VISOKO UČILIŠTE ALGEBRA

# PROJEKTNI ZADATAK

# Virtualizacija IT infrastrukture 2

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#### 1. Uvod

Za potrebe rješavanja zadatka koji su navedeni u projektu koristit će se računala: dva ESXi hipervizor računala i dva Linux računala s CentOS operacijskim sustavom. U navedenoj infrastrukturi ESXi hipervizor računala su u instaliranome stanju i sprema su za korištenje. Hipervizor ESXi računala potrebno je konfigurirati mrežni adapter IP adrese iz mreže 172.60.0.0/22. Kad su ESXi hipervisor računala uspješno konfigurirana što se tiče mreže spremna su za dodavanje u vSphere dana center koristeći vSphere Client. Nakon dodavanja ESXi hipervizora u vSphere Client potrebno je konfigurirati Linux računala tako da prvi mrežni adapter služi za izlaz na Internet, drugi i treći za storage. Razlog zbog kojeg se koriste dva mrežna adaptera za storage je zbog redundancije, točnije ako jedan link otkaže pristup prema storage-u je moguće ostvariti preko drugog mrežnog adaptera. Sljedeća konfiguracija koju je potrebno podesiti na Linux računalima je vezana za podizanje NFS i iSCSI datotečnog sustava. Sada na ESXi hipervizor računalima preko vSphere Client GUI sučelja podesiti ostala dva mrežna adaptera tako da IP adrese pripadaju mrežama 192.168.20.0/24 i 192.168.30./24. Ovime postavkama mrežnih adaptera osiguran je pristup do NFS i iSCSI datotečnih sustava. Sada na ESXi hipervizor računala preko vSphere Client GUI sučelja je potrebno dodati NFS i iSCSI, bitno je da se na jednome i drugome ESXi hipervizoru vide spojeni NFS share-ovi i trajno podignuti iSCSI softverski initiator na iSCSI target preko jednog i drugog mrežnog adaptera. I za kraj podignuti jednu praznu virtualnu mašinu te isprobati migraciju s jednog ESXi hipervizor računala na drugi, kao i migraciju virtualne mašine s iSCSI datotečnog sustava na NFS datotečni sustav pohrane. Zatim kreirati klaster te konfigurirati značajke "High Availability" nad klasterom i "Fault Tolerance" nad virtualnim preklopnikom kao uključivanje vMotion mogućnosti na virtualni preklopnik.

## 2. Zahtjevi infrastrukture

- Konfiguracija ESXi hipervizor računala tako da se podesi prvi mrežni adapter na IP adresu iz mreže 172.60.2.0/22, te ih dodati u vSphere dana center koristeći vSphere Client
- Na Linux računala podesiti ostala dva mrežna adaptera IP adrese iz mreže 192.168.20.0/24 i 192.168.30.0/24
- Na prvo Linux računalo podesiti NFS datotečni sustav, a na drugo Linux računalo podesiti iSCSI datotečni sustav
- Zatim koristeći vSphere Client preko GUI sučelja konfigurirati ostala dva mrežna adaptera IP adrese iz mreže 192.168.20.0/24 i 192.168.30.0/24 tako da mogu ostvariti vezu s Linux računalima
- Koristeći vSphere Client preko GUI sučelja trajno podići iSCSI softverski initiator i spojiti ga na ISCSI target koristeći oba mrežna adaptera, napraviti konfiguraciju za oba ESXi hipervizor računala
- Isto napraviti i za NFS
- Kreirati praznu virtualnu mašinu nad jednim od ESXi hipervizor računala te ju migrirati na drugi ESXi hipervizor, zatim migrirati virtualnu mašinu s iSCSI storage-a na NFS storage
- Kreirati klaster te nad klasterom uključiti značajku "High Availability"
- Kreirati virtualni preklopnik i omogućiti mu značajku vMotion
- Kreirati virtualni preklopnik i omogućiti mu značajku "Fault Tolerance"

# 3. Opis infrastrukture

ESXi hiper	vizor 02 🎬		📅 ESXi h	ipervizor 01
VCPU	2		VCPU	2
RAM	8		RAM	8GB
Storage	1x8GB		Storage	1x8GB
Network adapter 1	172.60.2.49/22		Network adapter 1	172.60.2.48/22
Network adapter 2	192.168.20.212/24		Network adapter 2	192.168.20.112/24
Network adapter 3	192.168.30.212/24		Network adapter 3	192.168.30.112/24
CentO	S 02 🎬	Virtualizacija II infrastrukture 2	📅 Ce	ntOS 01
VCPU	1		VCPU	1
RAM	4		RAM	4
Storage	1x16GB, 3x20GB		Storage	1x16, 3x20GB
Network adapter 1	Internet		Network adapter 1	Internet
Network adapter 2	192.168.20.162/24		Network adapter 2	192.168.20.62/24
Network adapter 3	192.168.30.162/24		Network adapter 3	192.168.30.62/24

