# CloudForge Disaster Recovery Guide

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## Overview

CloudForge provides comprehensive disaster recovery (DR) capabilities to ensure business continuity. This guide covers backup strategies, failover procedures, and recovery configurations.

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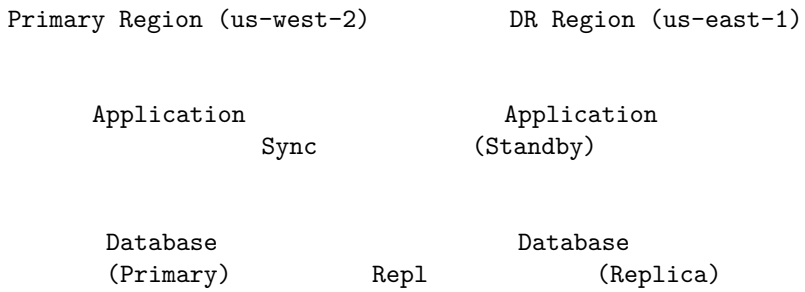
## DR Architecture

### Recovery Objectives

| Tier | RPO | RTO | Use Case |
|---|---|---|---|
| Platinum | 0 (sync) | <15 min | Critical production |
| Gold | <1 hour | <1 hour | Production |
| Silver | <4 hours | <4 hours | Staging/Important |
| Bronze | <24 hours | <24 hours | Development |

**RPO** = Recovery Point Objective (max data loss) **RTO** = Recovery Time Objective (max downtime)

### Multi-Region Architecture



Storage

Storage
(Replica)

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## Backup Configuration

### Automated Backups

```yaml
# environment.yaml
backup:
  enabled: true
  schedule: "0 2 * * *"      # Daily at 2 AM
  retention:
    daily: 7                 # Keep 7 daily backups
    weekly: 4                # Keep 4 weekly backups
    monthly: 12              # Keep 12 monthly backups
  encryption:
    enabled: true
    key: ${BACKUP_ENCRYPTION_KEY}
  storage:
    type: s3
    bucket: cloudforge-backups-${ENV}
    region: us-west-2
```

### Database Backups

```yaml
databases:
  - name: primary-db
    backup:
      type: continuous       # Point-in-time recovery
      retention_days: 35
      snapshot:
        enabled: true
        schedule: "0 3 * * *"
        retention: 30
      cross_region:
        enabled: true
        target_region: us-east-1
```

### Application State Backups

```
applications:
  - name: api-service
    backup:
      volumes:
        - /data/uploads
        - /data/cache
      config:
        - /etc/app/config.yaml
      secrets:
        vault_path: secret/data/api-service
```

### Backup Validation

```
backup:
  validation:
    enabled: true
    schedule: "0 6 * * 0"    # Weekly on Sunday
    tests:
      - restore_test          # Test restore process
      - integrity_check       # Verify backup integrity
      - size_validation       # Check backup size
    notify:
      on_failure: [ops@novatech.com]
```

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## Replication

### Database Replication

```
databases:
  - name: primary-db
    replication:
      type: synchronous       # synchronous or asynchronous
      replicas:
        - region: us-east-1
          instance_type: db.r5.xlarge
          availability_zone: us-east-1a
        - region: eu-west-1
          instance_type: db.r5.large
          availability_zone: eu-west-1b
      read_routing:
```

```
    enabled: true
    strategy: latency     # Route reads to lowest latency
```

### Storage Replication

```
storage:
  buckets:
    - name: app-data
      replication:
        enabled: true
        destinations:
          - region: us-east-1
            storage_class: STANDARD
          - region: eu-west-1
            storage_class: STANDARD_IA
        rules:
          - prefix: critical/
            priority: 1
            delete_marker_replication: true
          - prefix: logs/
            priority: 2
            delete_marker_replication: false
```

