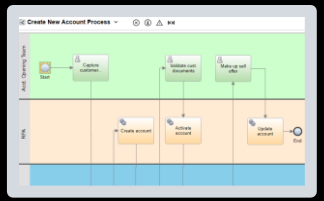


Robotic Process Automation

Workflow

Design and manage start-to-finish workflows

- Choreograph human and automated activities
- Improve consistency across business operations
- Increase straight-through processing

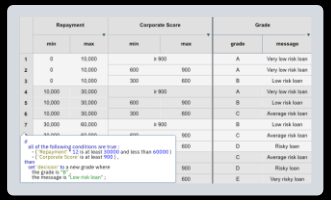


Business Automation Workflow

Decisions

Automate decisions with business rules

- Rapidly adapt to business change
- Increase consistency and auditability of decisions
- Integrate with predictive analytics

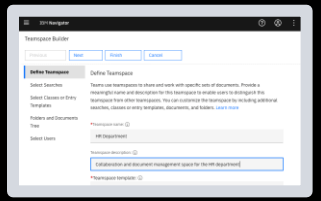


Operational Decision Manager

Content

Share, manage, and collaborate on content

- Instant access to content
- Connect content to digital business applications
- Assure governance and compliance

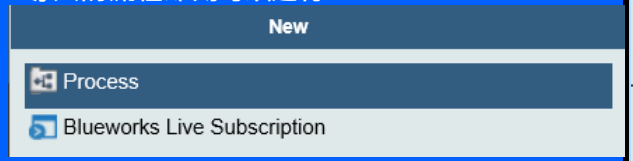


FileNet Content Manager

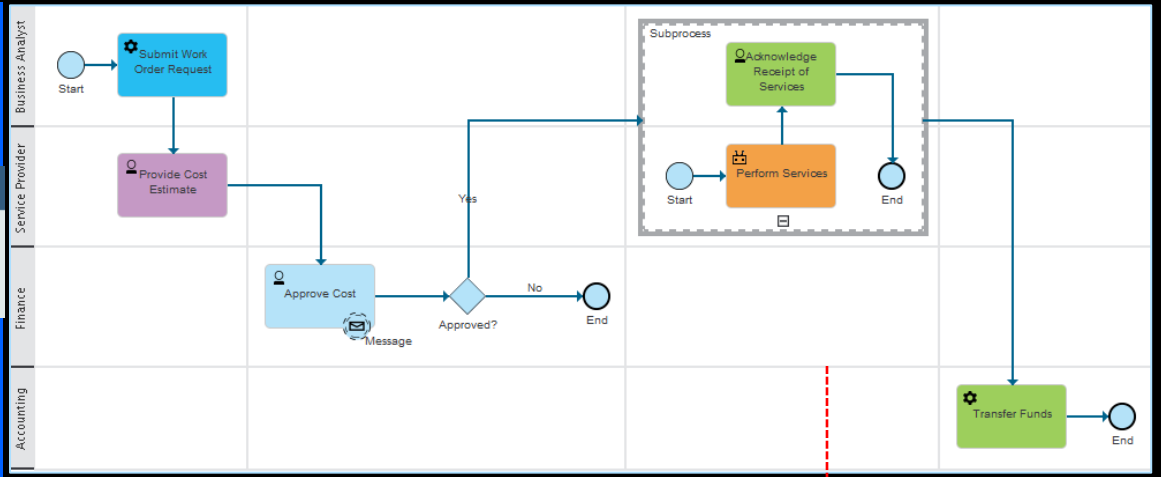
Automation - 圖形化流程建模

1. 使用圖形化流程建模

