AWS re:Invent

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PNU303

Real-time wind farm health: AWS IoT and Greenko case study

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Agenda

- Who is Greenko
- What is the AS-IS situation
- Greenko pilot: What we achieved
- AWS conceptual architecture: Renewable energy asset optimization
- Greenko architecture
- Costs
- Live demo and Q&A
- Complete survey

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Who is Greenko?

Assets at a Glance

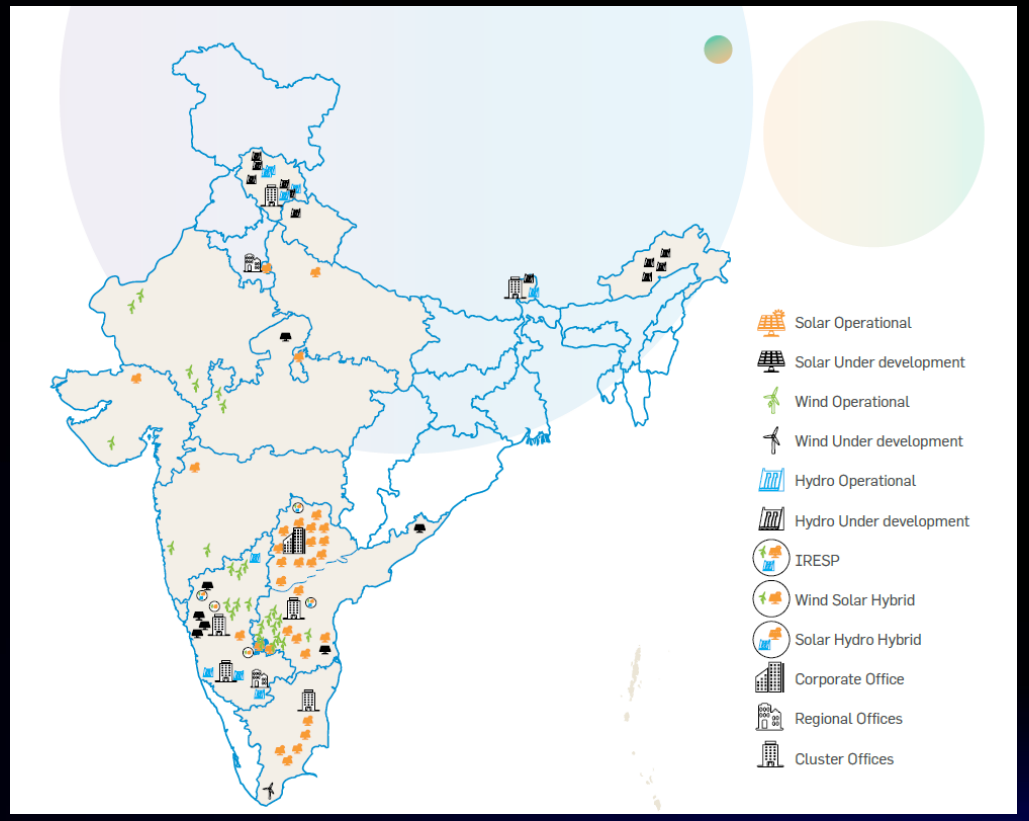
6.2 GW Installed Capacity	5.9 Mn Solar Modules	112 Sites (Projects)
660.9 Revenue (Million USD)	1931 (Solar) Inverters	15 States in India
2600+ Employees		
2300+ Length of the transmission line (km)		
62 (hydro) 1184 (wind) Turbines		







Greenko is one of India's leading renewable energy companies, replacing fossil fuels with integrated decarbonized energy and grid assets enabling sustainable and affordable energy, with a net installed capacity of 6.2 GW across 15 states in India



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What was the AS-IS situation