### Application Replication

```
applications:
  - name: api-service
    replication:
      strategy: active-passive
      primary_region: us-west-2
      dr_region: us-east-1
      sync:
        config: true
        secrets: true
        deployments: true
      health_check:
        endpoint: /health
        interval: 30
        threshold: 3
```

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## Failover Configuration

### Automatic Failover

```
failover:
  type: automatic
  trigger:
    health_check_failures: 3
    response_time_threshold: 5000ms
    error_rate_threshold: 50%
  cooldown: 300              # Seconds before another failover
  notifications:
    - email: ops@novatech.com
    - slack: "#alerts-critical"
    - pagerduty: dr-oncall
```

### Manual Failover

```
# Initiate failover
cloudforge dr failover \
  --environment production \
  --target-region us-east-1 \
  --confirm

# Check failover status
cloudforge dr status --environment production

# Failback to primary
cloudforge dr failback \
  --environment production \
  --confirm
```

### DNS Failover

```
dns:
  failover:
    type: route53_failover
    primary:
      region: us-west-2
      health_check:
        endpoint: https://api-west.novatech.com/health
        interval: 30
        failure_threshold: 3
    secondary:
```

```
      region: us-east-1
      health_check:
        endpoint: https://api-east.novatech.com/health
        interval: 30
```

### Load Balancer Failover

```
load_balancer:
  global:
    enabled: true
    routing_policy: latency
    health_check:
      protocol: HTTPS
      path: /health
      interval: 10
      healthy_threshold: 2
      unhealthy_threshold: 3
    failover:
      enabled: true
      primary_region: us-west-2
      secondary_region: us-east-1
```

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## Recovery Procedures

### Full Environment Recovery

```
# Step 1: Assess the situation
cloudforge dr assess --environment production

# Step 2: Initiate recovery
cloudforge dr recover \
  --environment production \
  --backup-id backup-20240115-020000 \
  --target-region us-east-1

# Step 3: Verify recovery
cloudforge dr verify --environment production

# Step 4: Update DNS
cloudforge dr cutover --environment production --confirm
```

### Database Recovery

```
# Point-in-time recovery
cloudforge db restore \
  --database primary-db \
  --point-in-time "2024-01-15T14:30:00Z" \
  --target-instance restored-db

# Restore from snapshot
cloudforge db restore \
  --database primary-db \
  --snapshot snap-20240115-030000 \
  --target-instance restored-db
```

### Application Recovery

```
# Restore application to previous state
cloudforge app restore \
  --application api-service \
  --backup-id backup-20240115-020000 \
  --environment production

# Verify application health
cloudforge app health --application api-service
```

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## DR Testing

### Test Types

| Test | Frequency | Scope | Impact |
|---|---|---|---|
| Tabletop | Quarterly | Full DR plan | None |
| Backup Restore | Weekly | Automated | None |
| Failover Test | Monthly | Single component | Minimal |
| Full DR Test | Annually | Complete failover | Planned downtime |

### Automated DR Testing

```
dr_testing:
  enabled: true
  schedule:
```

```
    backup_restore: "0 6 * * 0"    # Weekly
    failover_test: "0 2 1 * *"     # Monthly
  tests:
    - name: database-restore
      type: restore
      resource: primary-db
      target: dr-test-db
      cleanup: true
    - name: app-failover
      type: failover_simulation
      resource: api-service
      duration: 300              # 5 minutes
      rollback: automatic
  reports:
    recipients: [dr-team@novatech.com]
    format: pdf
```

#### Manual Test Procedure

```
# Step 1: Announce test
cloudforge dr test announce --scheduled-time "2024-01-20T02:00:00Z"

# Step 2: Execute test
cloudforge dr test execute \
  --test-plan full-dr-test \
  --environment production-dr-test

# Step 3: Generate report
cloudforge dr test report --test-id test-20240120
```

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## Monitoring & Alerting

#### DR Health Dashboard

Monitor DR readiness: - Replication lag - Backup status - Failover readiness - RTO/RPO compliance