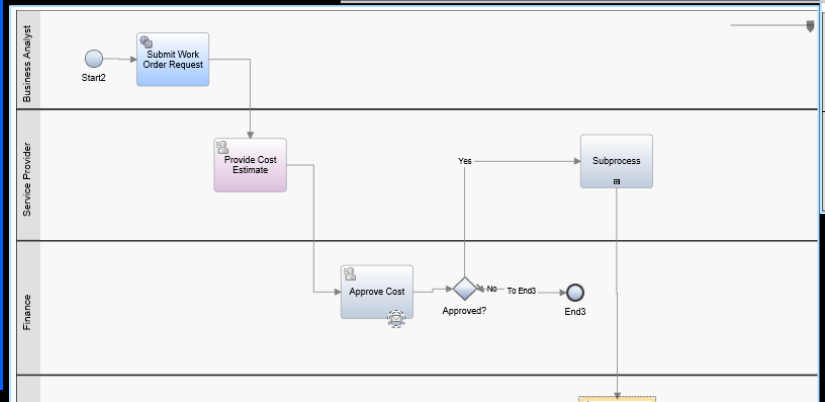
- IBM Blueworks Live導入
- 導入的流程即刻可以運行

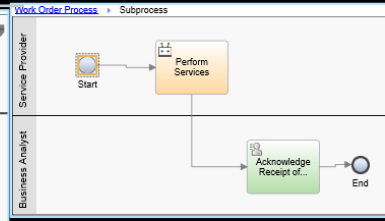


Blueworks Live



Process Designer 流程設計器



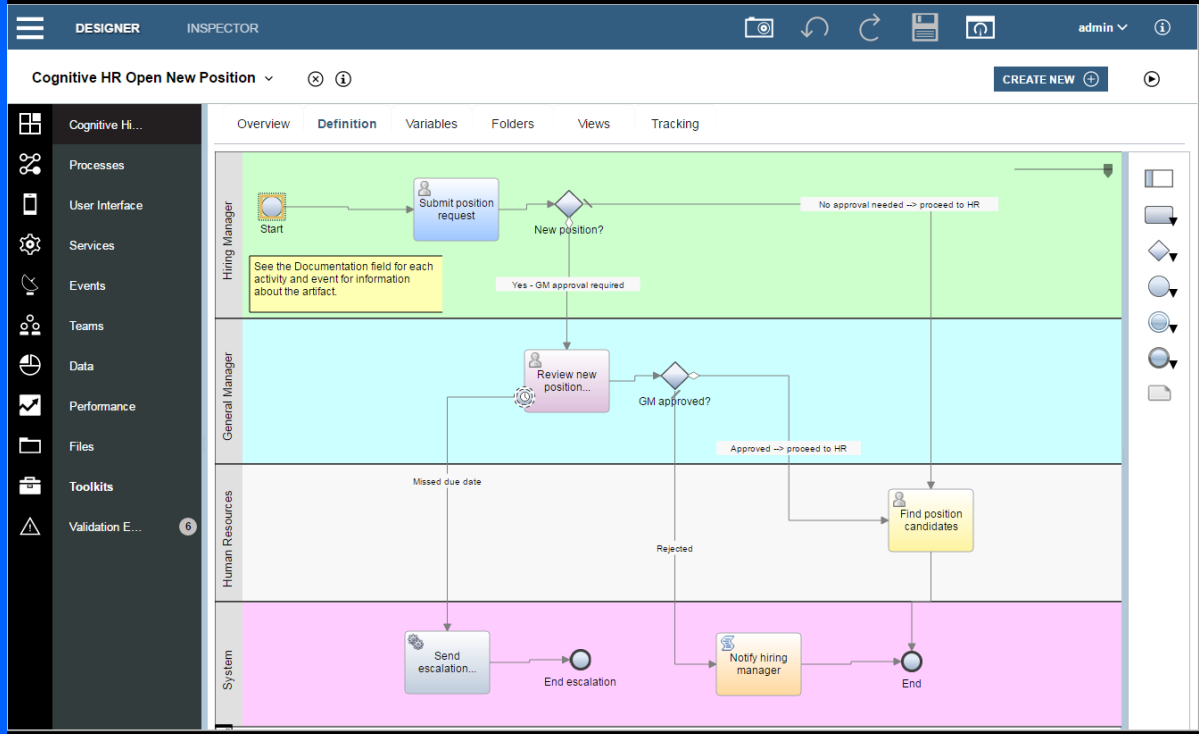


Automation - 人工任務為中心的流程

1. 以任務為中心的流程

- 圖形化開發介面
- 基於**BPMN**開放標準
- 低代碼 / 零代碼開發
- 團隊協作
- 測試與調試
- 版本控制

Process Designer 流程設計器



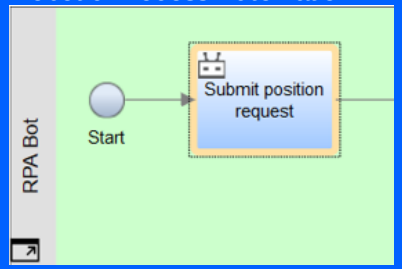
Automation - 任務的實現

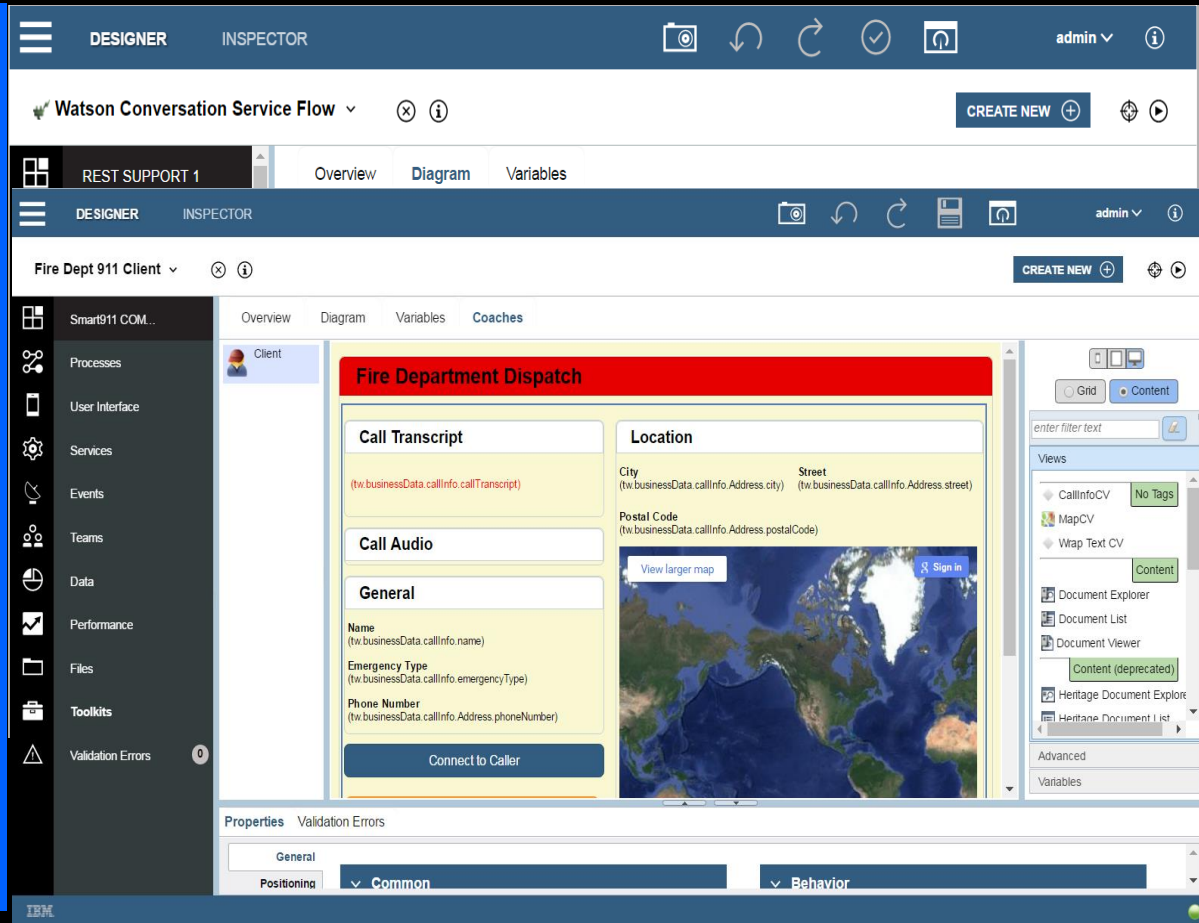
Integration Services with Customer UI Design

1. 執行任務

- 開放通訊標準 (WSDL, JSON)
- 內建的集成服務
- 通過Point and click定義UI介面
- 業務規則
- 機器人流程自動化 (RPA)

Robotic Process Automation



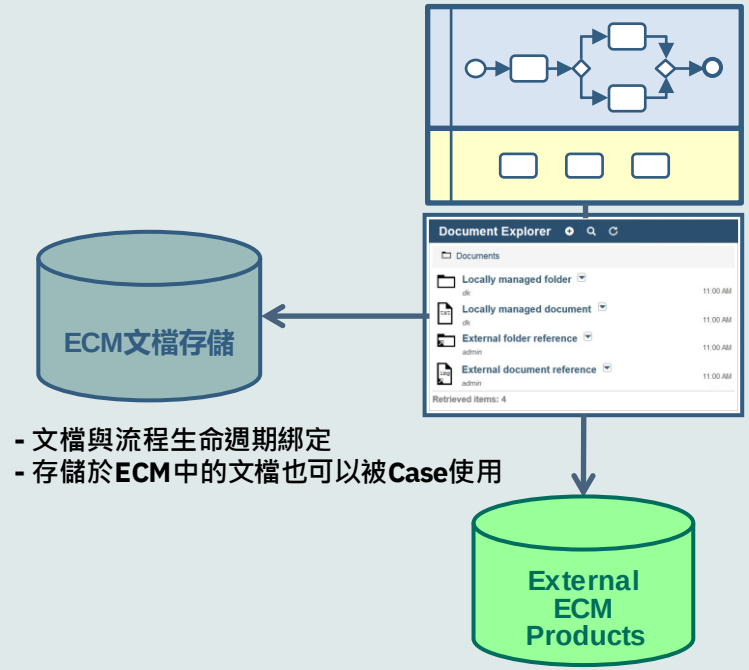


Automation – 流程內容及案例檔案

Business Automation Workflow

1. 儲存流程內容及案例檔案

- **ECM**引擎提供文檔管理
- 流程實例提供臨時的文檔存儲
- 案例提供永久的文檔存儲
- **CMIS**協定連接外部文檔存儲的能力



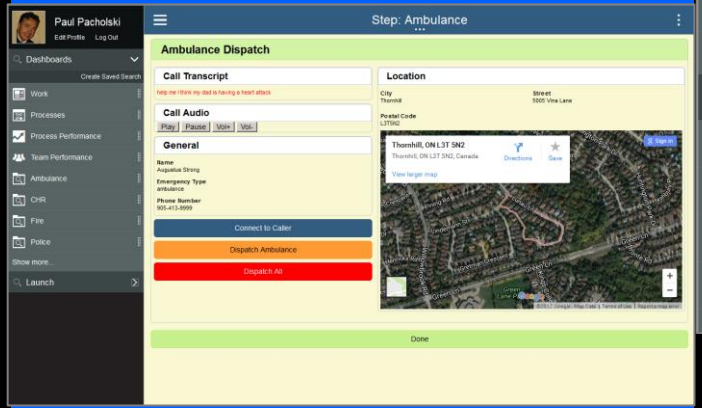
- 流程文檔的單一視圖
- 文檔與流程生命週期綁定
- 存儲於**ECM**中的文檔也可以被**Case**使用