Slika 1: prikaz opisa infrastrukture kroz umnu mapu

# 4. Topologija infrastrukture



Slika 2: prikaz topologije infrastrukture

#### 5. Razrada projekta - projektno rješenje

#### 5.1. Prikaz instalirani ESXi hostova

IP adresa prvog mrežnog adaptera preko kojeg će se ESXi hipervizor računalo dodati u vSphere database je 172.60.2.49/22.

📌 2020-VIRT2062-KZOS-ESXi-1-2020 - VMware Remote Console			– a ×
VMRC ▼      ▼ 母 [0]			2 2 2 2 ⊂ ≪
	System Customization	Configure Management Network	
	Configure Ressard Configure Lacidoum Mode And Loce Auguster Relatorit Restore Resource Relatorit Restore Responses Configure England Insolutions ing Options Visor Spites Lagos Visor Spites Lagos Visor Spites Lagos	Notione: W2-39 IVA Advess: IZ-00-20 Fetual: Identity acquired from DKP server IZ-00-3-251 IVA Advesses: rdm::20-3647-rdH-64C3/64 To viscar molecular the server in the server is a server in the server in the server is a server in the server in the server is a server in the server in the server in the server is a server in the server	
		Cinter) Hore Cisc) Log Dut	
	Where ESXi 6.5.0 (VMKerr	el Release Build 13932383)	
= 🧿 🛋 📲 🗯 📌			18:19 10/02/2021

Slika 3: ESXi 01 hipervizor računalo

IP adresa prvog mrežnog adaptera preko kojeg će se ESXi hipervizor računalo dodati u vSphere database je 172.60.2.48/22.



Slika 4: ESXi 02 hipervizor računalo

## 5.2. Dodavanje ESXi hipervizor računala u vSphere database

vm vSphere Client Menu v	$Q_{\rm c}$ Search in all environments				C 0~	ajanach@VSPHERE.LOCAI	~ ©
	📄 ajanach 🛛 🗛 🗸						
virt-vcsa.vua.cloud	Summary Monitor Configure	Permissions Hosts & Clusters	VMs Datastores Ne	etworks Updates			
🔄 ajanach							
	Hosts: 0 Virtual Machines: 0					CPU	Pree: 0 HZ
	Clusters: 0					Used: 0 Hz	Capacity: 0 Hz
	Networks: 0					Memory	Title. 0 D
	Datastores: 0					Used: 0 B Storage	Capacity: 0 B
						Used 0.B	Canacity: 0.B
						Osec. 0 B	Capacity, o b
	Custom Attributes		~	Tags			~
	Attribute	Value		Assigned Tag	Category	Description	
	4			4			<b>3</b> ×
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Remove host 172.60.2.49	✓ Completed	VSPHERE	LOCAL\ajanach 4 ms	02/10/2021, 6:24	1:46 PM 02/10/2021, 6:	24:46 PM virt-vcsa.vua.c	loud
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Prvo je potrebno pristupiti vSphere Client sučelju preko adrese 10.10.51.242/ui.

Slika 5: vSphere Client sučelje

Kako bi dodao ESXi hipervizor računalo potrebno je desnim klikom iz izbornika odabrati "Add Host". Pritiskom na "Add Host" otvara se "Wizard" kroz kojeg je potrebno proći. Na kartici "Name and location" dodati IP adresu ESXi hipervizor računala. Zatim upisati korisničke podatke za ESXi hipervizor koje glase: username: root, password: Pa\$\$w0rd. Ostale postavke ostaviti na zadano.

