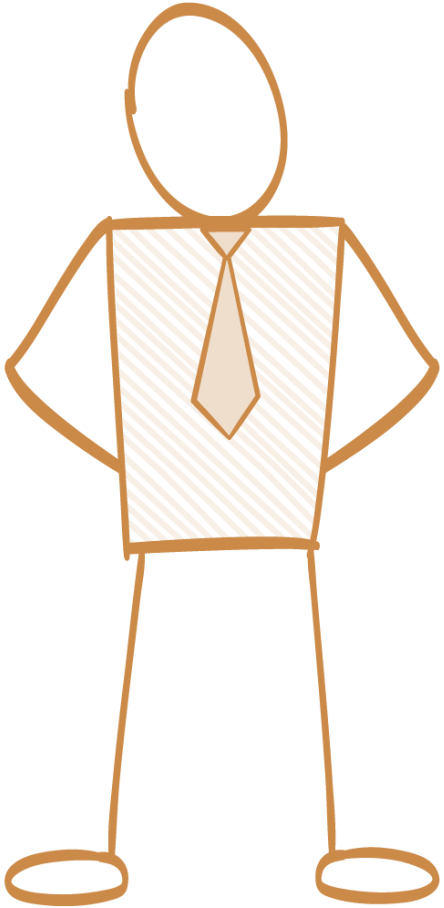

Module 13: Disaster Recovery and High Availability

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Topics

- How High Availability and Disaster Recovery work together
- Building highly available systems on AWS
- Best practices for high availability and disaster recovery
- Common patterns of disaster recovery on AWS

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How Availability and Disaster Recovery

- Think of it as a spectrum
- It's part of a business continuity plan
- It's not an all or nothing proposition
- In the face of internal or external events, how to you….
  - Keep your application running 24x7
  - Make sure your data is safe
  - Get an application back up after a major disaster

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How Availability

- HA is one end of the spectrum
  - Rather than recovery with defined RTO/RPO, design for continuous availability
- Goal: application never goes down
  - Eliminate single points of failure
  - "Self Healing" app recovers automatically from component failures
  - Use graceful degradation if necessary
- Traditional IT model: HA is very expensive, suitable only for absolutely mission-critical apps

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How Availability Terms

- Uptime: period when system is availability for use
- Downtime (or Outage): period when system is unavailable for normal function or offline
- Graceful Degradation: system continues to be available, but at a reduced level of service or function
- Availability: percentage uptime in a given period (nines)
  - –99,999% (“five nines”) availability= no more than about 5 minutes downtime per year

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Disaster Recovery on the spectrum

- Recover from any event
- Recover Time Object (RTO)
  - Acceptable time period within which normal operation (or degraded operation) needs to be restored after event
- Recovery Point Object (RPO)
  - Acceptable data loss measured in time
- Traditional IT model has DR in a second physical site
  - Low end DR: off-size backups
  - High end DR: hot size active-active architecture

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Topics

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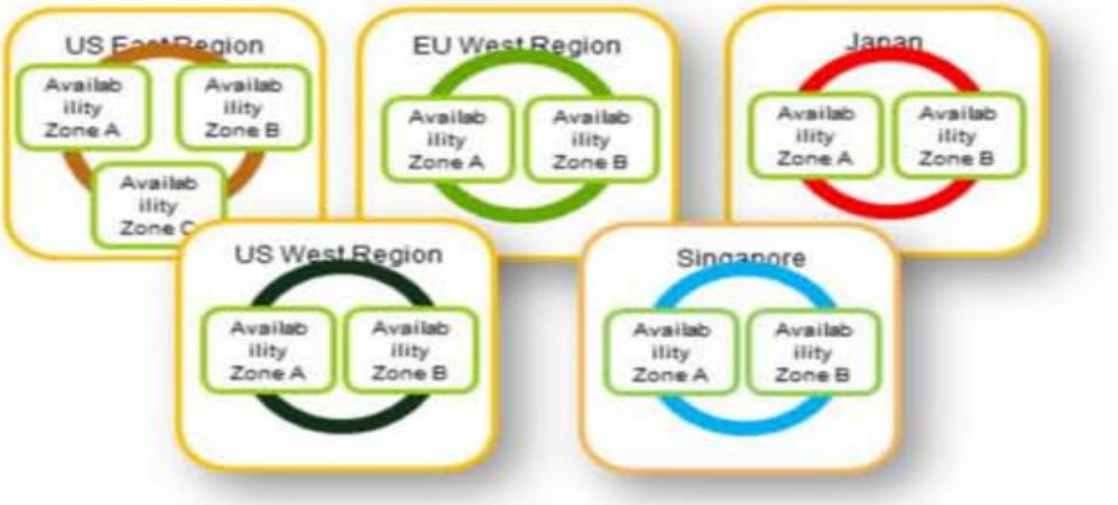
AWS: Regions and Availability Zones

- Regions are completely separate clouds
- Multi network-connected Availability Zones in each Region



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High Availability (HA)

High Availability Introduction

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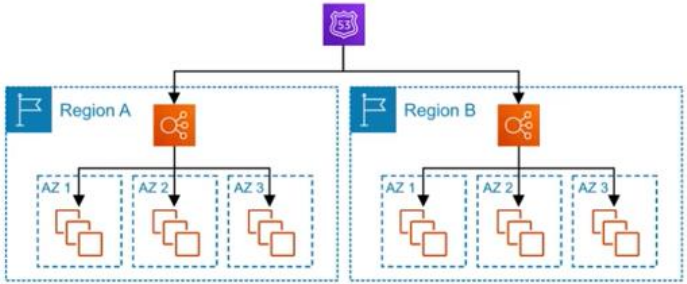
High Availability (HA)

