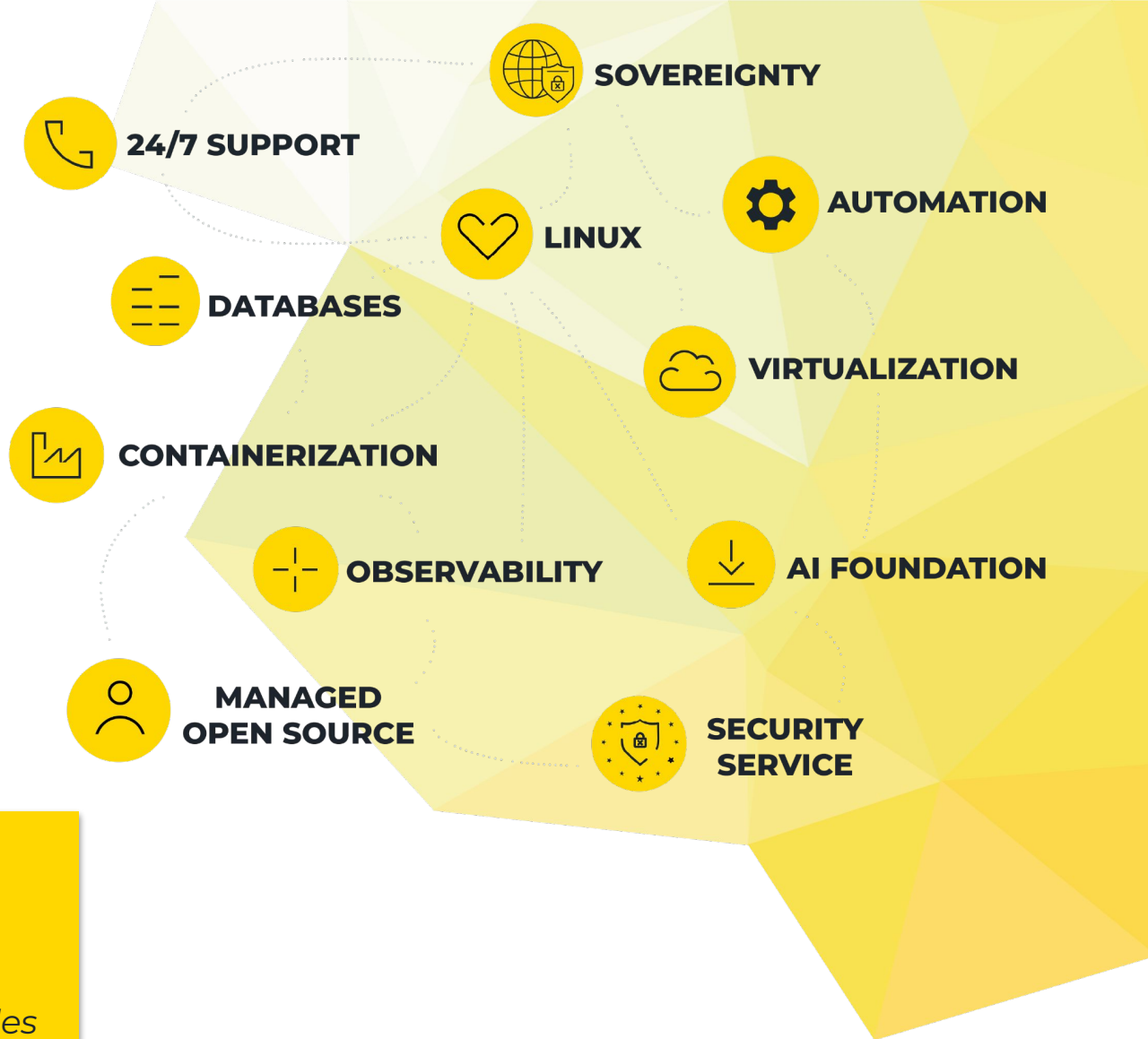


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Run PostgreSQL your way

Guy Gyles



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Question is no longer “Can PostgreSQL do it?”

PostgreSQL already delivers

- Enterprise-grade reliability
- Rich SQL capabilities
- High availability
- Replication
- Partitioning
- Encryption

Models:

- Traditional VM deployment
- Containerized PostgreSQL
- Kubernetes-native PostgreSQL



Deployment Evolution



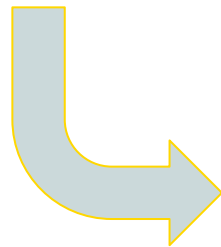
Each step reduces infrastructure management, while increasing automation.