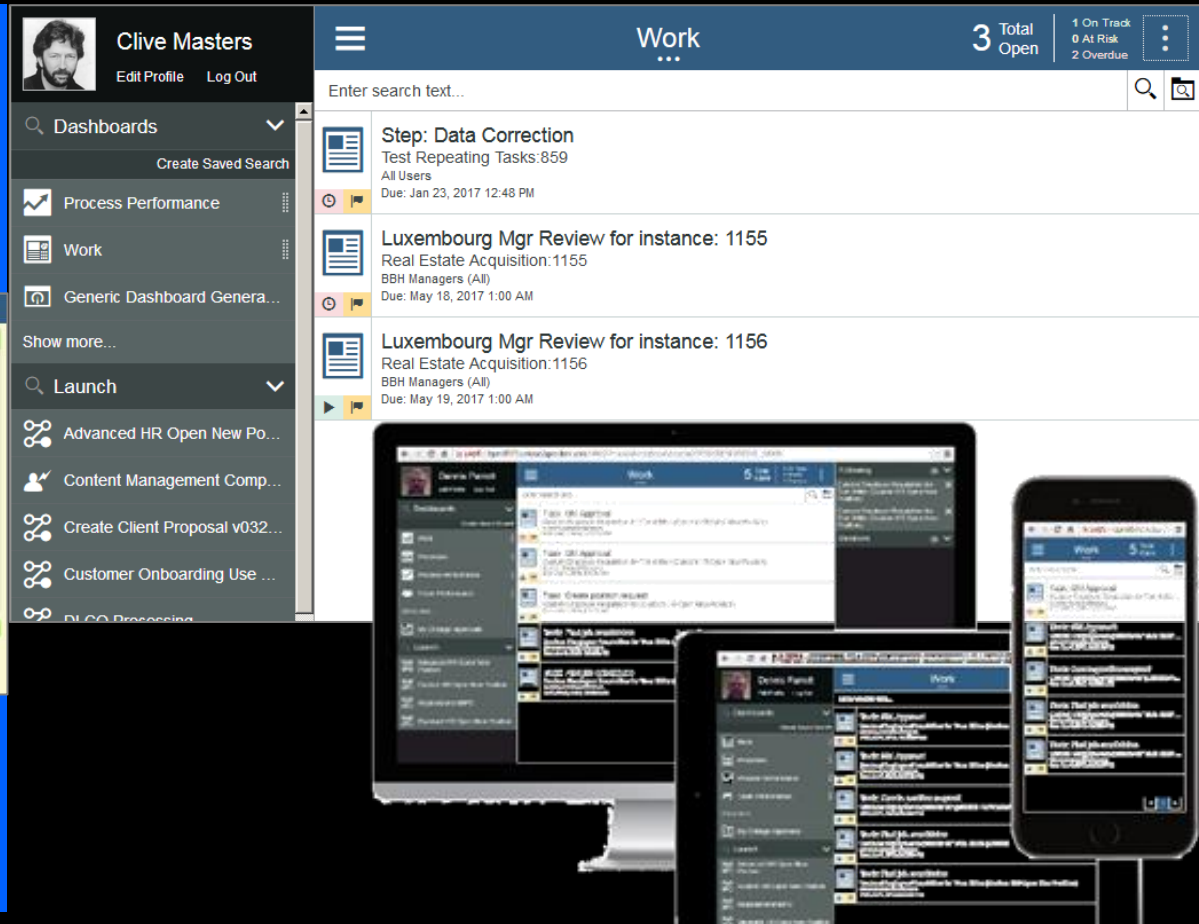
Automation - 業務流程執行

Task View and end-User Design with RWD

1. 業務流程執行

- 任務管理和完成
- 每個單獨的流程都可視
- 安全的協作
- 同時支援桌面環境和移動終端
- 可以使用自訂門戶



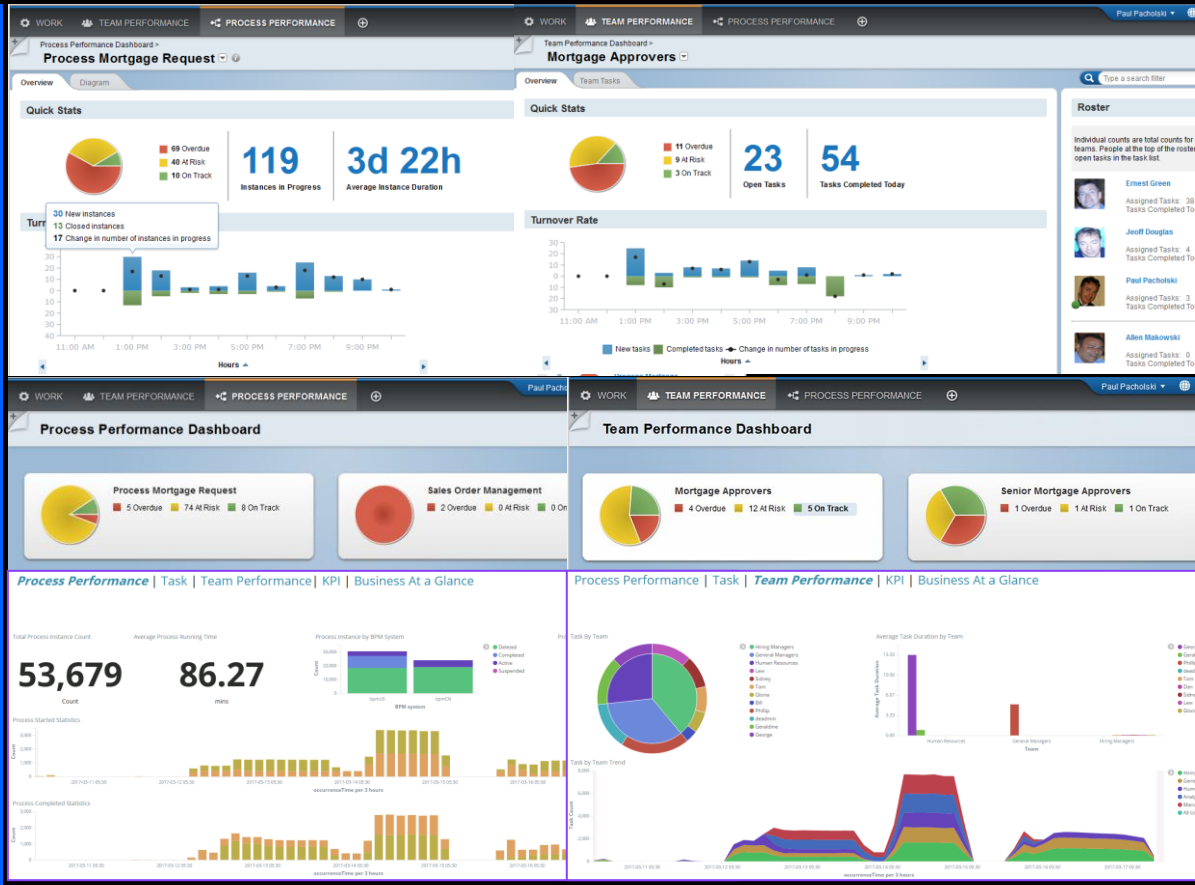


Automation - 業務流程管理和優化

1. 業務流程管理

- 社交化的儀錶板
- 即時流程監控資料
- 流程和團隊績效
- 基於**Kibana**的報表
- 自訂圖表

Team and Process KPI View

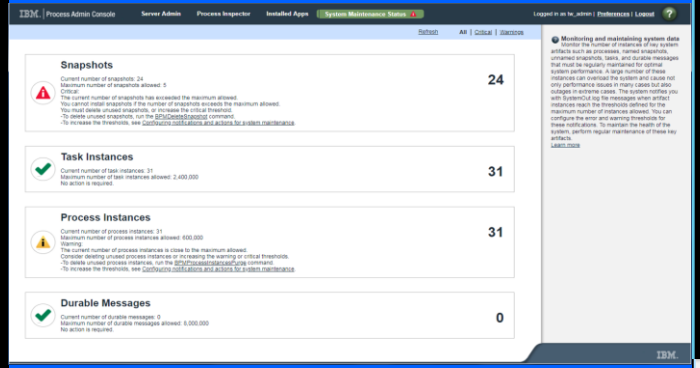


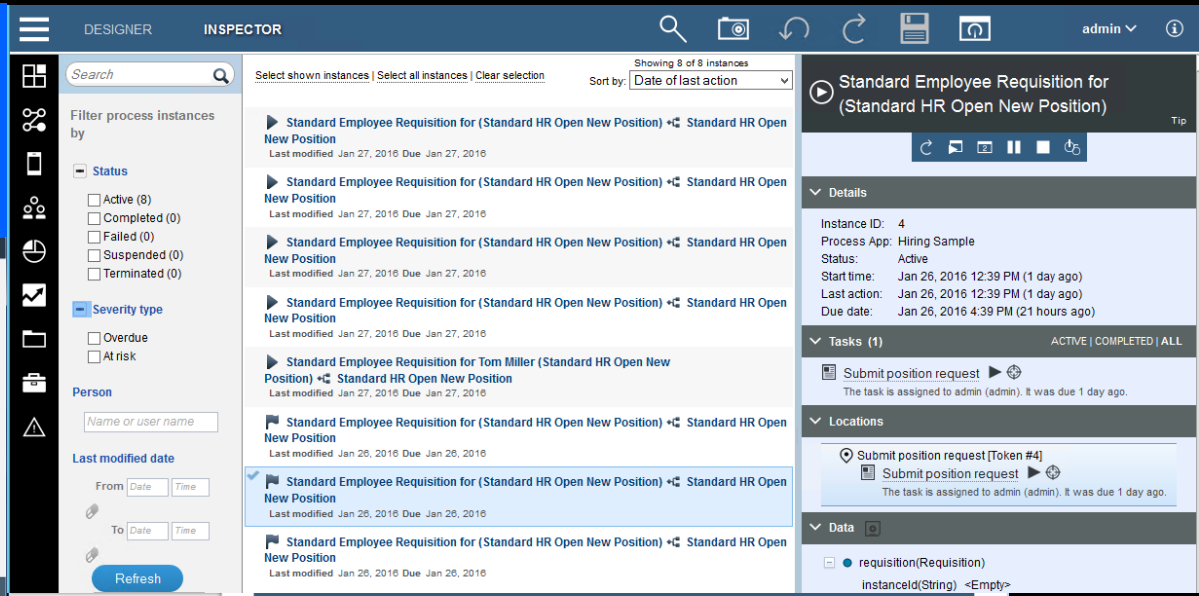
Automation - 即時流程監控及管理

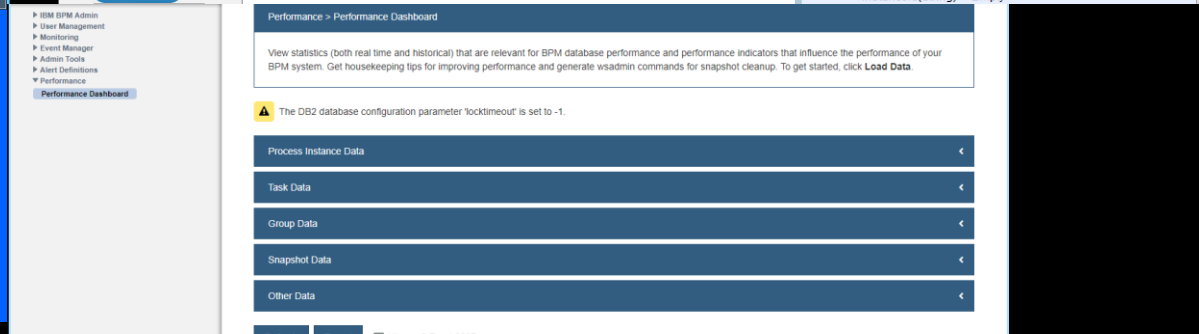
Process Server Maintenance and Management

1. 業務流程管理

- 監控並管理流程實例和人工任務
- 修復失敗的任務實例
- 部署流程，遷移在途流程
- 監控流程伺服器的運行狀態並執行維護操作







AIOps雲服務價值的融合

IT/OT + AIOps 雲服務

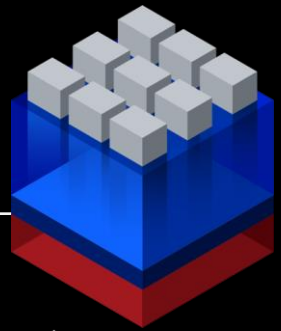
所見即所得的部署及建置韌體/軟體

元宇宙概念 (Metaverse)