The ability for a system to remain available

Think about what could cause a service to become unavailable:

1. When an AZ becomes unavailable eg. data-center flooded
2. When a Region becomes unavailable eg. meteor strike
3. When an web-application becomes unresponsive eg. too much traffic
4. When an instance becomes unavailable eg. instance failure
5. When a web application becomes unresponsive due to distance in geographic location



The solution we need to implement in order to ensure **High Availability**:

1. We should run our instances in Multi-AZ, an **Elastic Load Balancer** can route traffic to operational AZs.
2. We should run instances in another region. We can route traffic to another Region via **Route53**
3. We should use **Auto Scaling Groups** to increase the amount of instances to meet the demand of traffic
4. We should use **Auto Scaling Groups** to ensure a minimum amount of instances are running and have **ELB** route traffic to healthy instances
5. We should use **CloudFront** to cache static content for faster delivery in nearby regions. We can also run our instances in nearby regions and route traffic using a geolocation policy in **Route53**

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High Availability (HA)

Scale Up and Scale Out

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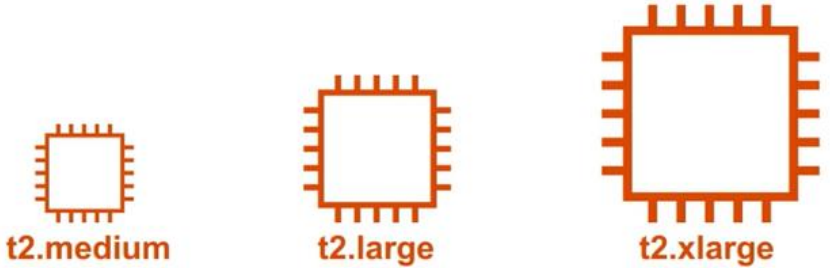
Scale Up vs Scale Out

When utilization increases and we are reaching capacity we can:

Scale up (Vertical Scaling)

Increasing the size of instances

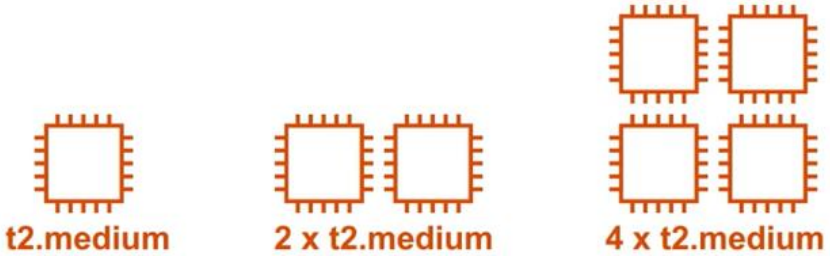
- Simpler to manage.
- Lower availability (if a single instance fails service becomes unavailable)



Scale out (Horizontal Scaling)

Adding more of the same

- More complexity to manage.
- Higher availability (if a single instance fail it doesn't matter)



You will generally want to **scale out** and **then up** to balance complexity vs availability

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Take advantage of multiple availability zones

- No cost difference between servers running in a single AZ versus multiple Azs
- Most services are designed with multiple AZ use in mind

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Topics

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Best Practices for HA

- Build loosely coupled systems
  - –Queues, load-balance tiers
- Implement elasticity
  - –Bootstrapping, load balancing, Auto Scaling, etc…
  - –Instance asks: ”Who am I and what is my role”?
- Use abstract machine and system representations
  - –Build images from recipes, stacks from CloudFormation

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Design for failure: Basic principles

- Goal: Applications should continue to function event if the underlying physical hardware fails or is removed or replaced
  - Avoid single points of failure
  - Assume everything fails, and design backwards
  - Design your recovery process

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Topic

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Common Practices of Disaster Recovery on AWS

- Example Architectural Patterns (sorted by increasingly optimal RTO/RPO)
  - Backup and Restore
  - Pilot Light
  - Fully Working Low Capacity Standby
  - Multi-Site Hot Standby

