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AI for Service Innovation of Medical Imaging Systems Challenges in Compliance and Operation

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innovation  you



Philips MRI scanner Ingenia 3.0T

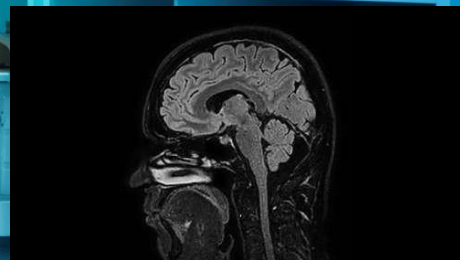
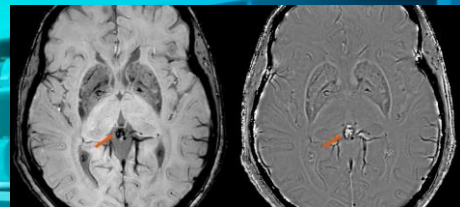
4600 Kg

Occupies 3 rooms:

- Examination (this picture)
- Operations
- Technical

Superconducting magnet
cooled with liquid Helium at
 $-269.15\text{ }^{\circ}\text{C}$

Millions of lines of code



Philips IGT Azurion



Occupies 2 rooms:

- Examination (this picture)
- Technical

6+1 degrees of freedom



Our customer needs

- Optimal clinical performance
- Predictable system operations
- Predictable cost of ownership





Strategic intent

Zero unplanned system downtime



PHILIPS

Healthcare

Aiming
for zero



At Philips we understand that providing care today means more than just providing technology. It is about making every investment worthwhile and every usable moment count. That's why we are dedicated to working with you to reduce unplanned downtime.

Three ways of increasing your uptime:

1. Reactive customer call handling and maintenance service

Customer informs Philips of a problem experienced with the product. Philips will diagnose the problem remotely and if possible resolves the issue remotely. Otherwise a field service engineer will be dispatched with guidance and needed parts for a single-visit repair.



2. Alert response

Alerts that are generated by the device itself or equipment installed at the hospital facility indicating that critical system and/or environmental parameters and conditions are out of specification.



3. Proactive monitoring

By means of data analytics algorithms, machine and service data is constantly analyzed to identify patterns and trends. These notifications are predictive in nature, enabling a service action to be scheduled in advance without interrupting regular clinical workflow.



Predictive maintenance is on the rise. We envision that, by 2018, one in every five system service events will be triggered by careful analysis of system data - and will therefore take place before any major issues arise. This maintenance can also be planned so there is no disruption to your workflow.



dedicated monitoring engineers are constantly on the lookout for issues that may impact your uptime:

10,000+

cases are proactively handled every year by our centralized monitoring team to reduce unnecessary downtime



>12,000

Philips Imaging systems are monitored daily to identify patterns that could indicate preventive action is required