- 融合公有雲、私有雲到混和雲都有大量的應用
- 未來的場景是隨處可見數以萬計的部建

Enable software to run anywhere, on any cloud, as agile cloud-native services

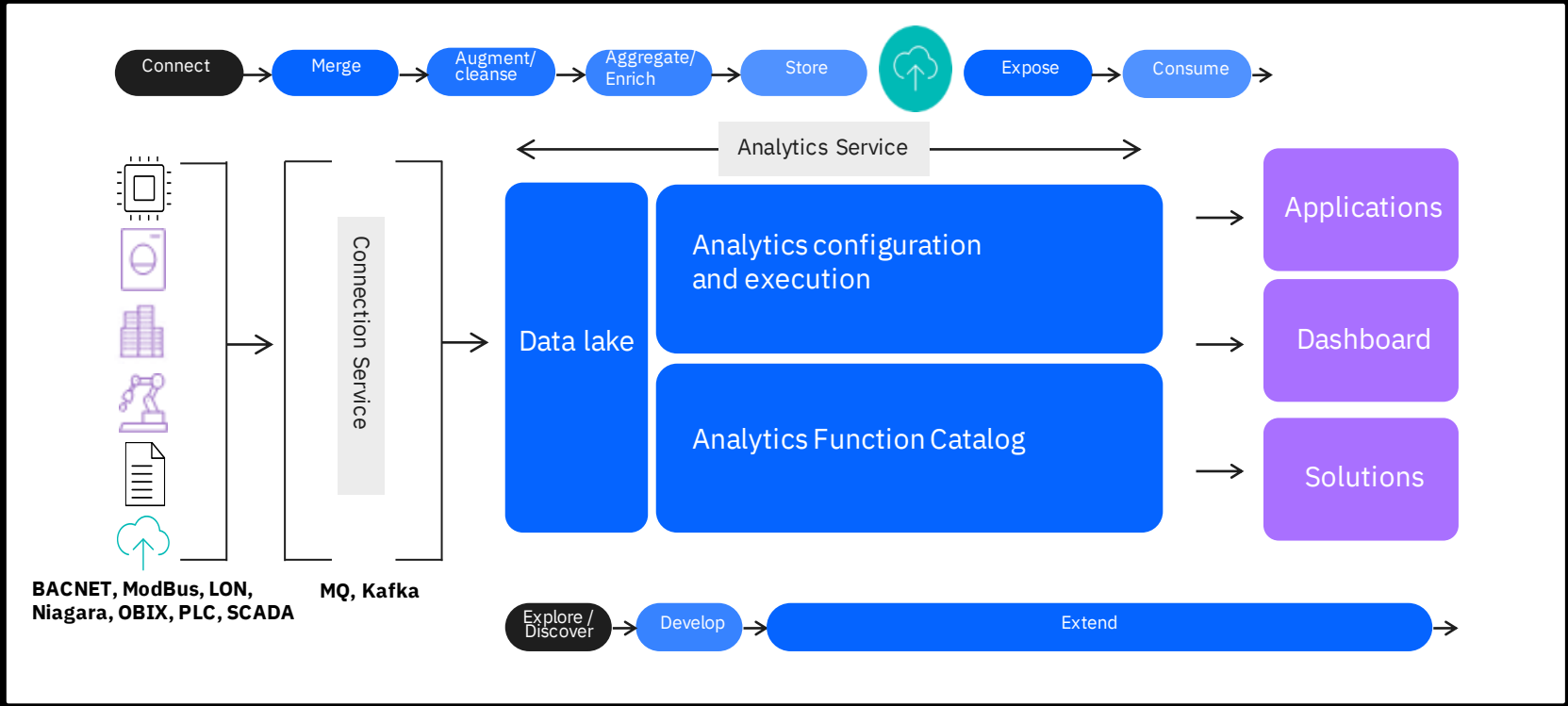
Red Hat OpenShift **Hybrid cloud platform**



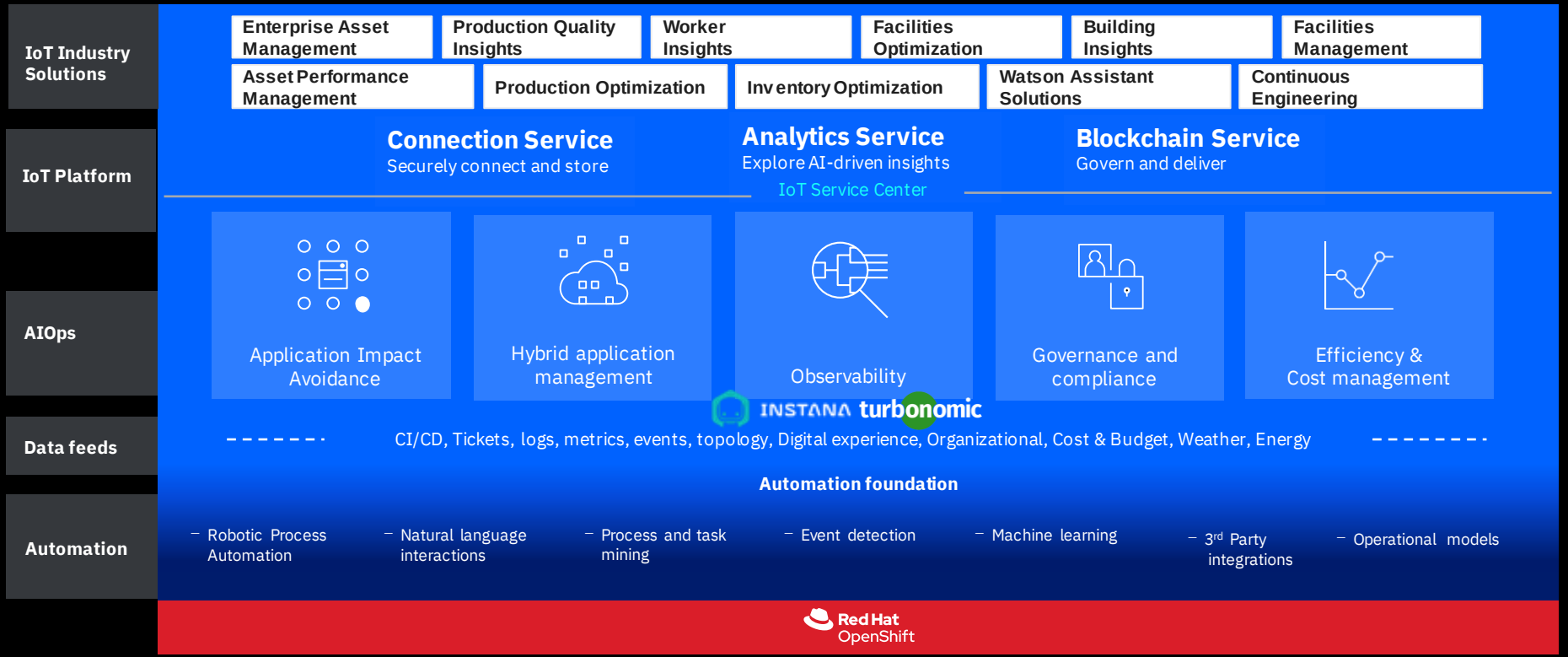
Watson

Infuse AI for business throughout our software

AIOps雲服務整合IT/OT資訊方案



AIOps雲服務整合IoT方案



IBM Cloud Pak for Watson AIOps: Differentiation

1

Pre-built ML models for brand new insights

Detect anomalies much earlier and correlate data in real-time to focus attention on the right issues. Apply Natural Language Understanding to offer concise insights and advise leveraging precedents

2

Application centricity

Access and organize relevant information across siloes and tools towards specific applications, providing an integrated perspective. Retain context and consistency when switching between UI and ChatOps engagement models.

3

Closed-loop integration

Break Dev / Sec / Ops siloes by extracting insides from CI/CD to enrich advise for Operations – and vice versa. Infuse security and governance as code and prevent violations. Automate mundane workflows to reduce toil and improve data quality.

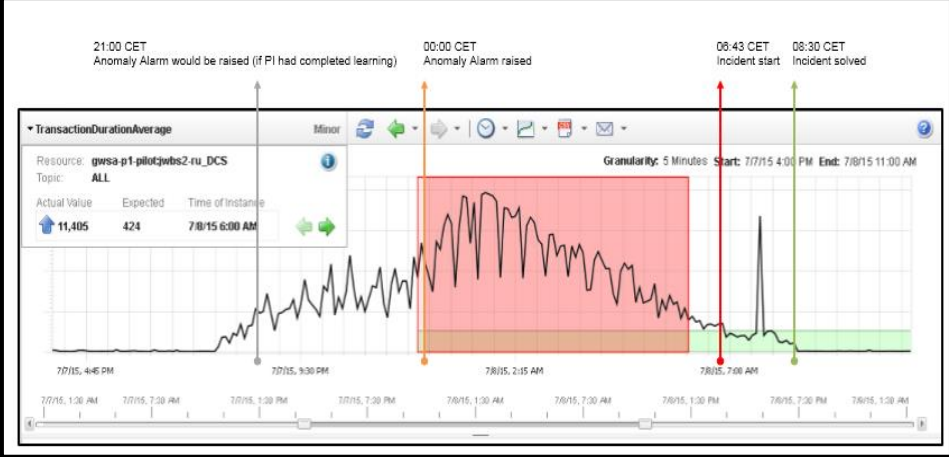
Utilize relevant data to proactively mitigate downstream impacts

Draw inferences across data silos via patented AI entity linking

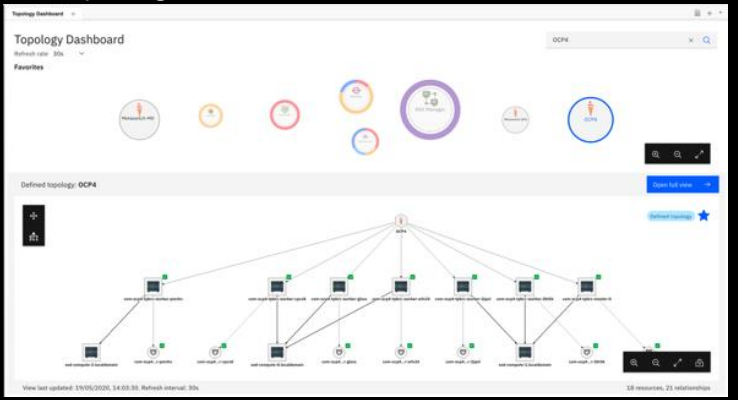
Identify and locate downstream risks and secondary impacts with real-time and historical blast-radius, topology mapping