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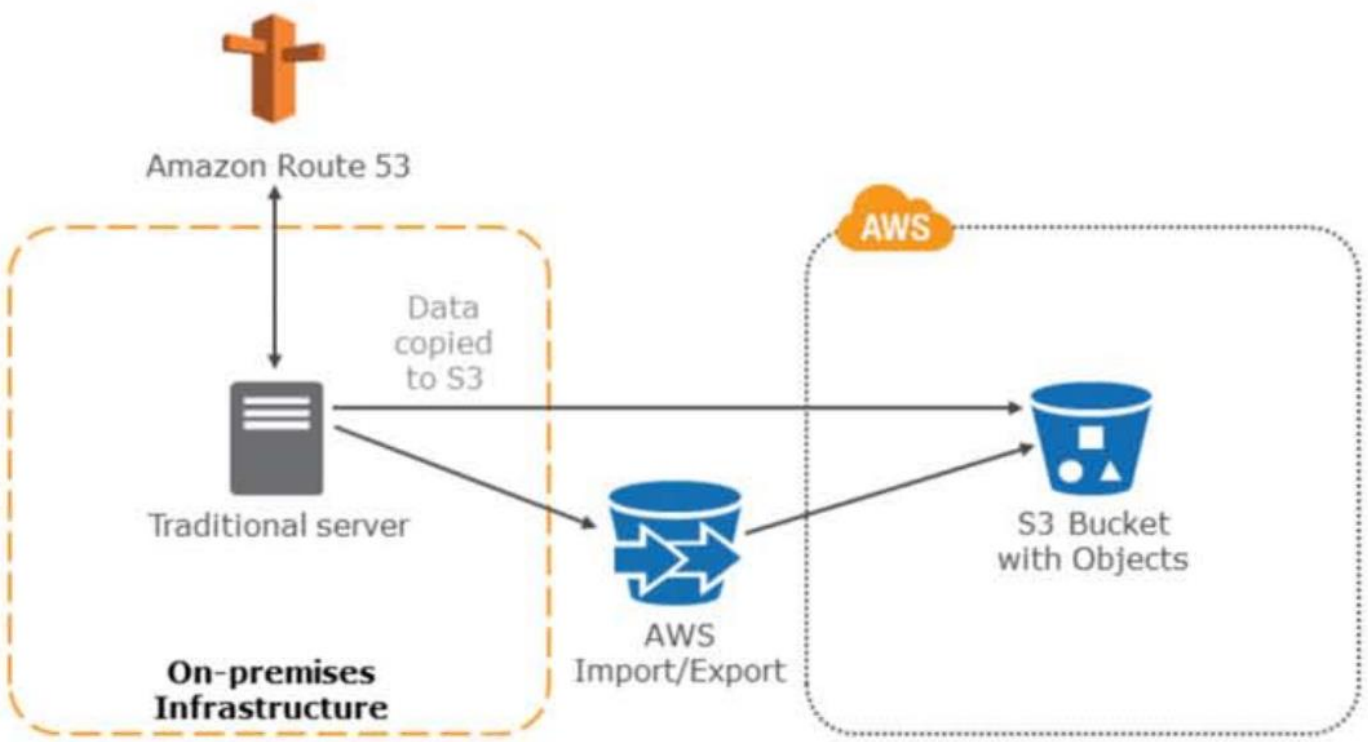
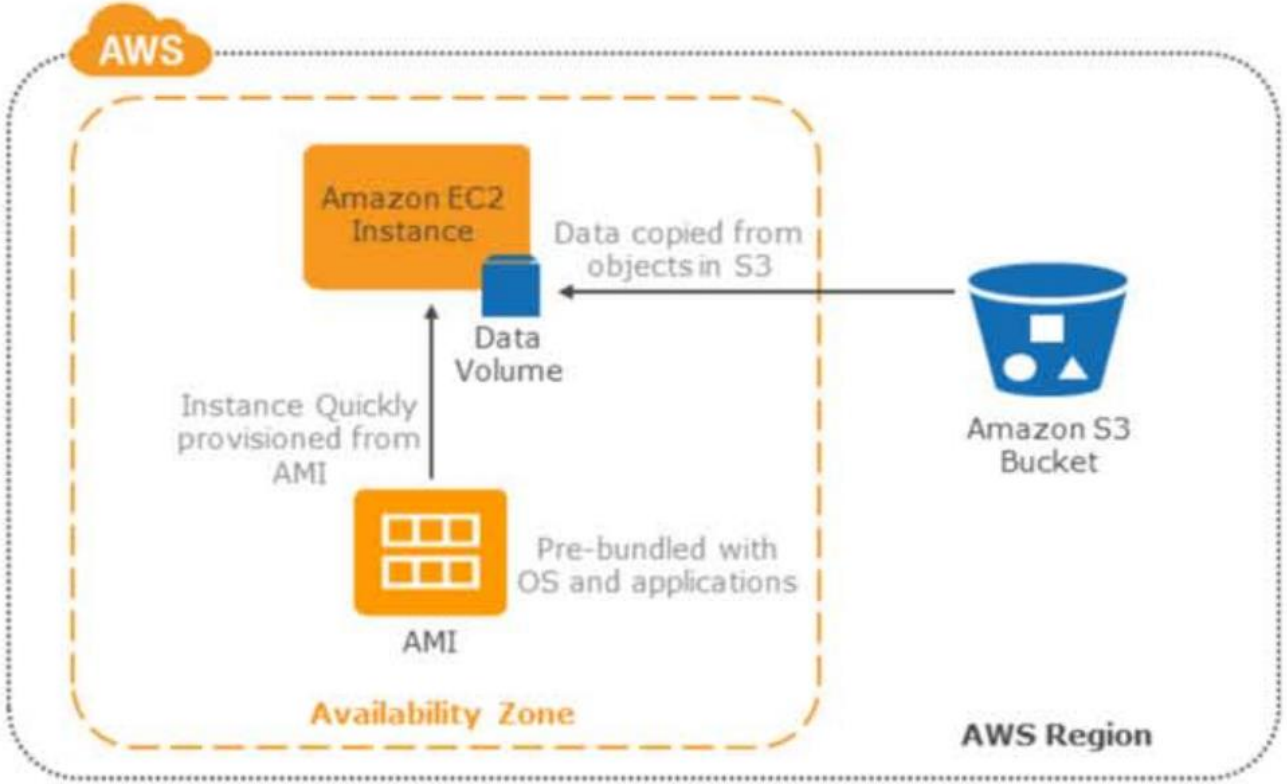
Backup and Restore