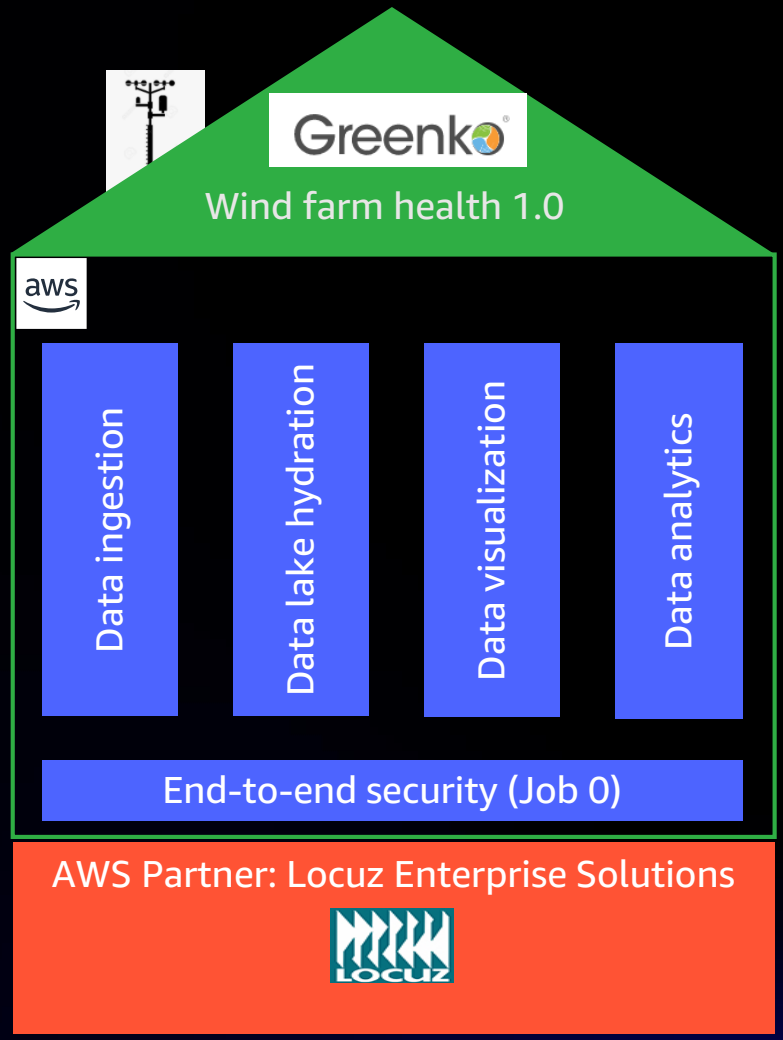
- Currently all infrastructure is on premises
- Telemetry data collected every 30 seconds
- No consolidated view of data
- Sites store data in historians/SQL databases
- Data visualization via GE Proficy Cimplicity

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Greenko pilot: What we achieved