Highlight potential performance deterioration with distinctive metric analysis & anomaly detection

Performance Metric Analytics & Anomaly Detection



AI Entity Linking & Blast Radius



Successful businesses use IBM Cloud Pak for Watson AIOps

Improved workflows

Built with IBM Watson, the AI-based virtual assistant manages more than 1.5 million client conversations each month

Uncovered new insights hidden in unstructured data

Watson AIOps helped SREs investigate otherwise hidden anomalies and remediate a long-standing issue that had been hampering performance for months

Accelerated resolution time

Watson AIOps recognizes what is "normal" for systems and uses that "normal" to identify changes in data--hours ahead of standard efforts

Thank you

Tony Liu 劉育誠
Technical Solution Architect

IBM Taiwan Co. Ltd
3F, No. 7, Songren Rd, Xinyi Dist
Taipei 110412
Tel: +886 2 8723 8888
Mobile: +886 909-221-826
Mail: tony.liu@ibm.com


IBM

CoreTek 克達科技

工業用物聯網裝置之完整解決方案

講師：馮育隆 Martin 0987-856086
martin@coretechnology.com.tw

KEYSIGHT TECHNOLOGIES Authorized Distributor

1

Angeda

CoreTek

1. 探討IOT在量測上所遭遇的難關
    1. 目前IOT的種類分布
    2. RF量測方案
        1. LPWAN
        2. SUB-GHz
    3. 實務量測上遇到的困難
2. 如何在ISM頻段內預防被干擾
    1. Swept SA VS RTSA
    2. RTSA的實務量測
3. 如何量測完整的PSM電流
    1. PSM的電流要求
    2. 量測的困難度
    3. 低功耗的實務量測
        1. NBIOT
        2. LORA
4. Q&A

KEYSIGHT TECHNOLOGIES Authorized Distributor

2

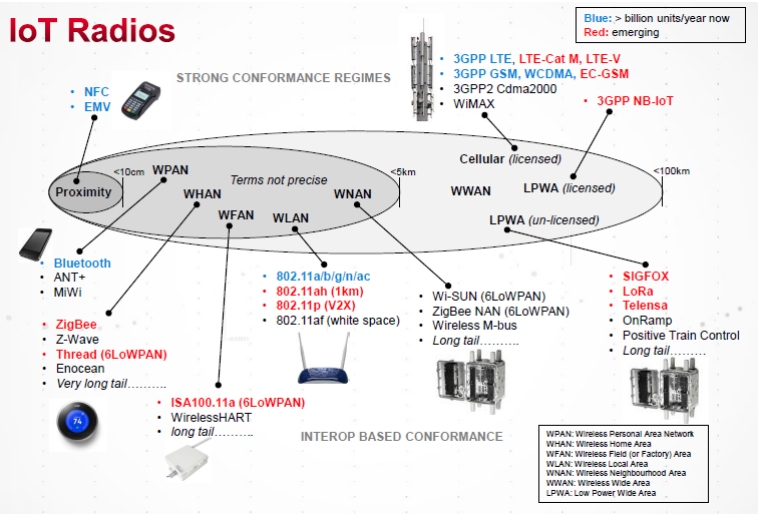
CoreTek 克達科技

探討IOT在量測上所遭遇的難關

3

CoreTek

目前IOT的種類分布



KEYSIGHT TECHNOLOGIES
Authorized Distributor

4

Bluetooth的RF解決方案

CoreTek

Type	Hardware		Software
Signal Generator (For RX tests)	X-Series signal generators (MXG or EXG) 	+	N7606EMBC Signal Studio for *Bluetooth* (BR/EDR/LE4.0/4.2/ BT5) 
Signal Analyzer (For TX tests)	X-Series signal analyzers (PXA, MXA, EXA, CXA) 	+	N9081EM0E *Bluetooth* Measurement Application (BR/EDR/LE4.0/4.2/BT5) 
One-box-tester (For TX and RX tests in volume manufacturing)	E6640A EXM 	+	Y9081B *Bluetooth* Measurement Application (BR/EDR/LE4.0/4.2/BT5) 
Over-the-air signaling test (For functional test)	X8711A IoT device functional test solution 	+	KS83301A BLE Signaling Measurement Suite (BLE 4.x only) 

KEYSIGHT TECHNOLOGIES
Authorized Distributor

5

WIFI的RF解決方案

CoreTek

Type	Hardware		Software
Signal Generator (For RX tests)	X-Series signal generators (MXG or EXG) 	+	N7617EMBC Signal Studio for WLAN 
Signal Analyzer (For TX tests)	X-Series signal analyzers (UXA, PXA, MXA, EXA, CXA) 	+	N9077EM0E & N9077EM1E WLAN Measurement Application 
One-box-tester (For TX and RX tests in volume manufacturing)	E6640A EXM 	+	Y9077B WLAN Measurement Application 5/50 waveform pack N7606C Bluetooth Signal Studio 
PXI VSG/VSA (For MIMO and beamforming test)	M9381A/M9391A PXI VSG/VSA 	+	N7617EMBC Signal Studio for WLAN N9077EM0E & N9077EM1E WLAN Measurement Application 89601B VSA Software 
Over-the-air signaling test (For functional test)	X8711A IoT device functional test solution 	+	KS83302A WLAN Signaling Measurement Suite (802.11b/g/n only) 

KEYSIGHT TECHNOLOGIES
Authorized Distributor

6

Lora/Zigbee/Z-Wave/Wi-Sun的RF解決方案

Type	Hardware	Software
Signal Generator (For RX tests)	X-Series signal generators (MXG or EXG) +	N7610EMBC Signal Studio for IoT Signal Studio (for ZigBee/Z-Wave/Wi-SUN/ LoRa)
Signal Analyzer (For TX tests)	X-Series signal analyzers (PXA, MXA, EXA, CXA) +	N9084EM0E IoT Measurement App (for ZigBee/Z-Wave) N9054EM0E VMA Vector Signal Analysis (for Wi-SUN) N9063EM0E Analog Demodulation (for LoRa) 89601B VSA software option AYA
One-box-tester (For TX and RX tests in volume manufacturing)	E6640A EXM +	V9064B VXA Measurement Application (For ZigBee, Z-Wave and Wi-SUN) V9063B Analog Demodulation (for LoRa)
Low cost solution (for TX and RX tests)	33600 series function generators, N9010A signal generator and N9000A CXA analyzer +	N9084EMBC IoT Measurement Application (for ZigBee/Z-Wave) N9063EM0E Analog Demodulation (for LoRa)

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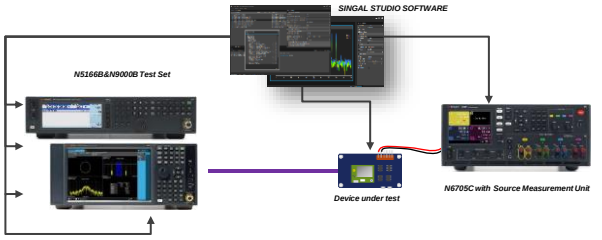
LPWAN
Measuring Lora capabilities



Characterization	Performance	Acceptance
- Extreme Sensitivity - Sync under low SNR - Transmitted Signal - Blocking and Intermodulation	- Energy consumption - Data rates - Propagation conditions - Different operation modes	- 3GPP - GCF, PTCRB - Operators acceptance

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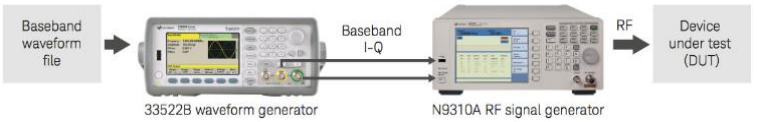
8