Backup and Restore



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Backup and Restore

- Advantages
  - Simple to get started
  - Extremely cost effective (mostly backup storage)
- Preparation Phase
  - Take backups of current systems
  - Store backups in S3
  - Describe procedure to restore from backups on AWS
    - Know which AMI to use, build your own as needed
    - Know how to restore system from backups
    - Know how to switch to new system
    - Know how to configure the deployment

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Common Practices of Disaster Recovery on AWS

- In case of disaster
  - Retrieve backups from S3
  - Bring up required infrastructure
    - EC2 instance with prepared AMIs, Load Balancing, etc.
  - Restore system from backup
  - Switch over to the new system
    - Adjust DNS records to point to AWS
- Objectives
  - RTO: as long as it takes to bring up infrastructure and restore system from backups
  - RPO: time since last backup

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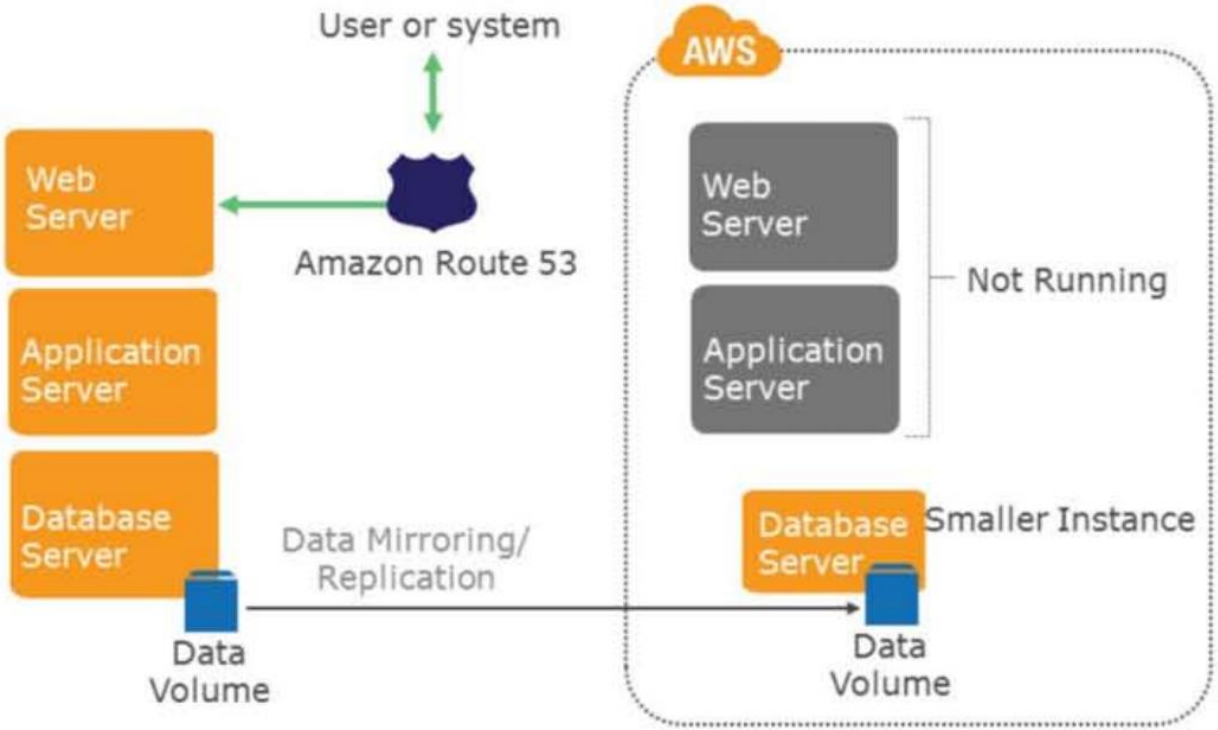
Pilot Light