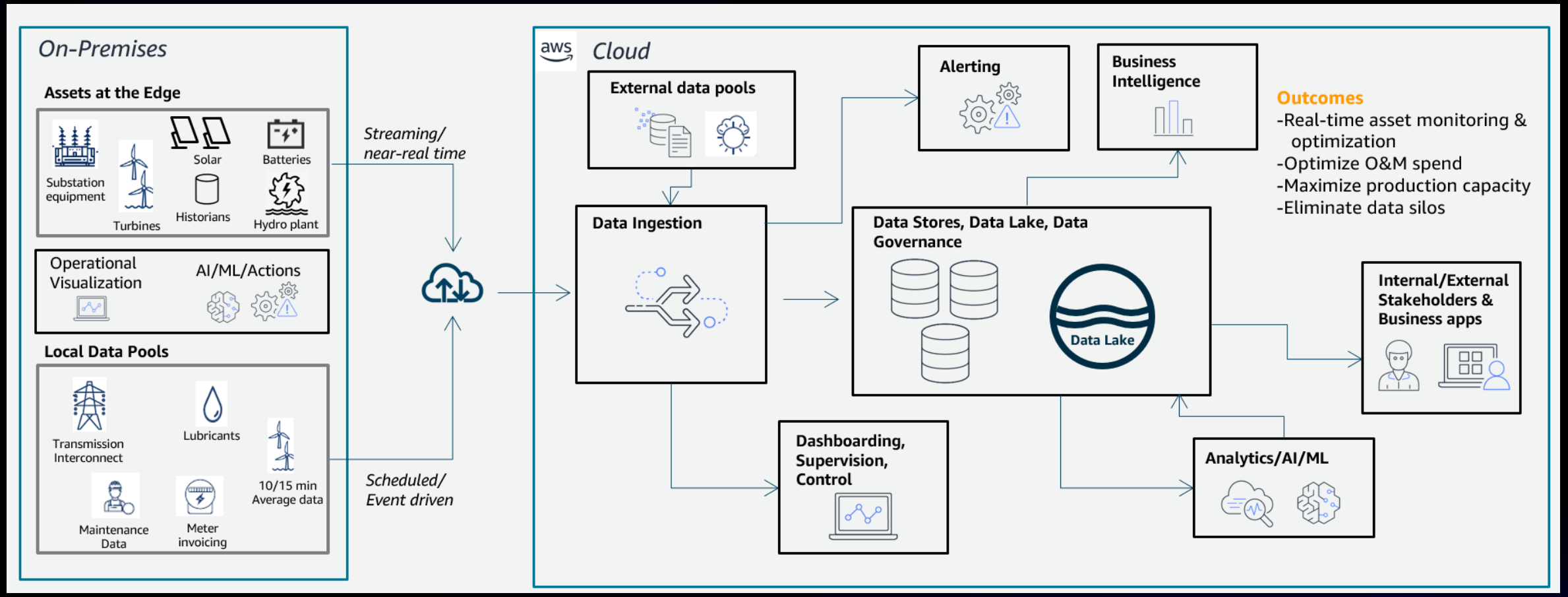
Ingest live data from 100 wind turbines

- Data ingestion
  - 93 tags per turbine
  - Collection frequency – 10 seconds
- Hydrate IoT data lake
  - Highly available and scalable IoT data lake
- Data visualization
  - Live operational dashboard of a wind farm for 100 turbines
  - Dashboard refresh rate of 1 minute
- Data analytics
  - CloudWatch