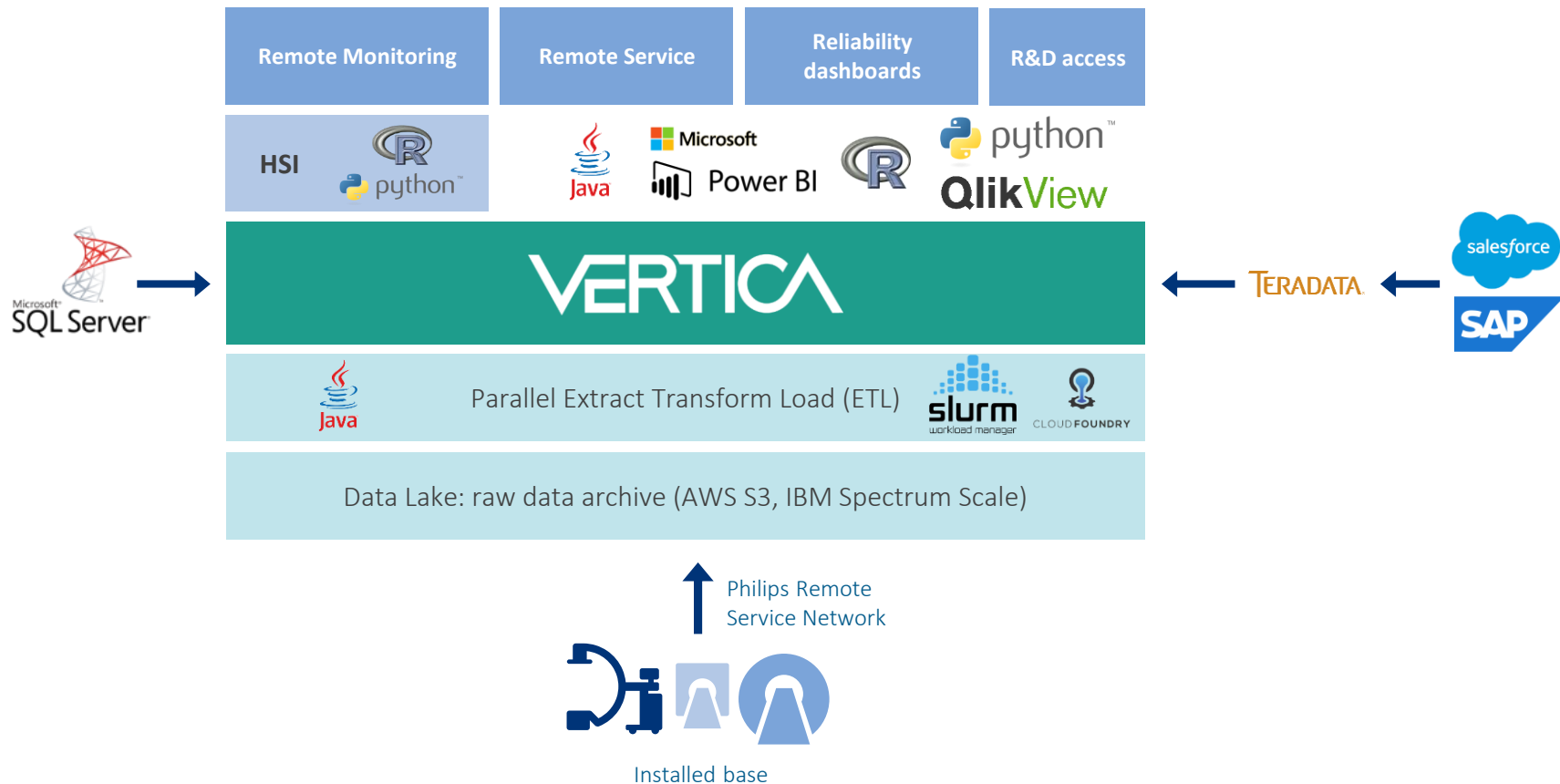


central monitoring locations in major time zones help resolve your problems quickly and effectively