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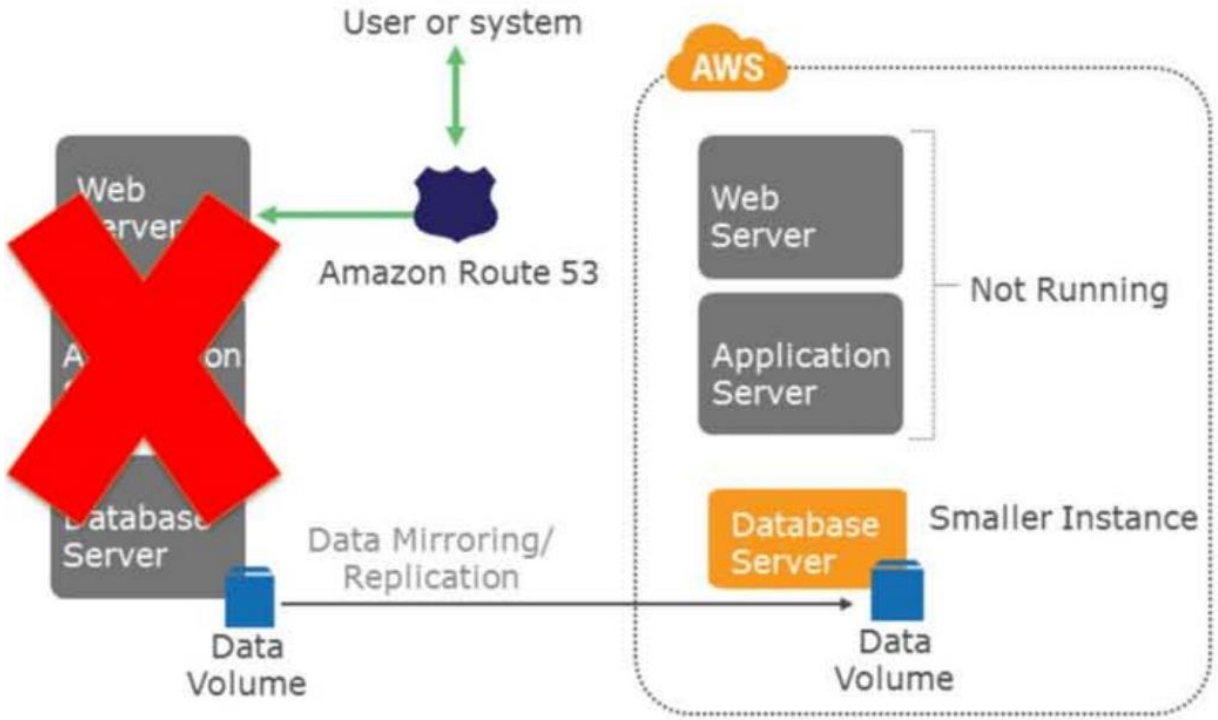
Pilot Light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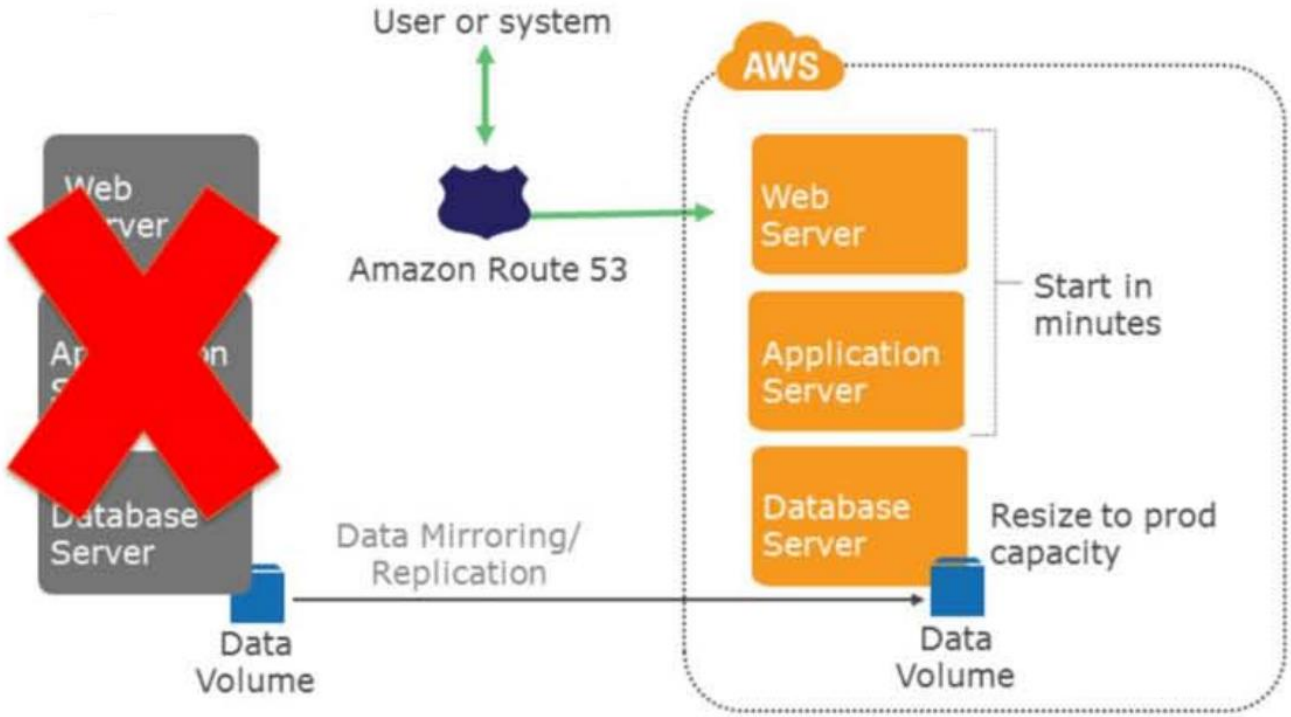
AWS
Web Server
Application Server
Not Running
Amazon Route 53
Database Server
Smaller Instance
Data Mirroring/ Replication
Data Volume
Data Volume

Pilot Light


User or system
AWS
Amazon Route 53
Web Server
Application Server
Database Server
Start in minutes
Resize to prod capacity
Data Mirroring/ Replication
Data Volume
Data Volume

Pilot Light

- Advantages
  - Very cost effective (fewer 24/7 resources)
- Preparation Phase
  - Enable replication of all critical data a AWS
  - Prepare all required resources for automatic start
    - AMIs, Network Settings, Load Balancing, ect..
  - Reserved Instances