SUB GHz、2.4 GHz O-QPSK ZigBee Rx/Tx Test Solution

Rx：透過AWG傳送PPDU資料至SG，即可輸出自訂義的Zigbee訊號



Tx：透過N9320B/22C量測功率強度、訊號準確度等或透過N9000B解析訊號正確性，實地安裝時則可透過N9913A搭配指向性天線，確認干擾源

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9

實務量測上遇到的困難

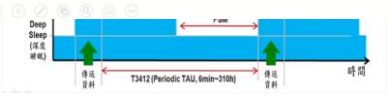
CoreTek 克達科技

一、

二、

IIOT的實務量測

講師：馮育隆 Martin 0987-856086
martin@coretechnology.com.tw



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10

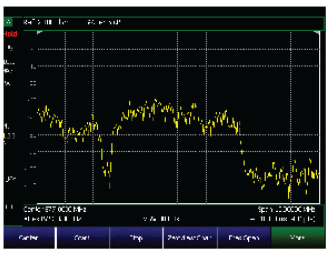
如何預防ISM Band的干擾源

11

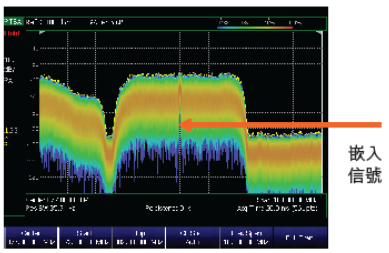
Swept SA VS RTSA

頻譜接收器架構簡介

– 兩者的差異性



在傳統的SA模式下，很難找到隱藏在載波下的訊號



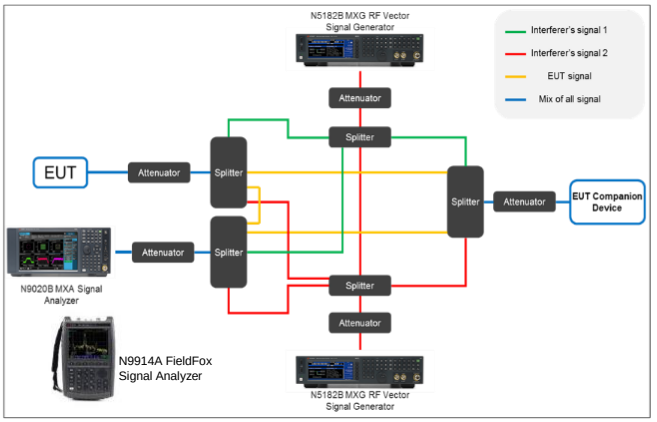
在RTSA模式下，很清晰的確定877MHz處的嵌入訊號

12

RTSA的實務量測

ISM頻段的實務量測

– ANSI C63.27量測



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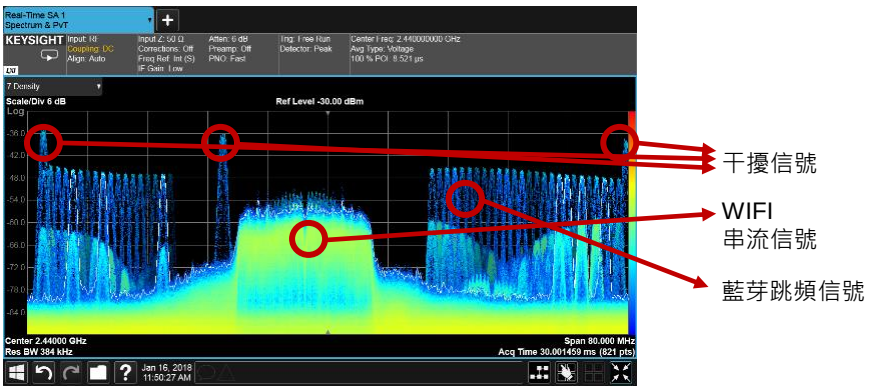
RTSA的實務量測

實際的共存案例



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CoreTek 克達科技

如何量測完整的PSM電流

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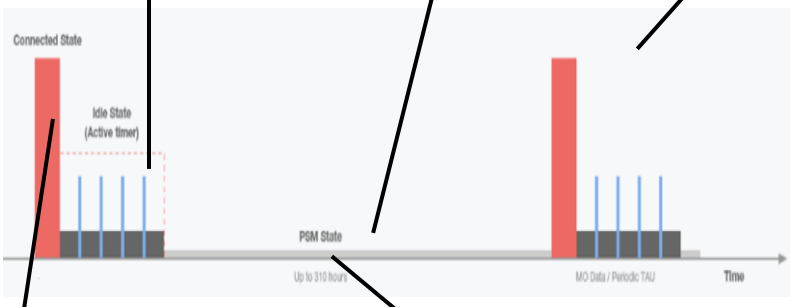
PSM的電流要求

CoreTek

TX RX Time：20μs ↓

Idle Time：300Hr ↑

Active Time：s~100s ↑



Active mode：100mA ↑

Idle mode：10μA ↓

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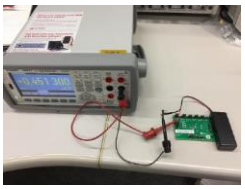
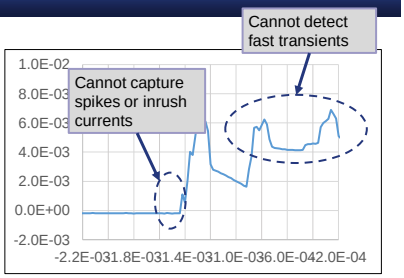
量測的困難度

CoreTek

使用電表進行動態電流量測





Too slow to characterize fast transient signals and spikes

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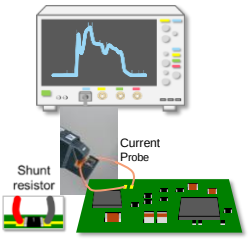
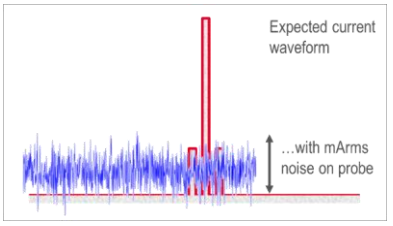
量測的困難度

CoreTek

使用示波器進行動態電流量測





Probe noise prevents the determination of accurate sleep currents

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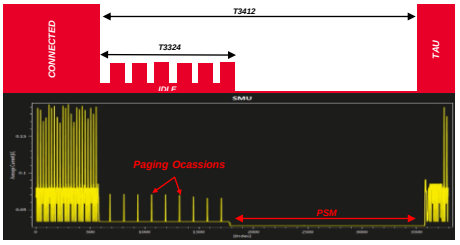
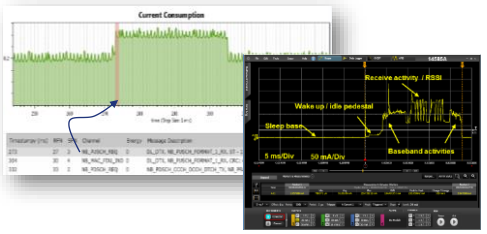
低功耗的實務量測
NBIOT完整量測PSM電流



Power consumed vs Time for a PSM NB-IoT module
Keysight TAP Result Viewer



Protocol and power analysis
N6705C data logging

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低功耗的實務量測
NBIOT完整量測PSM電流

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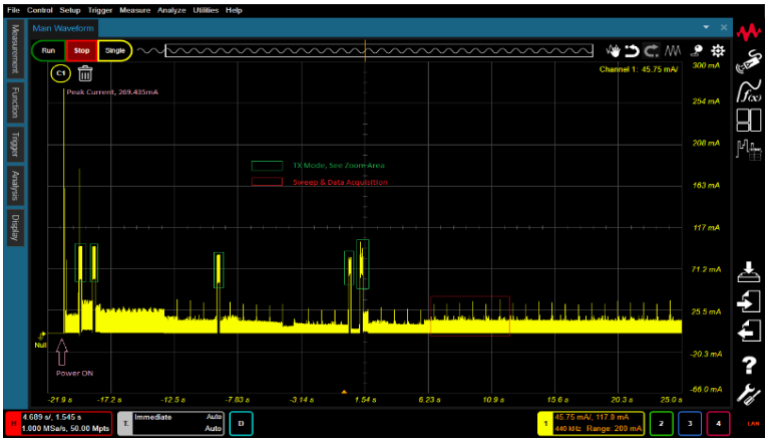
Lora完整量測PSM電流



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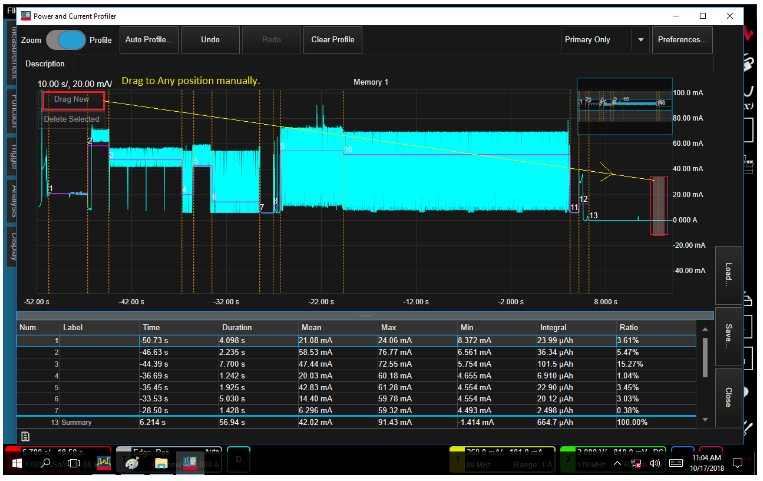
一鍵提取功耗分析