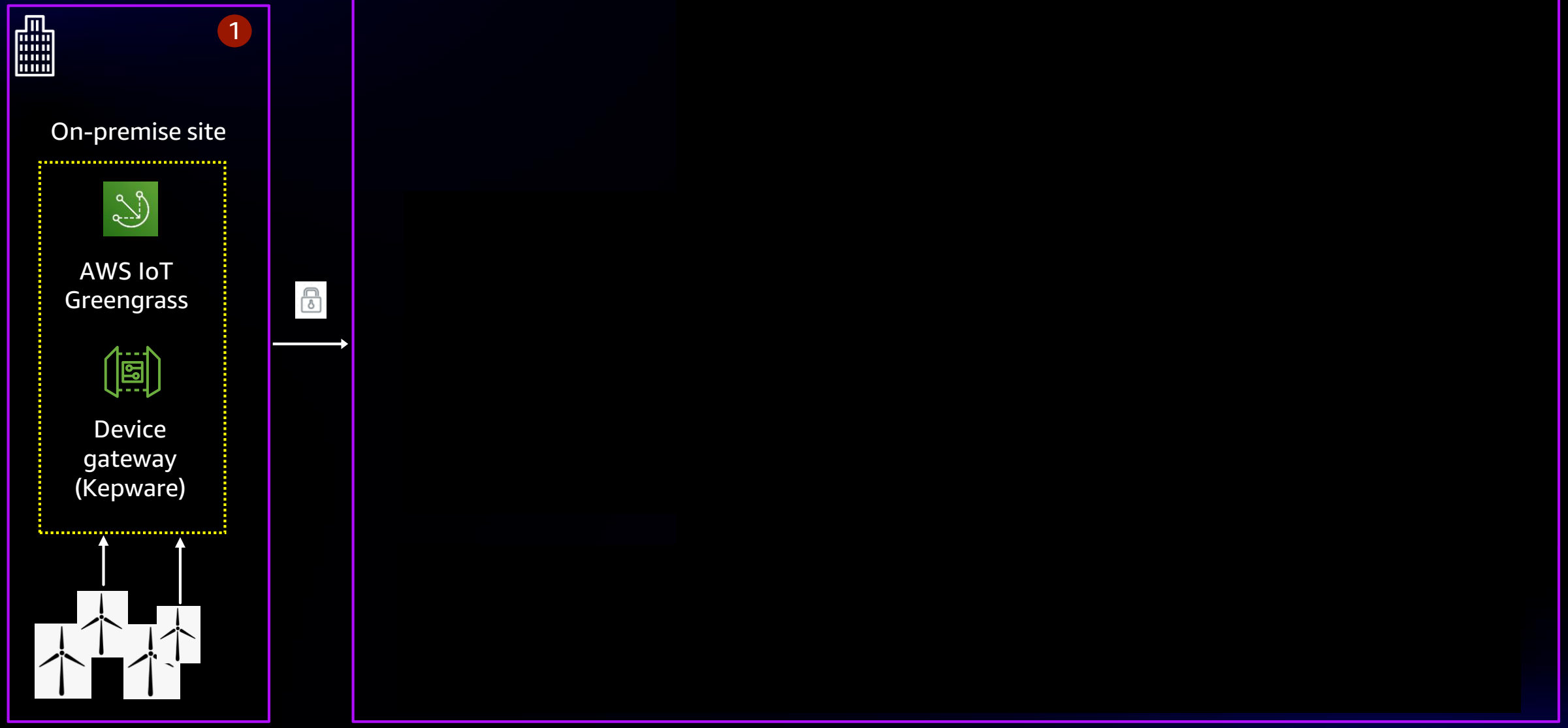
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AWS conceptual architecture: Renewable energy asset optimization



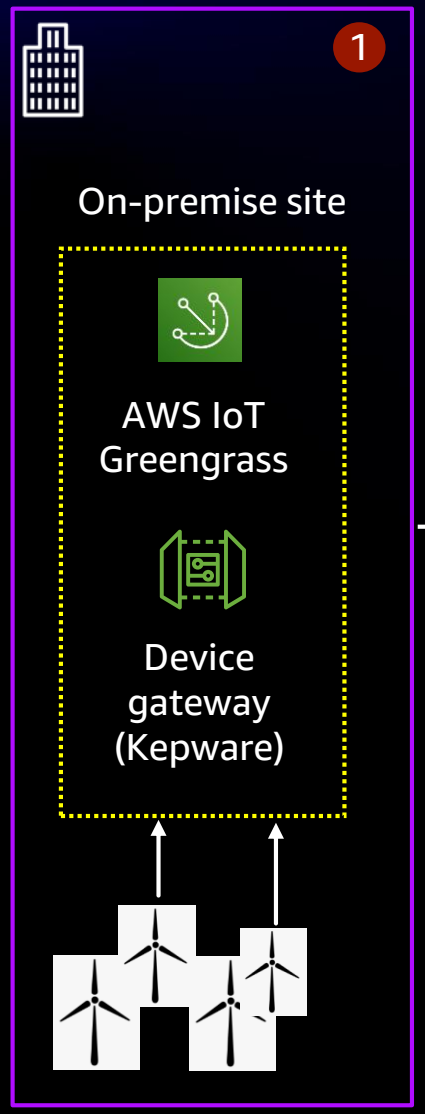
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Greenko architecture