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Pilot Light

- In case of disaster
  - –Automatically bring up resources around the replicated core data set
  - –Scale the system as needed to handle current production traffic
  - –Switch over to the new system
    - Adjust DNS records to point to AWS
- Objectives
  - –RTO: as long as it takes to detect need for DR and automatically scale up replacement system
  - –RPO: depends on replication type

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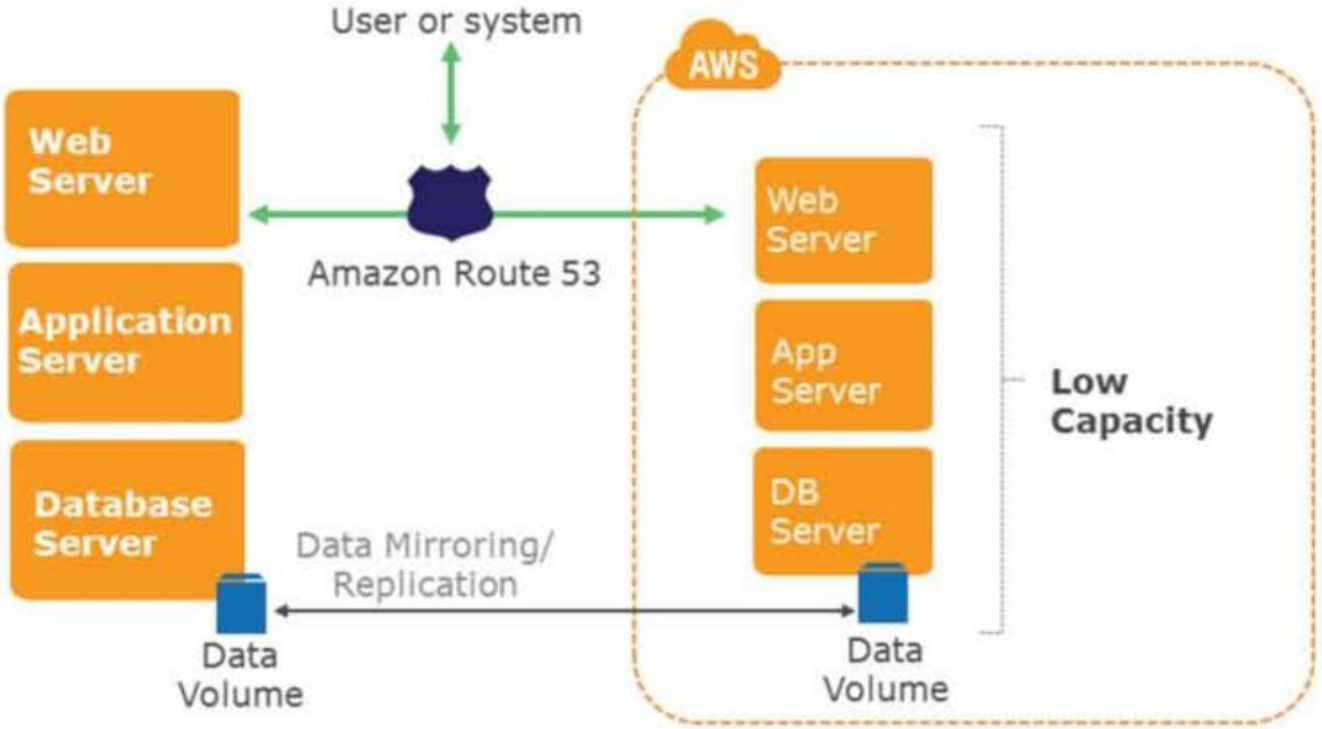
Fully-Working Low Capacity Standby



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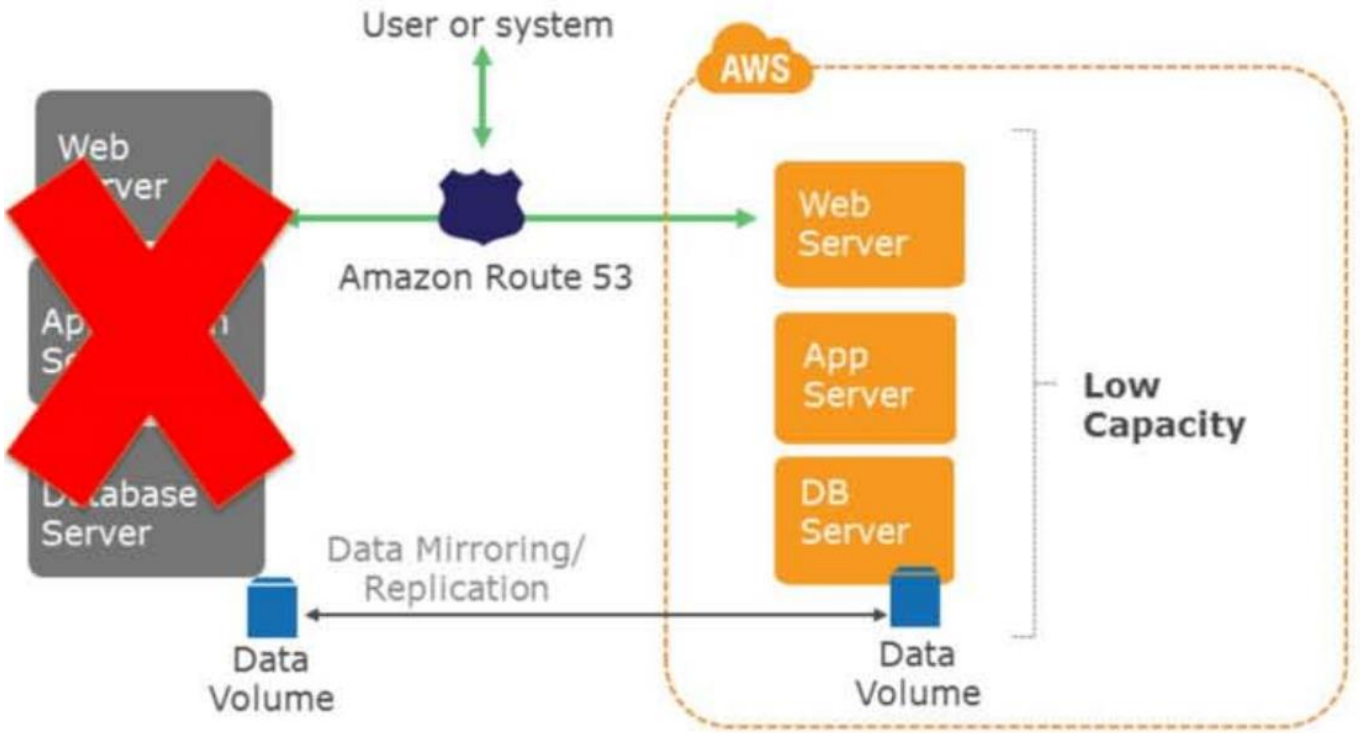
Fully-Working Low Capacity Standby