#### Alerts

```
alerts:
  dr:
```

```yaml
    - name: replication-lag
      condition: replication_lag > 60s
      severity: warning
      notify: [ops@novatech.com]

    - name: backup-failed
      condition: backup_status == "failed"
      severity: critical
      notify: [ops@novatech.com, "#alerts-critical"]

    - name: dr-region-unhealthy
      condition: dr_region_health < 80%
      severity: critical
      notify: [pagerduty:dr-oncall]

    - name: rpo-breach
      condition: last_backup_age > rpo_target
      severity: critical
      notify: [ops@novatech.com, compliance@novatech.com]
```

### Compliance Reporting

```
# Generate DR compliance report
cloudforge dr report compliance \
  --period last-quarter \
  --format pdf \
  --output dr-compliance-q4.pdf
```

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## Runbooks

### Runbook: Regional Outage

```
## Regional Outage Response

### Severity: P1
### Estimated RTO: 15-30 minutes

### Prerequisites
- DR region healthy and synced
- Failover authority approved

### Steps
```

````
1. **Confirm Outage**
   - Check cloud provider status page
   - Verify multiple services affected
   - Confirm not a local issue

2. **Notify Stakeholders**
   - Page incident commander
   - Notify customer success
   - Update status page

3. **Initiate Failover**
   ```bash
   cloudforge dr failover \
     --environment production \
     --target-region us-east-1 \
     --confirm
````

4. **Verify Services**

   - Check all endpoints responding
   - Verify database connectivity
   - Confirm data integrity

5. **Update DNS**

   ```
   cloudforge dr cutover --confirm
   ```

6. **Monitor**

   - Watch error rates
   - Monitor latency
   - Check replication to new region

**Rollback**

If failover fails:

```
cloudforge dr rollback --confirm
```

````
### Runbook: Database Corruption

```markdown
## Database Corruption Response
````

```
### Severity: P1
### Estimated RTO: 1-4 hours

### Steps
1. **Isolate Affected Database**
   ```bash
   cloudforge db maintenance-mode --database primary-db
```

2. **Assess Corruption Scope**

   - Identify affected tables
   - Determine corruption time
   - Check replication status

3. **Choose Recovery Strategy**

   - Option A: Point-in-time recovery (preferred)
   - Option B: Snapshot restore
   - Option C: Promote replica

4. **Execute Recovery**

   ```
   # Point-in-time recovery
   cloudforge db restore \
     --database primary-db \
     --point-in-time "2024-01-15T14:00:00Z" \
     --target-instance primary-db-recovered
   ```

5. **Verify Data**

   - Run integrity checks
   - Verify recent transactions
   - Compare row counts

6. **Cutover**

   ```
   cloudforge db swap --old primary-db --new primary-db-recovered
   ```

   ‘‘‘

---
   ```

## Best Practices

### Design

1. **Multi-region by default** for production workloads
2. **Test DR regularly** - untested DR is not DR
3. **Automate failover** where possible
4. **Document everything** - runbooks save time in crisis

### Operations

1. **Monitor replication lag** continuously
2. **Validate backups** weekly
3. **Practice failover** monthly
4. **Review and update** runbooks quarterly

### Data

1. **Encrypt backups** at rest and in transit
2. **Test restores** not just backups
3. **Maintain multiple backup copies** in different locations
4. **Define clear retention policies**

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## Compliance

### SOC 2

- Documented DR plan
- Annual DR testing
- Backup encryption
- Access controls

### ISO 27001

- Business continuity planning
- DR procedures documented
- Regular testing evidence

**HIPAA**

- Data backup procedures
- Disaster recovery plan
- Emergency access procedures

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## Support

- **DR Planning:** dr@novatech.com
- **Emergency:** +1-888-NOVA-911
- **Documentation:** docs.novatech.com/cloudforge/dr

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*Related Documents: Multi-Region Deployment (PRD-CF-015), Backup Guide (PRD-CF-028), Security Guide (PRD-CF-040)*