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Greenko architecture

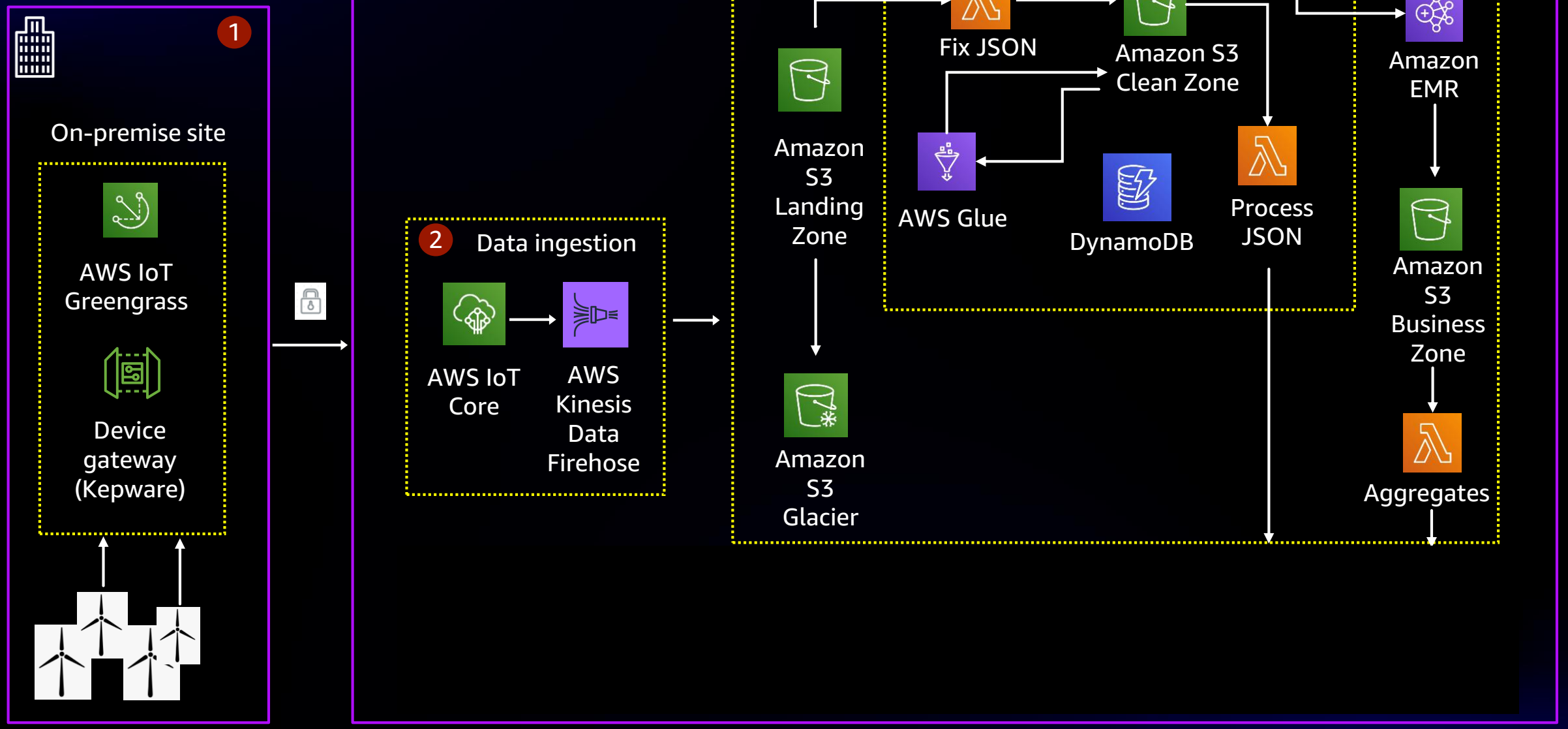