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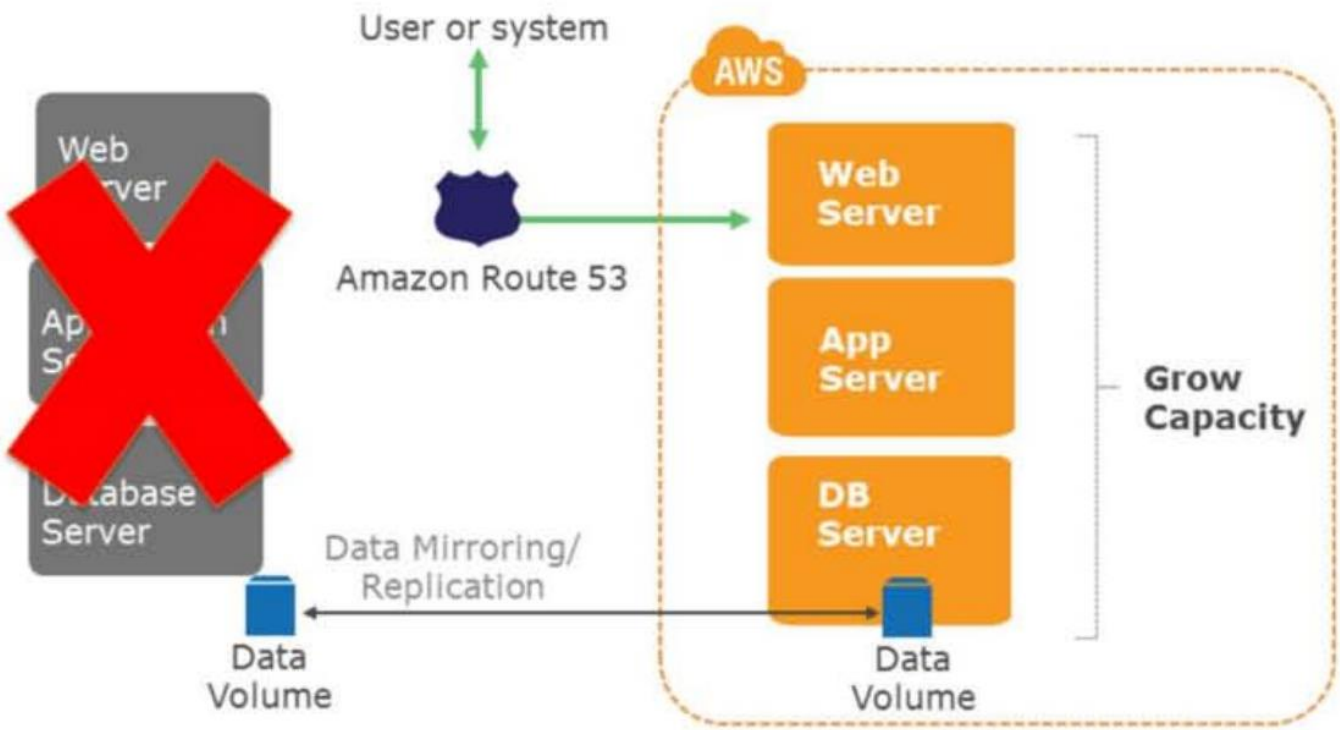
Fully-Working Low Capacity Standby



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Fully-Working Low Capacity Standby

- Advantages
  - –Can take some production traffic at any time
  - –Cost savings (IT footprint smaller than full DR)
- Preparation
  - –Similar to Pilot Light
  - –All necessary components running 24/7, but not scaled for production traffic
  - –Best practice-continuous testing
    - “Trickle” a statistical subset of production traffic to DR site

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Fully-Working Low Capacity Standby