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Deployment Evolution

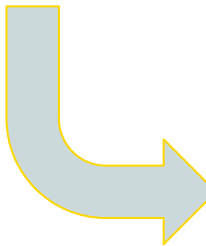


- Install OS & PostgreSQL
- Configure Replication
- Testing Backups & Recovery
- Manage failover
- Upgrade PostgreSQL
- Patching



Deployment Evolution



- 
- Pod scheduling
 - Service discovery
 - Self-healing
 - Resource management
 - Scaling framework

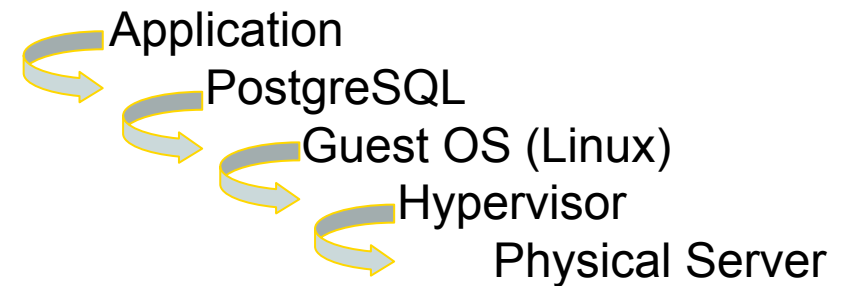


Architecture of Virtual Machines



Each VM contains

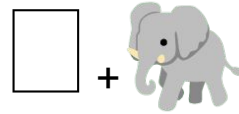
- Its own operating system
- Its own kernel
- Dedicated CPU / RAM allocation
- Separate PostgreSQL instance(s)



PostgreSQL on Virtual Machines



Applications



PostgreSQL on a VM



Storage

Advantages

- Mature
- Predictable
- Simple troubleshooting
- Easy backup strategy
- Good for DBA-centric teams

Challenges

- Manual scaling
- Patching effort
- Failover automation often custom
- Longer provisioning times



Architecture of Containers



Applications Container



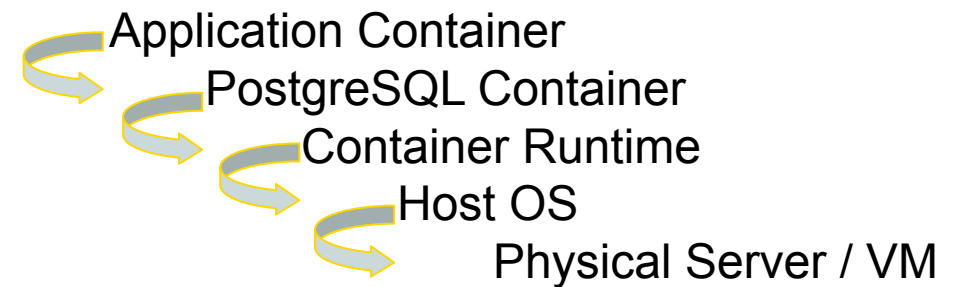
PostgreSQL Container



Storage

Containers

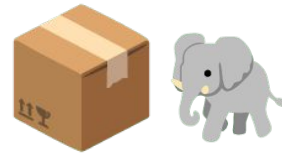
- Share the host OS kernel
- Package only application + dependencies
- Are much lighter than VMs
- Can be orchestrated



PostgreSQL in Containers



Applications Container



PostgreSQL Container



Storage

Benefits

- Consistent deployments
- Fast provisioning
- Immutable infrastructure
- Easier CI / CD integration

Challenges

- Storage management still matters
- Container $\neq$ Cloud-Native
- Failover often external

Containers solve packaging, not operations.



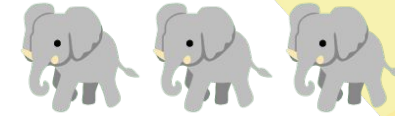
PostgreSQL Cloud-Native



Kubernetes



PostgreSQL Operator



PostgreSQL Cluster

Operator automates

- Provisioning
- Backups
- Replication
- Failover
- Upgrades

Operators

- CloudNativePG (Open Source)
- EDB Postgres AI for CloudNativePG Cluster
- Crunchy Data Operator
- Zalando Operator



PostgreSQL Operator

A PostgreSQL operator extends the Kubernetes API with custom resources that represent PostgreSQL clusters.