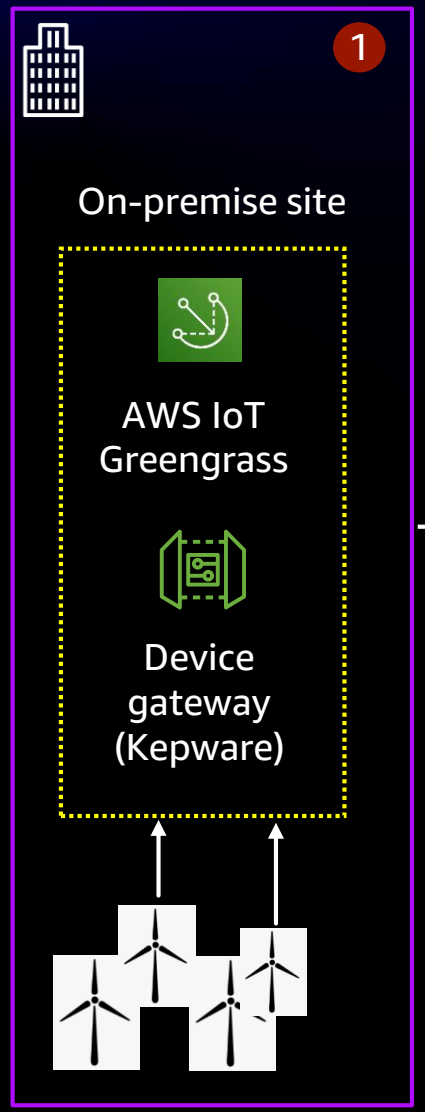
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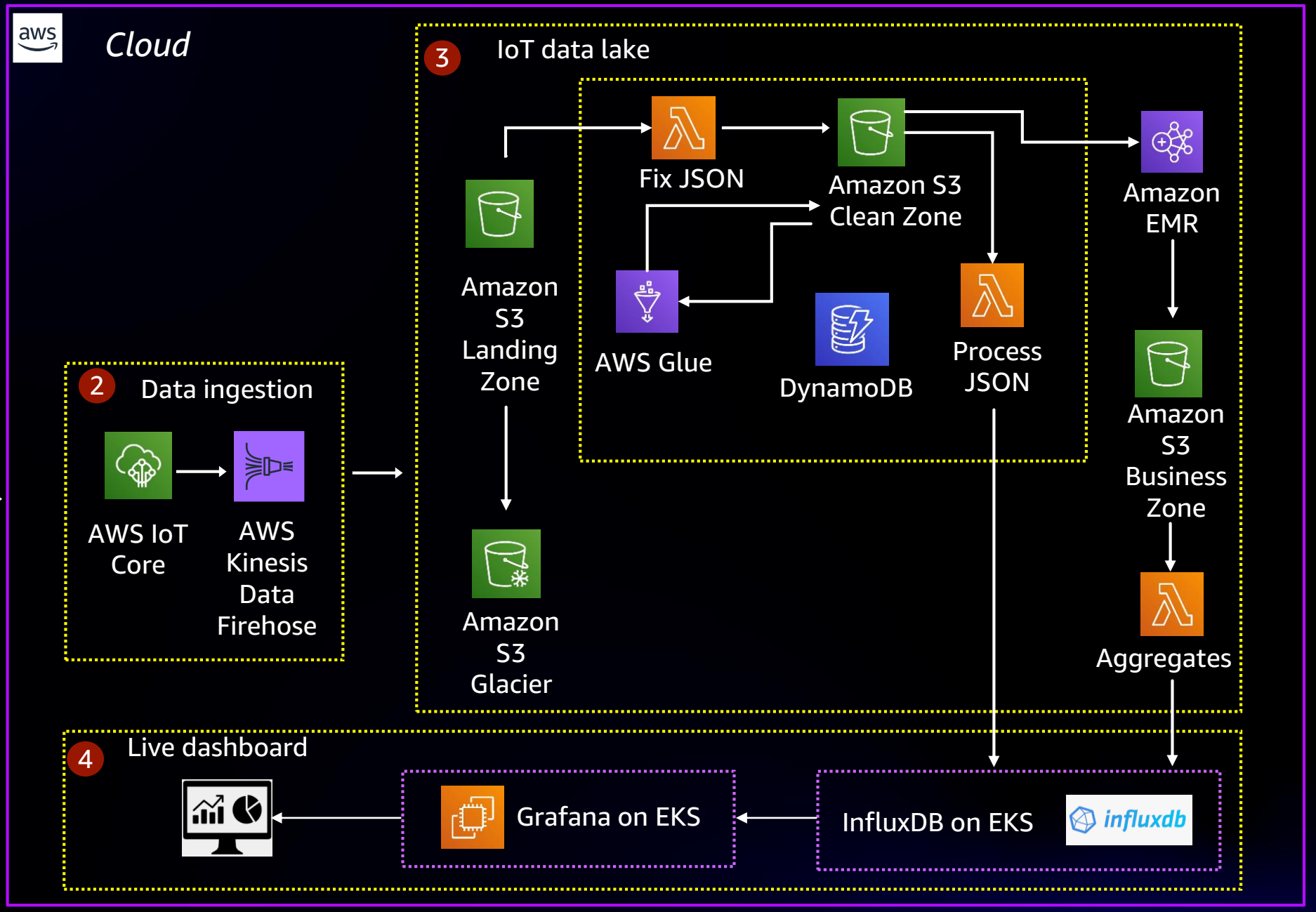
Greenko architecture