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超薄均溫板熱擴散率以及有效擴散熱傳導係數之量測

REPORTER: ***Professor 林唯耕 (Wei-Keng Lin)***

Email: *wklin@ess.nthu.edu.tw*

Date: ***Nov. 25, 2021***

均溫板有效熱傳導係數 K_{eff}

➢以Angstrom法測量熱管，均溫板，石墨片（石墨烯）K值的原理

熱傳導係數 k（W/m.k）---決定該材料是否為良好的導熱體但無法確定達到熱平衡溫度所需的時間

熱擴散率α（cm^2/s）---單位時間以相同功率輸入時，該材料所能擴散該熱量的面積

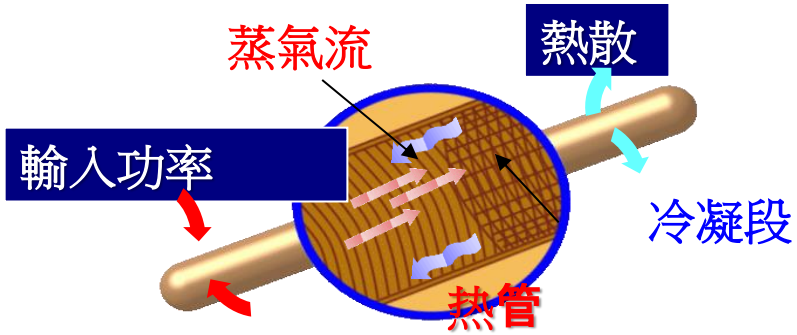


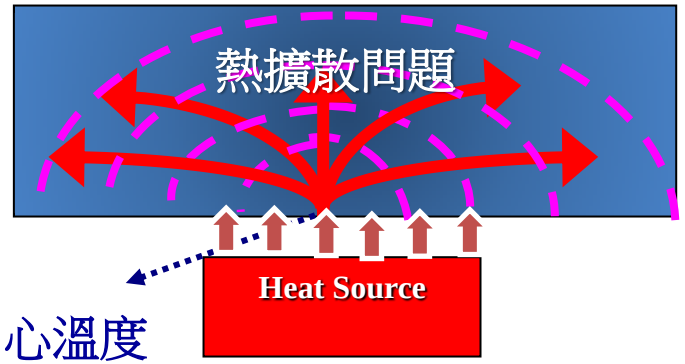
圖42.熱管通過工作流體的潛熱吸收熱量，然後利用熱對流傳遞熱量

$$Q = -K_M A_C \frac{(T_C - T_H)}{L}$$

傅立葉熱傳導定律

固體熱傳導和熱傳面積必須相同

T_{top}: 表面平均溫度



T_{hot}:底面中心溫度

圖46.當加熱面積和散熱面積不同時產生熱擴散之問題

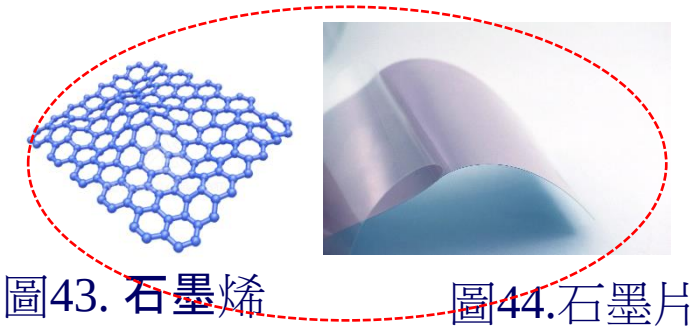


圖43. 石墨烯

圖44.石墨片

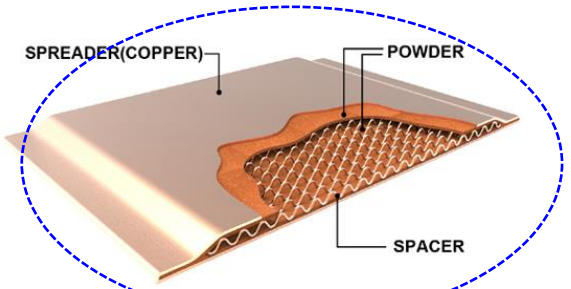
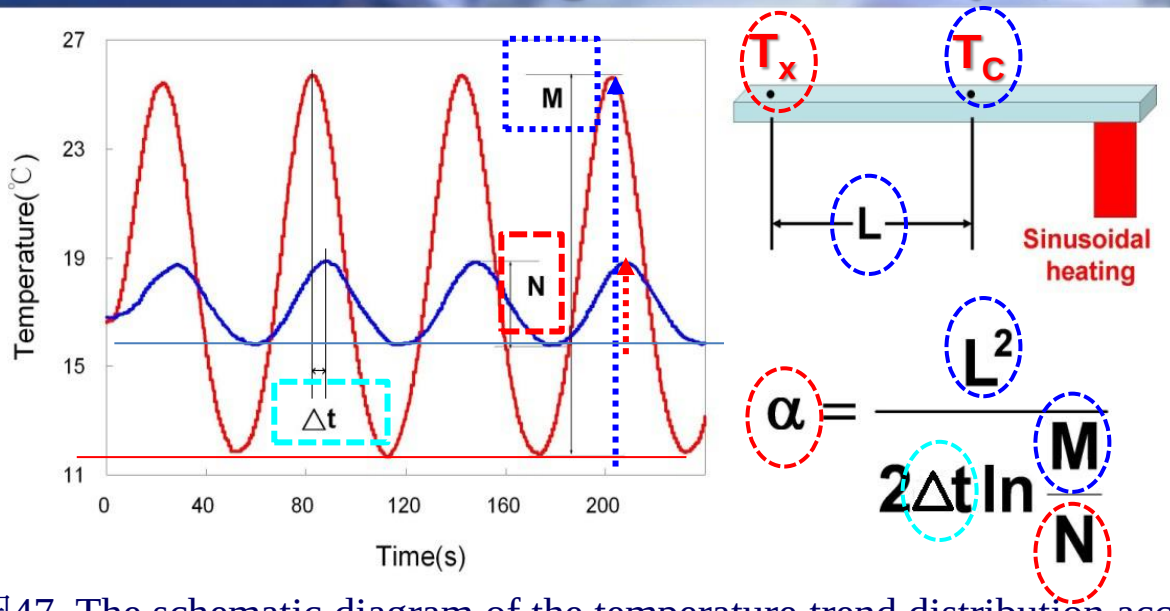


圖45. 均溫板

Measure K by D5470---不可行

Angstrom theory (TDMI)



$$-\left(\frac{\partial T}{\partial t}\right)+\alpha_1\left(\frac{\partial^2 T}{\partial x^2}\right)-\frac{h}{B\rho C_P}(T-T_a)=0 \ \ldots \text{Eq.(1)}$$

$$\alpha_1=\frac{k_{eff}}{\rho C} \ \ldots\ldots\ldots \text{Eq. (2)}$$

圖47. The schematic diagram of the temperature trend distribution according to Angstrom theory

Angstrom's theory---periodic heating pattern

Heating power --- sine wave

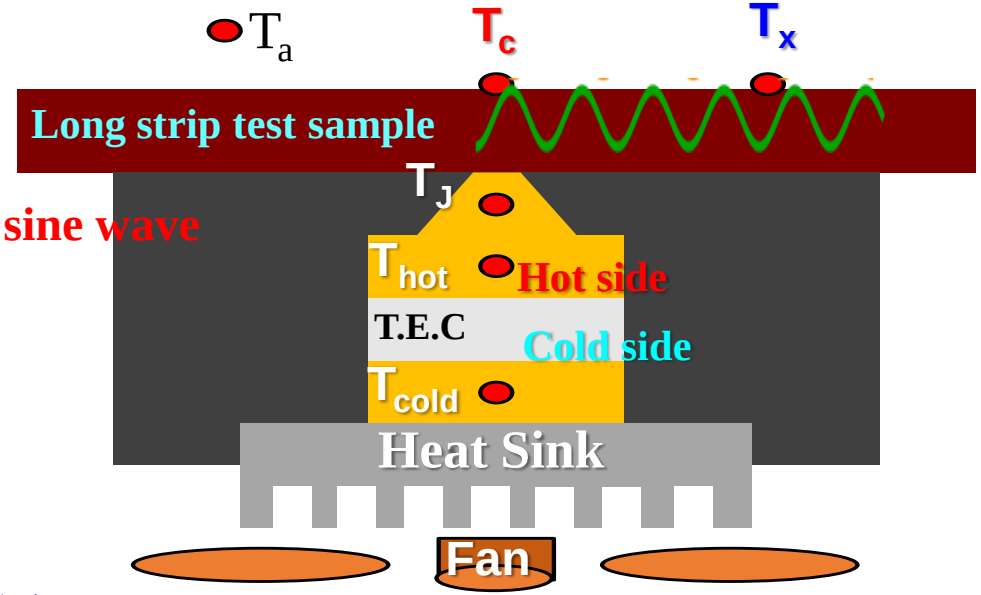


圖48. concept of thermal diffusivity measurement device

圖49. 一維尺寸測試樣本

表8. 不同金屬材料的一維測試樣品的精度誤差分析 (sample size: W=10mm, L=100mm, T=1mm, τ=0.1)

Test material	α_{std} (cm^2/s)	α_{1D} (cm^2/s)	$\varepsilon_{M,std,1D}$
Red copper (Cu)	1.17	1.18	0.85%
Brass (Bs)	0.33	0.31	6.06%
Silver (Ag)	1.75	1.77	1.14%
Aluminum (AL1050)	0.97	0.85	12.37%
Aluminum Nitride (AIN)	0.58	0.58	0%