Instead of manually managing StatefulSets, PersistentVolumeClaims, ConfigMaps, and backup CronJobs, the operator handles the entire lifecycle:

- **Cluster provisioning**
 - Declarative YAML defines replica count, storage, resource limits
- **Automated failover**
 - Detects primary failure and promotes a replica automatically
- **Backup and restore**
 - Scheduled base backups via pg_basebackup or WAL archiving with continuous point-in-time recovery
- **Connection pooling**
 - Integrates pgBouncer or provides built-in pooler
- **Version upgrades**
 - Rolling major/minor version upgrades with minimal downtime
- **Monitoring**
 - Exports Prometheus metrics for query performance, replication lag, and resource utilization



When a node fails?

Virtual Machine



Node Fails



Monitoring Alert



Intervention

Cloud Native



Node Fails



K8s Detects Failure



Automatic Rescheduling



Service Restored



Comparing Models

Feature	VM	Containers	Cloud Native
Simplicity	High	Medium	Medium
Automation	Low	Medium	High
Provisioning speed	Slow	Fast	Very Fast
Scaling	Manual	Manual	Automated
Self-healing	Limited	Limited	Strong
DBA control	Maximum	High	Different

Cloud-Native doesn't eliminate DBAs, it changes their focus.

A K8s PostgreSQL operator must simulate some work of a DBA.



Cost Considerations

Cloud-Native isn't always cheaper

VMs can be cheaper when

- Workloads are stable
- Infrastructure already exists
- Team expertise is strong

Cloud-Native wins when

- Many environments
- Rapid delivery required
- Frequent deployments
- High automation needs



Decision Matrix

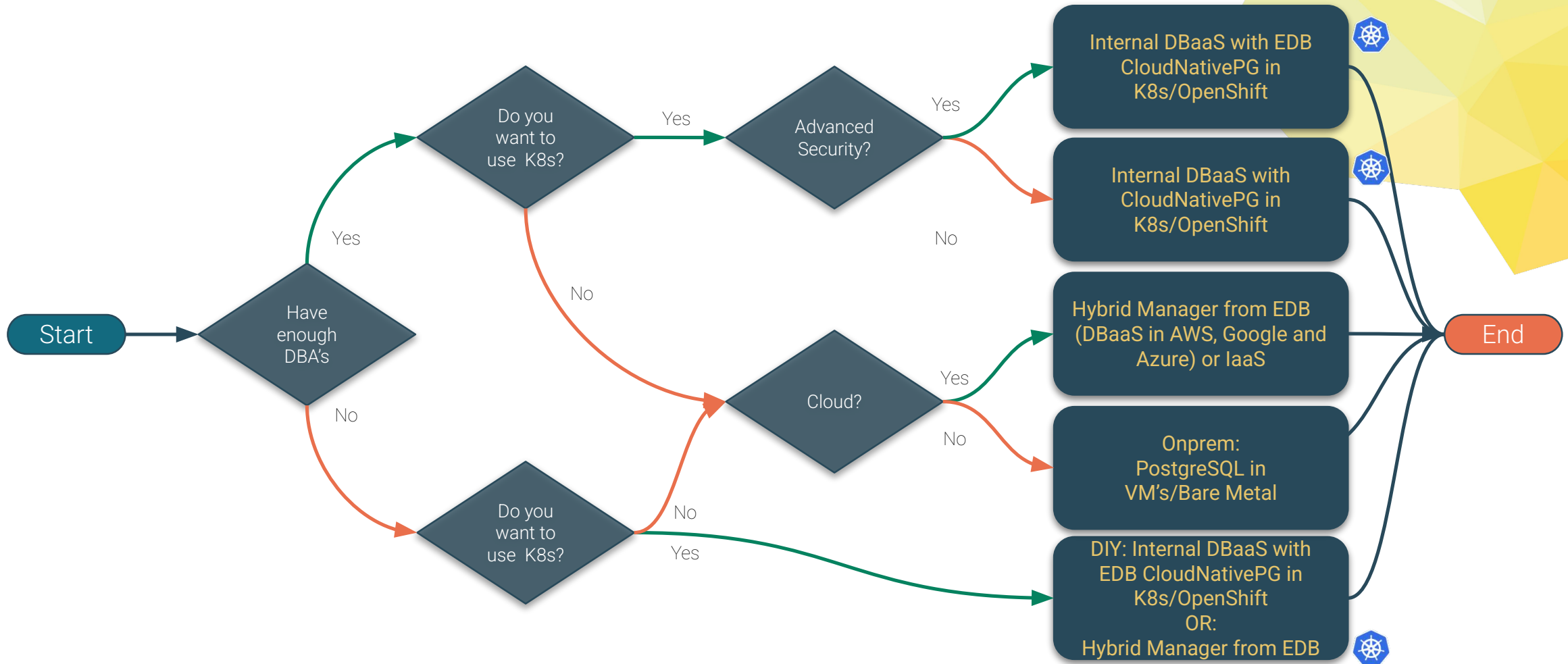
Requirement	Choice
Simplicity	VM
Existing datacenter	VM
Drops culture	Containers
Kubernetes platform	Cloud Native
Highly dynamic workload	Cloud Native
Fast provisioning	Cloud Native