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Greenko architecture





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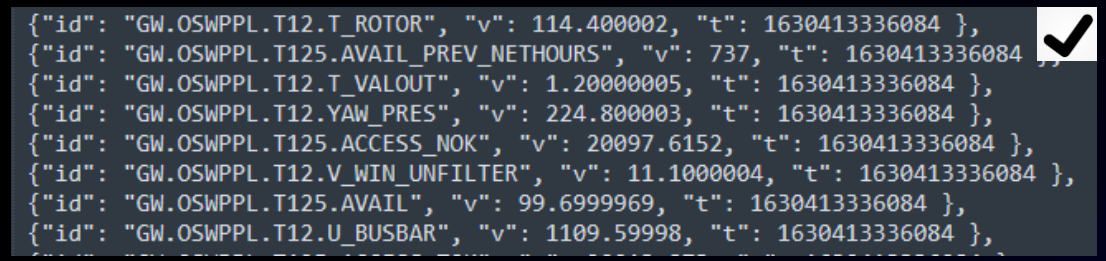
Key architecture decisions

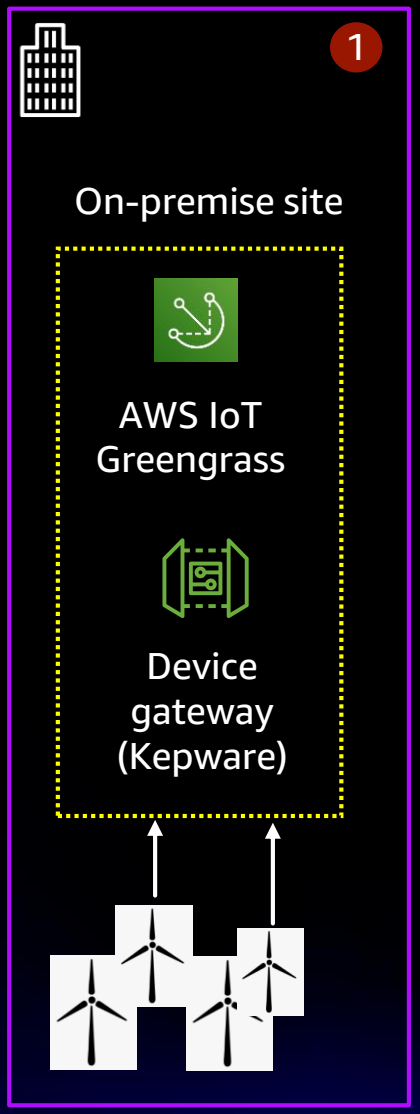
Custom JSON format in Kepware for AWS IoT Core

- Default Kepware format is not timeseries friendly



- Custom format that reflects timeseries data





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Key architecture decisions

- Amazon EC2 M6g instances powered by AWS Graviton2 for Amazon EMR
  - 15% improved performance at up to 50% lower costs for EC2

Region: Asia Pacific (Mumbai)