- In case of disaster
  - Immediately fail over most critical production load
    - Adjust DNS records to point to AWS
  - (Auto) Scale the system further to handle all production load
- Objectives
  - RTO: for critical load: as long as it takes to fail over; for all other load, as long as it takes to scale further
  - RPO: depends on replication type

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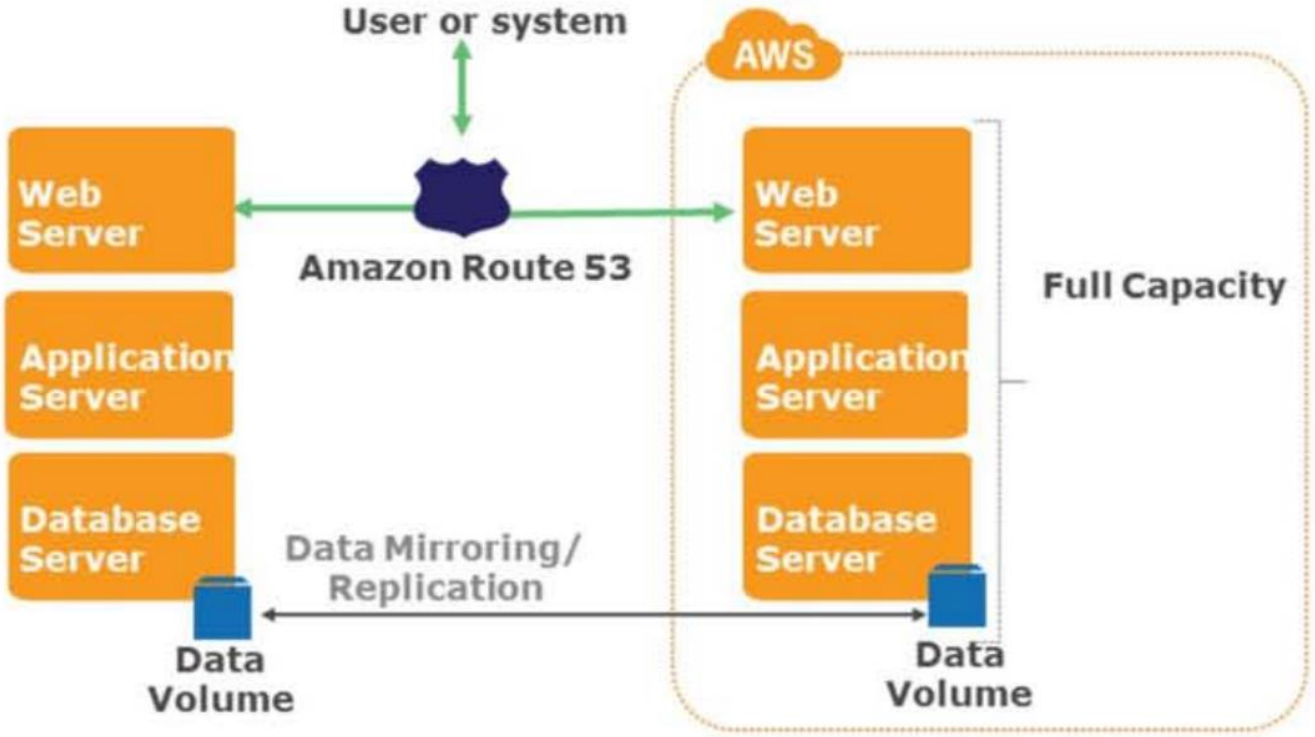
Multi-site Active-Active



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Multi-site Active-Active

- Advantages
  - At any moment can take all production load
- Preparation
  - Similar to Low-Capacity Standby
  - Fully scaling in/out with production load
- In case of Disaster
  - Immediately fail over all production load
    - Adjust DNS records to points to AWS
- Objectives
  - RTO: as long as it takes fail over
  - RPO: depends on replication type

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Hosted Desktop

- Advantages
  - –Replacement of workstations in case of disaster
  - –Pay only when used for DR
- Preparation
  - –Set up AMIs with appropriate working environment
- In Case of Disaster
  - –Launch desktop AMI and resume work
- Objectives
  - –RTO: as long as it takes to launch AMI and restore work environment on virtual desktop
  - –RPO: depends on state of AMI

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Best Practices for Being Prepared

- Start simple and work your way up
  - Backups in AWS as first step
  - Incrementally improve RTO/RPO as continuous effort
- Check for any software licensing issues
- Exercise your DR Solution
  - Game Day
  - Ensure backups, snapshots, AMIs, etc.. Are working
  - Monitor your monitoring system

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Conclusion – Advantages of disaster recovery with AWS

- Various building blocks available
- Fine control overs cost vs. RTO/RPO tradeoffs
- Ability to scale up when needed
- Pay for what you use, and only when you use it(when an event happens)
- Ability to easily and effectively test your DR plan
- Availability of multiple locations world wide
- Hosted desktops available
- Variety of Solution Providers

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Putting It Together: Incremental Improvement

- Start with existing on-premise app with traditional DR
- Gradually move DR (and thus the app) to the cloud:
  - Backup to S3 and Restore
  - "Pilot Light" on AWS for Quick Recovery
  - Fully Working Low Capacity Standby on AWS
- Migrate to primary on AWS, DR on-premise
- Add hot standby in second AWS AZ or Region
- Incrementally add HA features to primary app

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