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Virt-vcsa.vua.cloud	2	■ ajanach ACTIONS - Summary Monitor Configure	Permissions Hosts &	Clusters VMs Dat	astores	Networks Upda	ites				
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Remove cluster	New Clusterda	✓ Completed		VSPHERE.LOCAL\ajanach	3 ms		02/10/2021, 6:28:0	15 PM	02/10/2021, 6:28:05 Pl	M virt-vcsa.v	ua.cloud
Create cluster	ajanach	<ul> <li>Completed</li> </ul>		VSPHERE.LOCAL\ajanach	3 ms		02/10/2021, 6:28:0	IO PM	02/10/2021, 6:28:00 P	M virt-vcsa.v	ua.cloud
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Slika 6: ESXi hipervizor računala su dodana u vSphere Client

#### 5.3. Konfiguracija CentOS poslužitelja

#### 5.3.1. Konfiguraciaj CentOS 03 poslužitelja

Trajno podići iSCSI target, formatirati preostale diskove (sdb, sdc i sdd) i na njih smjestiti iSCSI target, tako da sdb bude LUN0, sdc LUN1 i sdd LUN2.

```
#!/bin/bash
#mrežna konfiguracija:
echo -e "BOOTPROTO=static
NAME=ens224
DEVICE=ens224
ONBOOT=yes
IPADDR=192.168.20.62
NETMASK=255.255.255.0" > /etc/sysconfig/network-scripts/ifcfg-ens224
echo -e "BOOTPROTO=static
NAME=ens256
DEVICE=ens256
ONBOOT=yes
IPADDR=192.168.30.62" > /etc/sysconfig/network-scripts/ifcfg-ens256
#ponovno pokretanje mrežnog servisa:
systemctl restart NetworkManager
echo -e "Mrežne postavke su uspješno konfigurirane."
fdisk /dev/sdb <<EEOF</pre>
n
р
1
2048
41943039
w
EEOF
fdisk /dev/sdc <<EEOF</pre>
n
р
1
2048
41943039
w
EEOF
```

```
fdisk /dev/sdd <<EEOF</pre>
n
р
1
2048
41943039
w
EEOF
#instalacija iSCSI target servisa:
yum install target* -y
systemctl start target
systemctl enable target
#konfiguracija u targetcliu:
targetcli /backstores/block create LUN0 /dev/sdb1
targetcli /backstores/block create LUN1 /dev/sdc1
targetcli /backstores/block create LUN2 /dev/sdd1
targetcli /iscsi create iqn.2021-02.cloud.vua:target
targetcli /iscsi/iqn.2021-02.cloud.vua:target/tpg1/acls create iqn.2021-02.cloud.vua:host1
targetcli /iscsi/iqn.2021-02.cloud.vua:target/tpg1/acls create iqn.2021-02.cloud.vua:host2
targetcli /iscsi/iqn.2021-02.cloud.vua:target/tpg1/luns create /backstores/block/LUN0
targetcli /iscsi/iqn.2021-02.cloud.vua:target/tpg1/luns create /backstores/block/LUN1
targetcli /iscsi/iqn.2021-02.cloud.vua:target/tpg1/luns create /backstores/block/LUN2
#isključenje firewall servisa:
systemctl stop firewalld
systemctl disable firewalld
echo -e "Skripta je izvršena."
```

= 💿 = = = 🖬 📌 🌢 🕼 🤻

Slika 7: rezultat pokrenute skripte

## 5.3.2. Konfiguracija CentOS 02 poslužitelja

Potrebno je podesiti preostala dva mrežna adaptera te prvome dodijeliti mrežu iz subneta 192.168.20.0/24, a drugom mrežnog adapteru 192.168.30.0/24. Zatim trajno podići NFS share, formatirati preostale diskove (sdb, sdc i sdd), trajno ih montirati na lokaciju /mnt/nfs01, /mnt/nfs02, /mnt/nfs03. NFS *shareovi* moraju biti eksportirani prema kompletnome *subnetu* na VIRT02 mreži. Ovaj zadatak riješit ću pokretanjem jedne skripte koja izvrši kompletnu konfiguraciju navedenog.

```
#!/bin/bash
#mrežna konfiguracija:
echo-e "BOOTPROTO=static
NAME=ens224
DEVICE=ens224
ONBOOT=yes
IPADDR=192.168.20.162
NETMASK=255.255.255.0" > /etc/sysconfig/network-scripts/ifcfg-ens224
echo -e "BOOTPROTO=static
NAME=ens256
DEVICE=ens256
ONBOOT=yes
IPADDR=192.168.30.162
NETMASK=255.255.255.0" > /etc/sysconfig/network-scripts/ifcfg-ens256
#ponovno pokretanje mrežnog servisa:
systemctl restart NetworkManager
echo -e "Mrežne postavke su uspješno konfigurirane."
#kreiranje particija:
fdisk /dev/sdb <<EEOF</pre>
n
р
1
2048
41943039
w
EEOF
fdisk /dev/sdc <<EEOF</pre>
n
р
1
2048
41943039
w
EEOF
fdisk /dev/sdd <<EEOF
n
```