熱管熱傳導係數不能用簡單的傅立葉定率計算

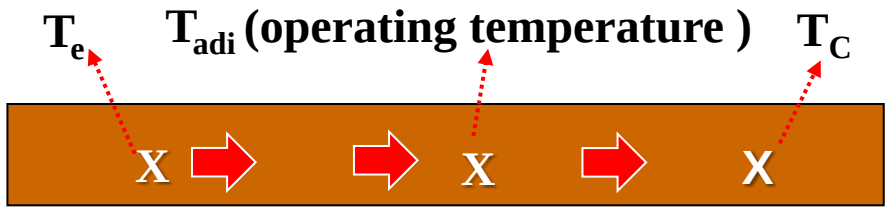


圖50. Schematic diagram of solid copper rod

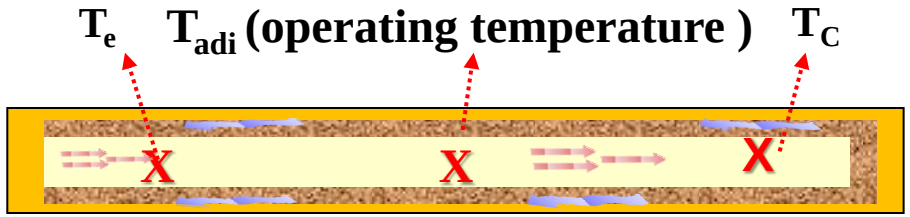
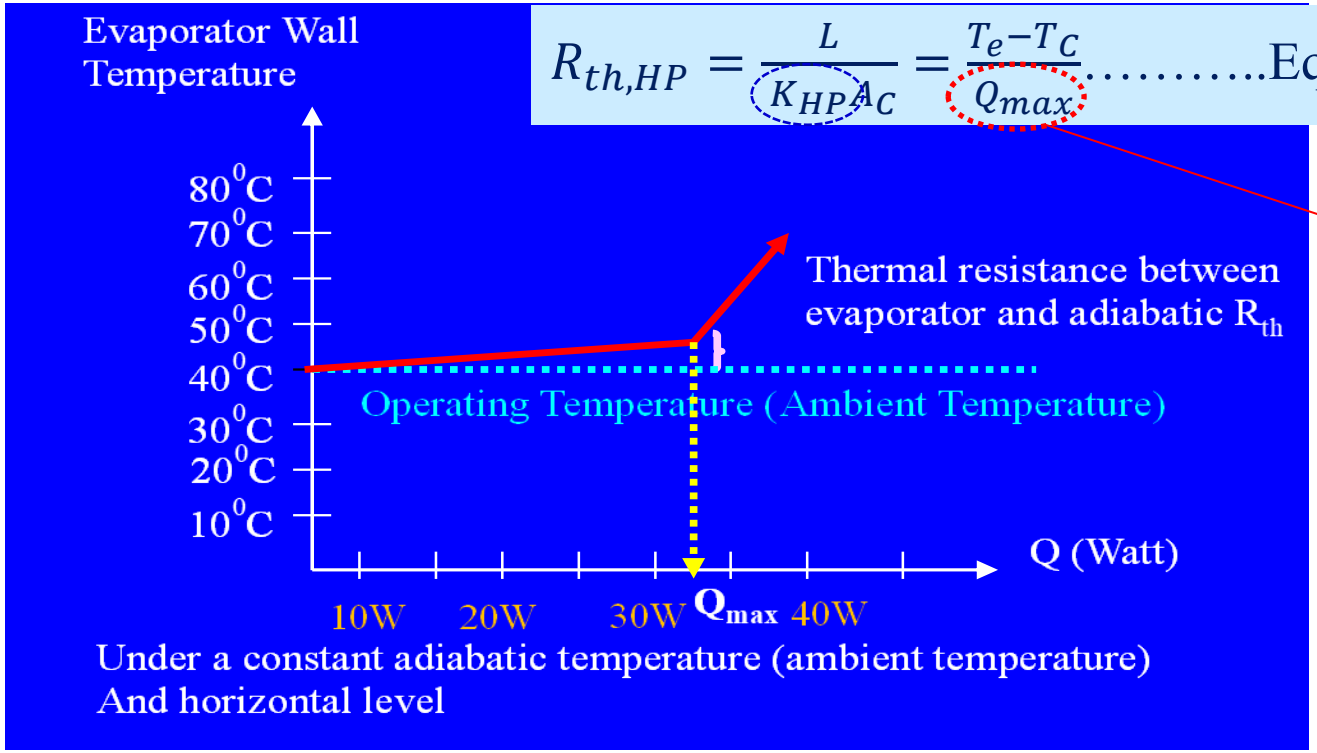


圖51. Schematic diagram of Heat Pipe flow pattern

傳熱介質必須是固體的導熱行為 **與傳統熱管熱傳機制完全不同** 使用液體蒸發的對流行為



Not right

如果沒有做絕熱，或絕熱不好，Q_{max}的數據就不正確

圖52. The Te-Q curve for the result of heat pipe standard test.

表9. 以熱管標準測試性能儀（HPPT）分別測量熱管A和B的Q_{max}和R_{th}(6mm diameter and 200mm length)

Sample	Q_{max} (W)	T_e (℃)	T_{adi} (℃)	T_c (℃)	R_{th} (℃/W)	$A_C = \frac{\pi}{4}(O.D)^2$ (m^2)	L (m)	$K_{HP,HPPT}$ (W/m-K)
A	20	58.5	50	35	1.17	1.25×10^{-5}	0.15	4536
B	40	55.1	50	34.5	0.8	1.25×10^{-5}	0.15	6634

≪ literature value

$$R_{th,HP} = \frac{L}{K_{HP}A_C} = \frac{T_e - T_C}{Q_{max}}$$ (Fourier heat conduction equation)

表10. The Thermal Diffusivity measured by TDMI for heat pipe A and B respectively. (6mm diameter and 200mm length)

$k_{TDMI} = \alpha \times \rho \times Cp$	Heat pipe A	Heat pipe B
ρ(g/cm³)	3.04	3.40
C(J/g·°C)	0.68	0.74
τ = O.D./L	τ=6/150=0.04>0.022	τ=6/150=0.04>0.022
Heat transfer mode	One-dimension	One-dimension
α_1(cm²/s)	115	167
$k_{HP,TDMI}$(W/m-k)	18843	29696
$k_{HP,HPPT}$ (W/m-k)	4536	6634
β=($k_{HP,TDMI}$/ $k_{HP,HPPT}$)	4.15	4.47

0.022< τ <0.075，Zone (B)，

$$\alpha_{M,1D} = \frac{L^2}{2\Delta t(\ln\frac{M}{N})}$$ ..Eq.(16)

表11. 以TDMI中測量均溫板VC-D，VC-E和VC-F的熱擴散率

item	VC-D	VC- E	VC- F
$\rho(g/cm^3)$	6.17	6.49	4.45
C(J/g·℃)	4.123	3.284	4.5
L×W×T (mm^3)	180×80×1	90×90×0.4	90×90×3
τ=T/W	τ_x=1/80 =0.0125<0.022 ; τ_y=1/180 =0.0055<0.022	τ_x=0.4/90 =0.004<0.022 ; τ_x=0.4/90 =0.0044<0.022	τ_x=3/90 =0.033>0.022 ; τ_x=3/90 =0.033>0.022
mode	2D mode (A)	2D mode (A)	1D mode (B)
$\alpha_{1D,total}$ (cm^2/s)	α_x = 0.52 ; α_y =0.43 ; $\alpha_{1D,total}$ =α_x+α_y=0.95	α_x = 0.4 ; α_y =0.32 ; $\alpha_{1D,total}$ =α_x+α_y=0.72	α_x = -0.78 ; α_y =2.98 ; $\alpha_{1D,total}$ =α_x+α_y=2.19
$\alpha_{2D,total}$ (cm^2/s)	= $\alpha_{1D,total}$ *2=1.9	= $\alpha_{1D,total}$ *2=1.44	--
$K_{VC,TDMI}$ (W/m-k)	K_{VC-A} =1.9*6.17*4.123*100=4833	K_{VC-B} = 1.44*6.49*3.284*100= 3069	K_{VC-C} =2.19* 4.45*4.5**100= 4385
Q_{max} (W)		210@T_C=60°C, $T_{j,surface}$=100°C	551@T_C=60°C,$T_{j,surface}$=100°C
Axial thermal resistance $R_{th,VC,Z}$(K/W)		0.04	0.08

圖53. VC-D 180*80*1mm

圖54. .均溫板VC-E 實體

圖55. 均溫板VC-F 實體

表12. 以TDMI中測量刺穿的均溫板VC-D，VC-E和純銅的熱擴散率比較

item	VC-D	VC- E	Pure copper
$\rho(g/cm^3)$	8.933	8.933	8.933
C(J/g·°C)	0.383	0.383	0.383
L×W×T (mm^3)	180×80×1	90×90×0.4	
τ=T/W	τ_x=1/80 =0.0125<0.022 τ_y=1/180 =0.0055<0.022	τ_x=0.4/90 =0.004<0.022 τ_x=0.4/90 =0.0044<0.022	
mode	2D mode (A)	2D mode (A)	
$\alpha_{1D,total}$ (cm^2/s)	α_x=0.2603 α_y=0.2807 $\alpha_{1D,total}=\alpha_x+\alpha_y$=0.541	α_x=0.2931 α_y=0.2619 $\alpha_{1D,total}$ $\alpha_x+\alpha_y$=0.555	1.17
$\alpha_{2D,total}$ (cm^2/s)	= $\alpha_{1D,total}$ *2=1.082	= $\alpha_{1D,total}$ *2=1.11	--
$K_{VC,TDMI}$ (W/m-k)	K_{VC-D} =1.082*8.933*0.383*100=370.18	K_{VC-E}= 1.11*8.933*0.383*100= 379.8	K_{Cu}=380
Error (%)	2.58%	0.05%	

圖56. VC-D 180*80*1mm

圖57. VC-E 90*90*0.4mm

$$\text{Error} = \frac{\left|K_{VC,i,TDMI} - K_{cu}\right|}{K_{cu}} \times 100\%$$

表13.以TDMI中測量均溫板VC-G和VC-F的熱擴散率

item	VC-G			VC- H		
ρ(g/cm^3)	5.387			5.76		
C(J/g·℃)	3.604			3.54		
L×W×T (mm^3)	27*60*0.4			60×90×0.4		
τ=T/W	τ_x=0.4/27 =0.0148<0.022	τ_y=0.4/60 =0.0066<0.022		τ_x=0.4/60 =0.0066<0.022	τ_x=0.4/90 =0.0044<0.022	
mode	2D mode (A)			2D mode (A)		
$\alpha_{1D,total}$ (cm^2/s)	α_x=4.301	α_y=4.3315	$\alpha_{1D,total}=\alpha_x+\alpha_y$=8.6325	α_x=2.76	α_y=2.84	$\alpha_{1D,total}$ $\alpha_x+\alpha_y$=5.6
$\alpha_{2D,total}$ (cm^2/s)	= $\alpha_{1D,total}$ *2=17.265			= $\alpha_{1D,total}$ *2=11.2		
$K_{VC,TDMI}$ (W/m-k)	K_{VC-F} =33519.56			K_{VC-G}= 22837		

圖58. VC-G customer made entity diagram thickness 0.4mm made by ACL

圖59. VC-H 60x90x0.4 mm^3 entity diagram made by ACL

節能減碳，守望地球

Tomorrow will be much more better !

明天會更好

謝謝　敬請指教

Q & A