Learn more at www.philips.com/aimingforzero



High-level architecture

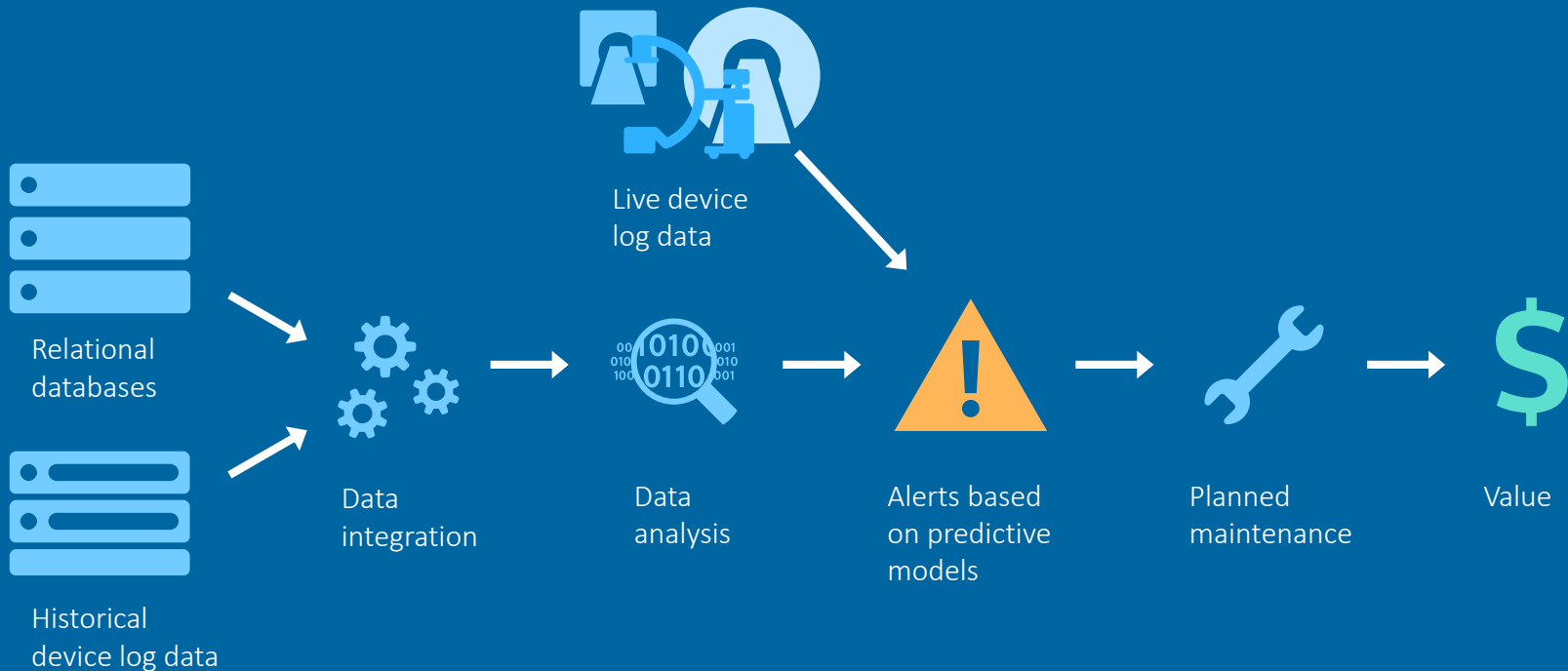


Data integrated

- 1.5 PB in hundreds of tables
- 3 trillion data points
- More than 80 different data sources integrated for the complete connected installed base including CRM system, SAP, factories, repair shops
- 3-9 years of historical data
- 24/7 live data feeds



Use case 1: proactive maintenance





Remote monitoring dashboard

PHILIPS RADAR 2.0 Help User Name ▾

Monitoring dashboard

▼ Global Stats

1620 systems processed 48%
Total systems in RDW **1840**

21 critical systems 14%
Total systems processed **1840**

45 systems analysed 10%
Total critical systems **1840**

📍 Location

All regions (5478)

- APAC (1923)
 - ASEAN (222)
 - Australasia (534)
 - Greater China (1893)
 - India (222)
 - Japan (534)
 - EMEA (222)
 - LATAM (534)

Country	Site Name	Category	Device type	System ID	Aggregate title	Priority	Last Alert date
Japan	[REDACTED]	<input type="checkbox"/> Predictive	1.5T 8R5	68942	▶ Highest severity alert description shown	CN 3	20-May-2017
Japan	[REDACTED]	<input type="checkbox"/> CAT matches	1.5T 8R5	78456	Alert description shown here	CN	21-May-2017
Japan	[REDACTED]	<input checked="" type="checkbox"/> All	1.5T 8R5	100200	▶ Highest severity alert description shown	CN 8	22-May-2017
Japan	[REDACTED]	<input checked="" type="checkbox"/> P <input type="checkbox"/> I	1.5T 8R5	35758	▶ Highest severity alert description shown	CN 888	24-May-2017
Japan	[REDACTED]	<input checked="" type="checkbox"/> P	1.5T 8R5	57941	Alert description shown here	IP 4	24-May-2017
Japan	[REDACTED]	<input type="checkbox"/> I	1.5T 8R5	57941	▶ Highest severity alert description shown	IP 4	24-May-2017
Japan	[REDACTED]	<input type="checkbox"/> I	1.5T 8R5	45887	Alert description shown here	SR	22-May-2017
Japan	[REDACTED]	<input checked="" type="checkbox"/> P <input type="checkbox"/> I	1.5T 8R5	78456	▶ Highest severity alert description shown	SR 24	21-May-2017
Japan	[REDACTED]	<input checked="" type="checkbox"/> P	1.5T 8R5	78456	Alert description shown here	SA 3	21-May-2017
Japan	[REDACTED]	<input type="checkbox"/> I	1.5T 8R5	45887	Alert description shown here	SA	22-May-2017
Japan	[REDACTED]	<input checked="" type="checkbox"/> P <input type="checkbox"/> I	1.5T 8R5	57941	Alert description shown here	SD 210	24-May-2017

Display alert legend 1/3



Remote monitoring dashboard

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Monitoring Dashboard **100200**

100200 Critical need 3

Site ID	Type	Model Name	Model Number	Version
1620420	Achieva	FD10/10	xx007	8.2.16.4

Overview

Notes User2 @ 18-A

Open Alerts

Category	AlertID	Description	Priority	Date and time
Category 3	458798	Description One	Critical need	11:48:14 20-May-2017
Category 2	987865	Description Three	System restricted	12:48:15 21-May-2017

Create new case

Alerts

Enter comment

Priority 5 Scheduled activity ▾

Ignore these alerts till 25-07-2017 or till case is closed

Selecting Priority 1 or 2 has safety/security implication!