р 1 2048 41943039 w EEOF #instalacija NFS servisa: yum install nfs-utils -y systemctl start nfs-server systemctl enable nfs-server #konfiguracija NFS-a: echo -e "/mnt/nfs01 \*(rw) /mnt/nfs02 \*(rw) /mnt/nfs03 \*(rw)" > /etc/exports mkdir /mnt/nfs01 mkdir /mnt/nfs02 mkdir /mnt/nfs03 mkfs.ext4 /dev/sdb1 mkfs.ext4 /dev/sdc1 mkfs.ext4 /dev/sdd1 mount /dev/sdb1 /mnt/nfs01 mount /dev/sdc1 /mnt/nfs02 mount /dev/sdd1 /mnt/nfs03 echo -e "diskovi su mountani." #trajni mount konfiguracije: tail -n 3 /etc/mtab >> /etc/fstab #provjera da li je sve ispravno: mount -a exportfs -avr



Slika 8: rezultat pokrenute skripte

Uspješnom konfiguracijom CentOS 01 i CentOS 02 poslužitelja, što se tiče mrežne konfiguracije oni moraju moći komunicirati s preko mreže 192.168.20.0/24 i mreže 192.168.30.0/24.



Slika 9: prikaz uspješne komunikacije između CentOS poslužitelja

## 5.4. Mrežna konfiguracija na ESXi hipervizor računala

Na ESXi hipervizor računala podesiti ostala dva mrežna adaptera tako da budu trajno upaljeni. Na prvu slobodnu mrežnu karticu postaviti IP adresu iz mreže 192.168.20.0/24, a na drugu 192.168.30.0/24.

Jednom kad smo dodali ESXi hipervizor host u vSphere dana centar koristeći vSphere GUI sučelje sve ostale postavke koje se žele podesiti, podešavaju se unutar vSphere Client-a. Desnim klikom miša na ESXi hipervizor 01 "Add Networking...". Otvara se "Wizard" gdje je potrebno odabrati "VMKernel Network Adapter", zatim u kartici "Select target device" odabrati New standard switch sa MTU(Bytes) vrijednosti 1500. Na kartici "Create a Standard Switch" odabrati jedan od ponuđenih adaptera i pritisnuti na "Next". Otvara se kartica "Port properties" gdje je potrebno ostaviti preddefinirane postavke i kliknuti na "Next". Otvara se kartica "IPv4 settings" gdje je potrebno odabrati "Use static IPv4 settings" i dodati IP adresu.

Ponoviti isto za drugi mrežni adapter samo je potrebno u kartici "IPv4 settings" dodati statičku IP adresu kako je navedeno u zadatku.

Također isti postupak ponoviti i na ESXi hipervizor 02. Postupak se ponavlja za svaki mrežni adapter. Svaki puta kad se konfigurira mrežni adapter može se primijetiti da je nužno kreirati VMKrenel virtualni preklopnik je uređaj s kojim vSphere Client komunicira s vanjskim svijetom. Tako omogućujemo da vSphere Client, točnije ESXi hipervizor računala mogu komunicirati s Linux poslužiteljima.

Svako Linux računalo mora moći komunicirati sa adresama 192.168.20.112, 192.168.30.112, 192.168.20.212 i 192.168.30.212.

vm vSphere Client Monu v										
	172.60.2.48	Actions +								
<ul> <li>Ø virt-vesa vua cloud</li> <li>I ajanach</li> </ul>	Summy Monto Cardigan Remote Via Resource Page Database Antivola Updates									
> 72.60.2.48	Storage     Storage	Virtual switches					ADD NETWORKING	REFRESH		
■ 17240.2.49	Storage Devices Heat Cache Configur Histocol Endpoints UC Piters • Networking Virtual switches Virtual switches TOVIC configuration • Virtual Machines Virtual Machines Virtual Machines	v tanded Settly visitifs and environments a	DT BARBAR PROTOCIAL ADAPTERS ***	Management Network         ***           VaNOC         ***           visitered Nation (1)         ***           visitered Nation (2)         ***           Visitered Nation (2)         ***           Vanisher (2)         ***	P     P     P     P			ĺ		
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Slika 10: rezultat konfiguriranih mrežnih adaptera na ESXi hipervizor 01