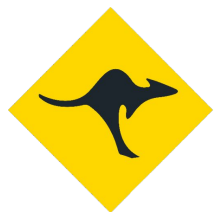
Modern PostgreSQL platforms should be

- Portable
- Automated
- Observed
- Recoverable



Decision Flow

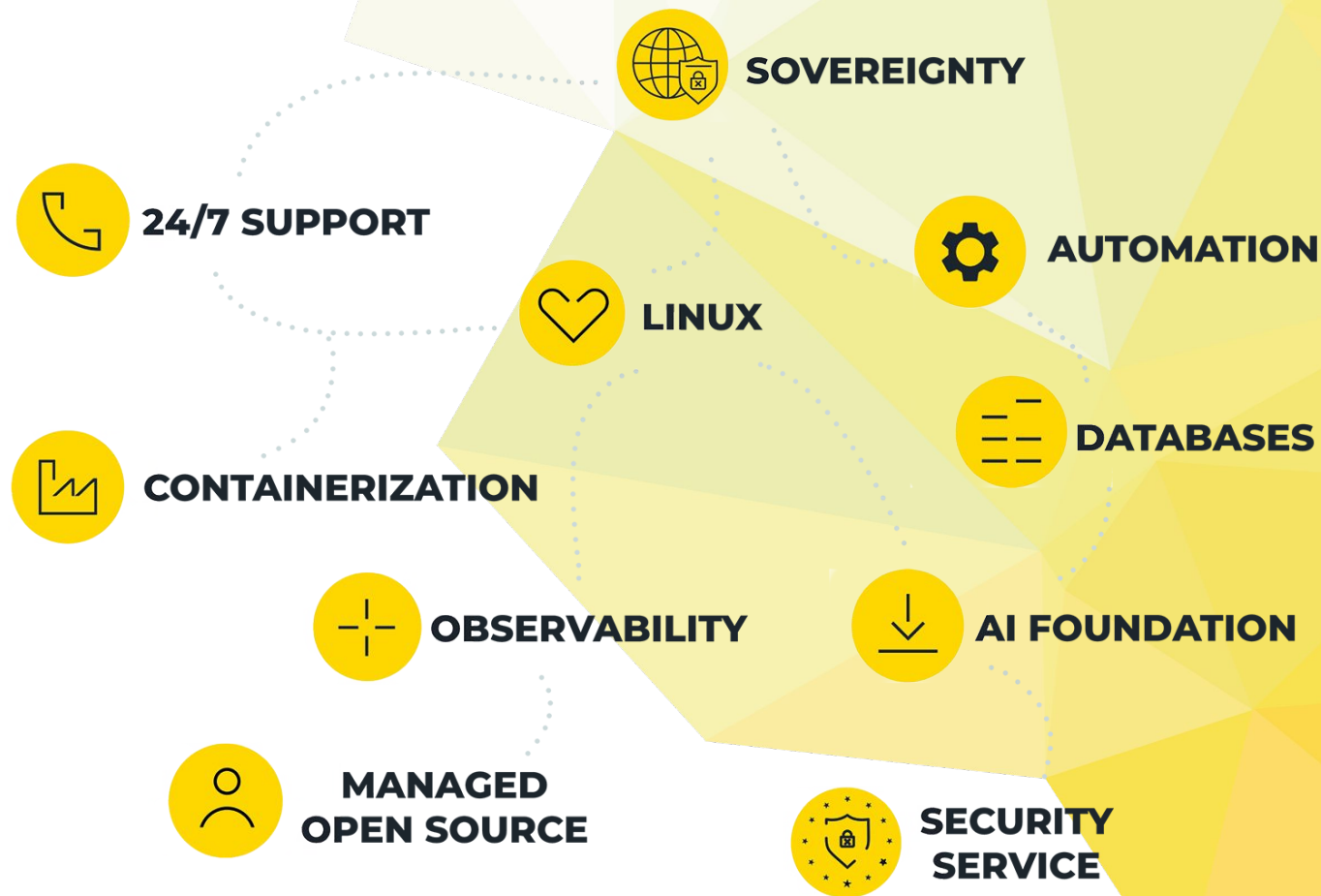




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