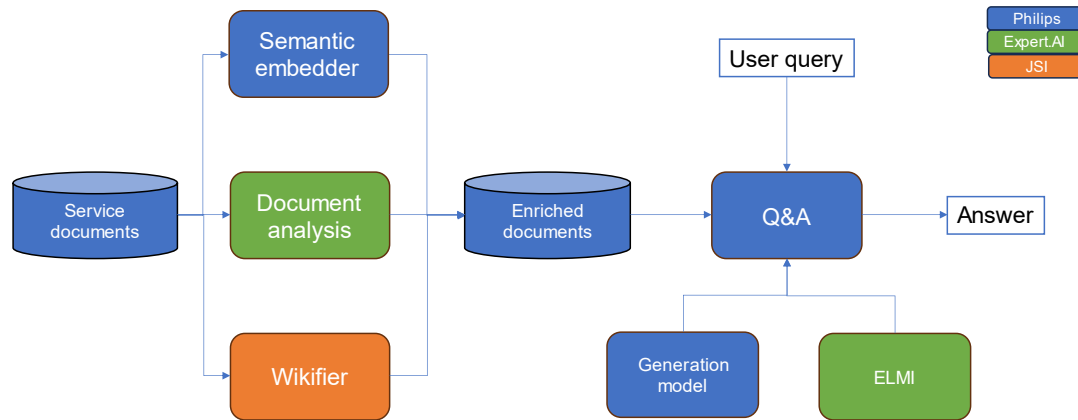
Submit Cancel

System Usage

Time	Activity	Time	Activity
07:31:17	Starting System	07:32:14	System Started
07:36:17	Case 1 Started	07:36:17	Case 1 Stopped
08:31:17	Case 2 Started	08:31:45	Case 2 Stopped
08:45:17	Case 3 Started	09:20:14	Case 3 Stopped
10:15:17	Case 4 Started	10:20:14	Case 4 Stopped

Use case 2: Knowledge search using GenAI

- Problem: find relevant information given a problem in service documentation
- Approach: information extraction & enrichment, search and Q&A using LLM
- Challenge: (pdf) documents contains domain specific languages, tables and figures, customize GenAI solution to domain specific use case



# Samples	Retrieval		Question answering		
	Recall@top5	MRR	Correct (%)	Partially correct (%)	Wrong (%)
55	1	0.92	78.17	12.73	9.09

Challenge in compliances

- Servicing of medical devices is regulated by government agencies (FDA, EMA, NMPA etc.)
 - Servicing is “the repair and/or preventive or routine maintenance of one or more parts in a finished device, after distribution, for purposes of returning it to the **safety** and **performance specifications** established by the OEM and to meet its **original intended use.**” [FDA]

Challenge in compliances

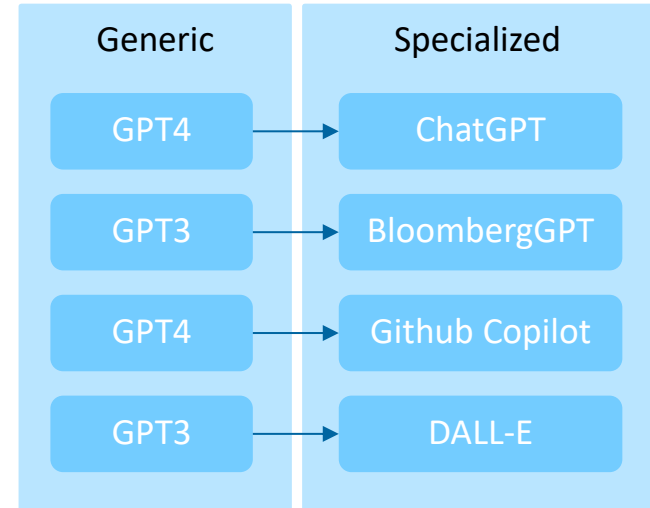
- Data capture & pipeline:
 - Data capture needs to be compliant on privacy and availability
 - Balance these aspects with regulatory obligations and Philips' intellectual property interests
- AI applications:
 - Model selection/reuse
 - Traceability
 - Trustworthiness
 - Explainability
 - Reliability
 - Data quality

Challenge in compliances

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Challenges in development and operation for GenAI solutions

