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## Summary

Earth is quite ready for re-colonization and a new version of humanity link software is required to cater for new requirements to protect earth and help speed up the terraforming efforts. A greenfield infrastructure design spanning across 3 physical sites on Earth.

## Assumptions

1. Three (3) physical sites will be equipped with redundant power / cooling / wan links
2. Physical Sites will be secured with CCTV, Physical Security personnel, Bio-Metric access cards
3. Physical sites will have application and equipment to retain CCTV footages and Biometric access

### Applications Required

Active Directory (Windows Server 2016)

Humanity Link (3 Tier) (Linux – Ubuntu / CentOS)

DNS – DHCP (Windows Server 2016)

Antivirus Server (Kaspersky or anyother) 2 x VMs (Windows Server 2016)

Monitoring (Nagios Enterprise / Solarwinds)

Data Backup (Rubrik across all 3 sites)

### Active Directory replication over VPN – Single Forest – Single Domain

1. 2 x DC per site (8GB Ram per node)
2. 2 x DNS servers per site (16GB RAM per node)
3. 2 x AV Servers per site (32GB RAM per node)
4. 4 x Cassandra Nodes per site (32GB RAM per node)
5. 2 x Node.js Middleware per site (32GB RAM per node)
6. 2 x Front-End web servers (NGINX / Apache) (16GB RAM per node)

## Requirements

- a) 3 physical sites
- b) All 3 sites equipped with redundant power, cooling, links and security
- c) A highly resilient (in as many layers as possible) and scalable infrastructure with the ability to handle unpredictable workloads.
- d) Humanity Link Application should be highly scalable and built on a resilient architecture
- e) Mobile app for the Humanity Link application
- f) Appropriate WAN links between 3 sites in order to cater for any data replication or movement

### Humanity Link Application requirements:

Humanity Link application will be a 3 tier application. With Database, logic and front-end tier.

- 1) Database Tier – Apache or Datastax Cassandra
- 2) Logic Tier – Node.js
- 3) Frontend / Web Tier – Angular

### Backend - Database:

We will be using Apache Cassandra database for our Humanity Link application. Apache Cassandra with its distributed design will offer site-level resiliency to humanity link application.

Cassandra is designed as a distributed system, for deployment of large numbers of nodes across multiple data centers. Key features of Cassandra's distributed architecture are specifically tailored for multiple-data center deployment. These features are robust and flexible enough that you can configure the cluster for optimal geographical distribution, for redundancy for failover and disaster recovery, or even for creating a dedicated analytics center replicated from your main data storage centers.

### [Reference : Datastax Cassandra](#)

Logic Tier – Node.js

Front-End Web Tier – Angular

## High-Level solution overview

### Physical Sites and Location:

3 x Datacenters will be built across Pakistan, with Karachi, Lahore & Islamabad hosting each datacenter respectively. Each site will be equipped with redundant power, cooling, wan links. Redundant Inter-site connectivity will be provided by two local connectivity providers.