	Amazon EC2 Price (On Demand)	Amazon EMR Price
General Purpose - Current Generation		
m6g.xlarge	$0.1012 per hour	$0.039 per hour
m6g.2xlarge	$0.2024 per hour	$0.077 per hour
m6g.4xlarge	$0.4048 per hour	$0.154 per hour
m6g.8xlarge	$0.8096 per hour	$0.308 per hour
m6g.12xlarge	$1.2144 per hour	$0.462 per hour
m6g.16xlarge	$1.6192 per hour	$0.616 per hour
m5.xlarge	$0.202 per hour	$0.048 per hour



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Key architecture decisions

- InfluxDB instead of Aurora Serverless to store time series data
  - RDBMS database is not correct fit for timeseries data
  - InfluxDB delivered the performance requirements for the live dashboard
  - InfluxDB costs less for the required performance



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Key architecture decisions

- InfluxDB on Kubernetes (EKS)
  - InfluxDB is not highly available (HA) by default
  - HA option of InfluxDB not available in Mumbai region
  - HA SAAS option had higher cost and requires data egress
  - Need for root level control of cluster





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Costs: Initial solution

Cost Projections Wind Farm 1 – 100 Wind Turbines 93 total tags per turbine | 58 hot tags (35 cold) | 10 sec intervals		
	Monthly Cost in USD without tax	
Ingestion	AWS IoT Core	81.00
	Amazon Kinesis	3.00
Storage	Amazon S3	11.00
Compute	Amazon EC2	480.00
	Amazon EBS	22.00
	Amazon ECS (Grafana)	300.00
	Amazon EMR	113.00
	AWS Lambda	5.00
	Amazon SQS	6.00
RDS	Aurora Serverless	6,000.00
Networking	Elastic Load Balancer	60.00
	Amazon Route 53	1.00
Security	AWS Secrets Manager (SSL certificate)	10.00
Analytics	Amazon CloudWatch	13.00
Total for 100 turbines		**$7,105.00**
Cost per turbine		**$71.05**

Data was collected continuously as more turbines were brought on line; this the difference in costs across same services

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Costs: Optimized solution

Cost Projections Wind Farm 1 – 100 Wind Turbines 93 total tags per turbine | 58 hot tags (35 cold) | 10 sec intervals				
	Monthly Cost in USD without tax		**Optimized Monthly Cost in USD without Tax**	
Ingestion	AWS IoT Core	81.00	AWS IoT Core	107.31
	Amazon Kinesis	3.00	Amazon Kinesis	5.77
Storage	Amazon S3	11.00	Amazon S3	23.08
Compute	Amazon EC2	480.00	Amazon EC2 for Amazon EMR	285.00
	Amazon EBS	22.00	Amazon EBS	34.62
	Amazon ECS (Grafana)	300.00	Amazon EKS (Influx + Grafana)	87.14
	Amazon EMR	113.00	Amazon EMR	40.38
	AWS Lambda	5.00	AWS Lambda	3.46
	Amazon SQS	6.00	Amazon SQS	1.15
RDS	Aurora Serverless	6,000.00	Aurora Serverless	0.00
Networking	Elastic Load Balancer	60.00	Elastic Load Balancer	115.38
	Amazon Route 53	1.00	Amazon Route 53	1.15
Security	AWS Secrets Manager (SSL certificate)	10.00	AWS Secrets Manager (SSL certificate)	5.77
Analytics	Amazon CloudWatch	13.00	Amazon CloudWatch	76.15
Total for 100 turbines		**$7,105.00**		**$786.37**
Cost per turbine		**$71.05**		**$7.86**

Wow! 9x reduction

Data was collected continuously as more turbines were brought on line, this the difference in costs across same services

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Costs: How does this compare?

Cost of a basic video streaming subscription = $8.99 per month

Video streaming service provider	Basic subscription
Provider 1	$8.99
Provider 2	$12.99
Provider 3	$8.99

Cost of monitoring a $1 million asset = $7.86 per month

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Thank you!

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