- **Specialized** models for **specific** tasks
- Specialization achieved by additional domain-specific data and/or modified model architecture
- Multiple deployment options
 - **Private APIs** (e.g. OpenAI ChatGPT)
 - **Cloud APIs** (e.g. AWS Bedrock – models by Anthropic, Stability AI etc)
 - **Self-hosted** (e.g. Meta LLaMa2)

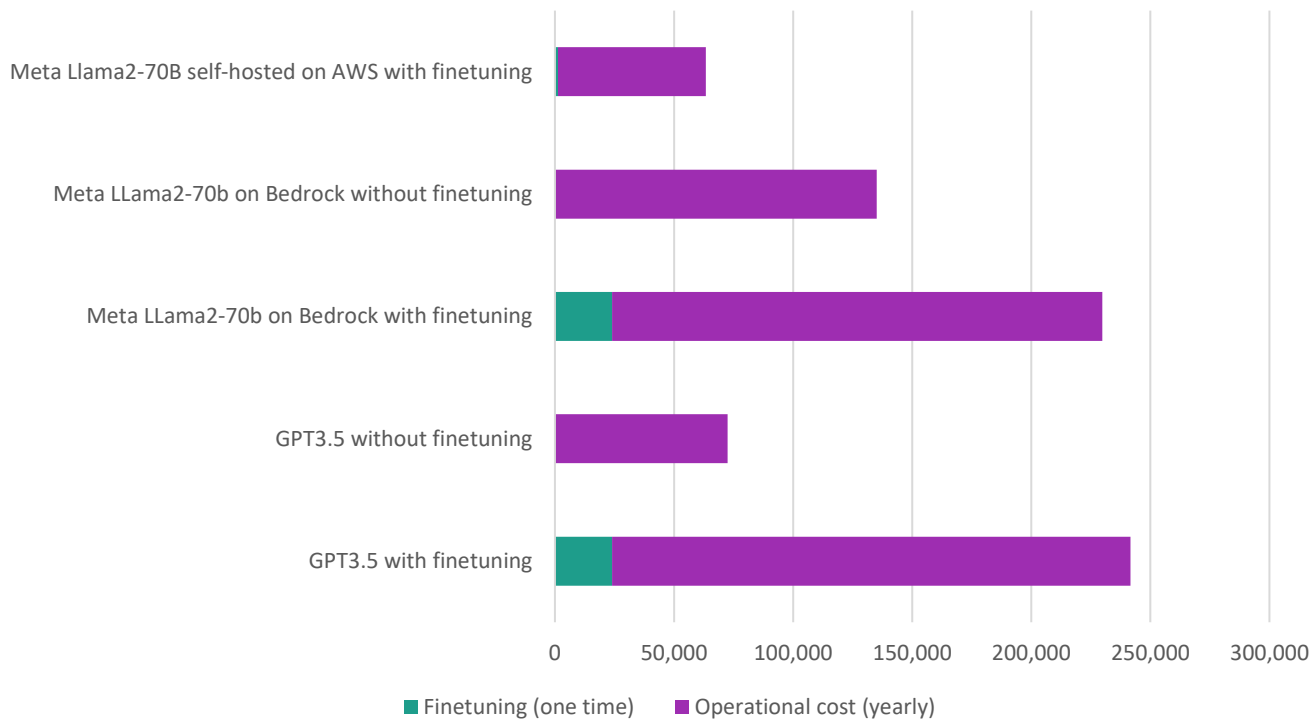


Customization of GenAI model for specific tasks/domain

- Implementation on new tasks (e.g. new domain) requires adaptation

	Prompting	Finetuning
What	Changing/extending prompt to steer LLM or to include supplementary data	Re-training of (a portion of) the model with additional data
Pros	<ul style="list-style-type: none">• Fast to implement• No (re)training• No technical expertise required	<ul style="list-style-type: none">• High adaptability• Better performance• Can learn from large dataset
Cons	<ul style="list-style-type: none">• Prompt size limits additional data• Limited adaptability• Hallucinations	<ul style="list-style-type: none">• Requires additional data• Computationally expensive• Requires deep technical expertise
When	<ul style="list-style-type: none">• Same or similar tasks/data• Fast prototyping	<ul style="list-style-type: none">• Novel task• Novel domain• High precision

Cost analysis for development and deployment



Input parameters	
Training	
# Training tokens	1000000000
# Training epochs	3
Inference	
Average #requests per hour	1800
Average #input tokens per request	4000
Average #output tokens per request	300



Thank you!

- If you are interested in collaboration, please reach out to g.gao@philips.com



enRichMyData