### Infrastructure – Hypervisor, Storage and Compute

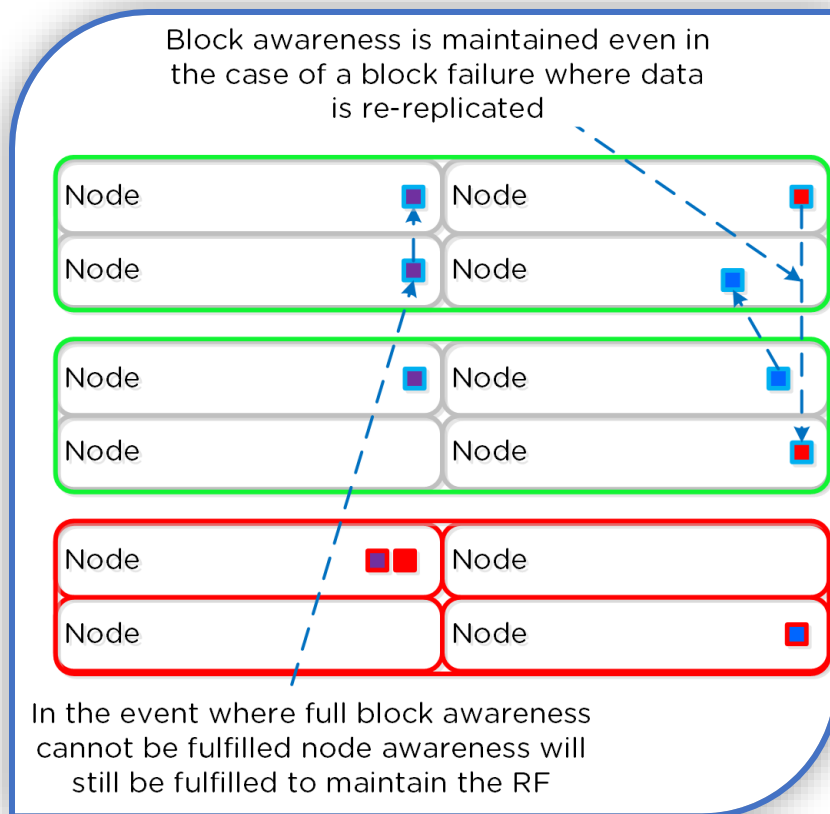
| SITE | Compute – Storage       | Specs per Node                                   |  |
|------|-------------------------|--|--|
|      |                         |  |  |
| KHI  | 3 NX-3060 Series Blocks | Dual Xeon, 10GbE, 256GB RAM, Dual SSD + Dual HDD |  |
| ISB  | 3 NX-3060 Series Blocks | Dual Xeon, 10GbE, 256GB RAM, Dual SSD + Dual HDD |  |
| LHR  | 3 NX-3060 Series Blocks | Dual Xeon, 10GbE, 256GB RAM, Dual SSD + Dual HDD |  |
|      |                         |  |  |
| Site | Networking              |  |  |
|      |                         |  |  |
|      |                         |  |  |
|      |                         |  |  |
| Site | Firewall                |  |  |
|      |                         |  |  |
|      |                         |  |  |
|      |                         |  |  |
| Site | Load Balancers          |  |  |

We will be using Nutanix across all sites to build a resilient and scalable infrastructure layer. Nutanix offers support for most major Hypervisors (ESXi, Hyper-V, XEN and their own AHV). Appropriate Nutanix nodes will be selected in order to avoid any single point of hardware failures which may impact the cluster. Nutanix requires a minimum of 3 nodes to form a cluster. Nodes are available in either standalone form-factor or in a chassis housing 4 nodes maximum or a block with 4 nodes.

We will be using Nutanix AHV as it is a native hypervisor and scales with the stack. Nutanix converges compute, storage and virtualization – which will enable operational efficiency.

Nutanix offers [Availability Domains](#) which offers data availability in an event of a single node or an entire block (Chassis with 4 nodes) failure. With availability domains – Nutanix distributes data, metadata and configuration data across the entire cluster.

- 1) Data (The VM data)
- 2) Metadata (Cassandra)
- 3) Configuration Data (Zookeeper)



Note: It is recommended to utilize uniformly populated blocks to ensure block awareness is enabled.

Availability Domains (aka node/block/rack awareness) is a key struct for distributed systems to abide by for determining component and data placement. DSF is currently node and block aware, however this can evolve to rack aware as supported cluster sizes grow in the future. Nutanix refers to a “block” as the chassis which contains either one, two, or four server “nodes”. NOTE: A minimum of 3 blocks must be utilized for block

awareness to be activated, otherwise node awareness will be defaulted to.

It is recommended to utilize uniformly populated blocks to ensure block awareness is enabled. Common scenarios and the awareness level utilized can be found at the bottom of this section. The 3-block requirement is due to ensure quorum. For example, a 3450 would be a block which holds 4 nodes. The reason for distributing roles or data across blocks is to ensure if a block fails or needs maintenance the system can continue to run without interruption.

We will be using Nutanix NX Nodes. NX 3000 Series across all 3 sites. With 4 nodes in one block.

The proposed hardware infrastructure will be hosting the following applications:

- a) Active Directory
- b) DNS servers
- c) Web Servers
- d) Application servers
- e) Database servers (Cassandra)
- f) File services

| No. | Application      | Number of Virtual Machines                   |  |
|-----|------------------|--|--|
|     |                  |  |  |
| 1   | Active Directory | 2 x Windows 2016 VMs per Site (2)            |  |
| 2   | Humanity Link    | 8 x Linux VMs (4 x DB + 2 x MW + 2 x FE) (8) |  |
| 3   | DNS Servers      | 2 x Windows 2016 DNS Server VMs (2)          |  |
| 4   |                  |  |  |

4 x Cassandra VMs

2 x Middleware

2 x Front End

Per site Loadbalancer

## Solution Components