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Slika 11:rezultat konfiguriranih mrežnih adaptera na ESXi hipervizor 02

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Slika 12: CentOS 01 računalo uspješno komunicira s ESXi hipervizor 01 i ESXi hipervizor 02

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Slika 13: CentOS 02 poslužitelj uspješno komunicira s ESXi hipervizor 01 i ESXi hipervizor 02

## 5.5. Spajanje iSCSI datotečnog sustava na ESXi hipervizor računala

Na ESXi trajno podići iSCSI softverski initiator i spojiti ga na iSCSI target LUN-ove. Datastoreovi se trebaju zvati LUN0, LUN1 i LUN2.

Za dodavanje iSCSI storage-a potrebno je u izborniku od ESXi01 odabrati karticu "Configure", iz padajućeg izbornika koji se pojavljuje klikom na "Configure" odabrati "Storage Adapters" -> "Add Software Adapter" -> "Add software iSCSI adapter" -> prebaciti se u CentOS virtualnu mašinu i u servis targetcli upisati pod "acls" iqn tog iSCSI adaptera. Kad je "iSCSI Software Adapter" kreiran potrebno je kliknuti na njega i iz donjeg izbornika odabrati "Network Port Binding" -> "Add..." -> odabrati "VMKernel01" i "VMKernel02". Zatim iz izbornika odabrati "Static Discovery" -> "Add..." -> upisati IPv4 adresu target i iqn virtualne mašine. I za kraj skenirati cijeli storage klikom na "Rescan Storage". U kartici "Devices" moraju se pojaviti 3 LUN-a. Sad je konfiguracija sprema za dodavanje Datastore-a. Desnim klikom Kliknuti na ESXi01 i odabrati "Storage -> "New Datastore..." -> "VMFS -> dodati ime storage-u -> i sve ostale postavke ostaviti na zadano.

U kartici "Network Port Binding" nužno je dodati oba virtualna preklopnika kako bi postigli redundanciju i u kartici "Static Discovery" je nužno dodati dva "Target" servera zato što jer će se tako postići konekcija preko oba mrežna adaptera i na taj način moći će se konfigurirati MPIO u "Round Robin" modu.

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Slika 14: prikaz dodanih virtualnih preklopnika za postizanje redundancije na ESXi 01

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Slika 17: trajno podignuti iSCSI target LUN-ovi na ESXi 01

Ponoviti postupak i za ESXi hipervizor 02. Kad se podesi kartica "Network Port Binding" i "Static Discovery". Potrebno je pritisnuti "Rescan Storage.." i pod "Datastores" će se pojaviti svi LUN-ovi koji su trajno podignuti.

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Slika 19: trajno podignuti iSCSI target LUN-ovi na ESXi 02

#### 5.5.1. Podešavanje MPIO konfiguracije u Round Robin mod

Cilj ovog poglavlja je nakon dodanih iSCSI diskova unutar vSphere Client sučelja prema ESXi 01 i ESXi 02 na korištenje. Potrebno je podesiti MPIO konfiguraciju u "Rount Robin" radi boljeg učinka redundancije. Konfiguraciju u "Round Robin" nužno je podesiti na sva tri iSCSI LUN-a.

Kako bi podesiti ovu konfiguraciju potrebno se je pozicionirati na jedan od ESXi hipervizor računala u vSphere Client GUI sučelju i odabrati karticu "Configure" iz padajućeg izbornika odabrati "Storage Devices" i odabrati jedan od LUN-ova. I u doljnjem prozoru koji se otvara pozicionirati se u "Properties" i ovog okvira potrebno je pristisnuti na "Edit Multipathing...".



Ovaj postupak potrebno je proći za sve LUN-ove koji su vidljivi unutar vSphere Client sučelja.

Slika 20: prikaz postavljene MPIO konfiguracije u Round Robin mod na ESXi 01

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Slika 21: prikaz postavljenje MPIO konfiguracije u Round Robin mod na ESXi 01

#### 5.6. Spajanje NFS datotečnog sustava na ESXi hipervizor računala

Potrebno je konfigurirati pristup NFS storage-u koji je prethodno konfiguriran na CentOS 02 poslužitelju.

Desnim klikom miša na ESXi 01 host iz izbornika odabrati Storage -> New Datastore... -> NFS -> NFS 3 -> dodijeliti Datastore name, putanja share foldera od NFS-a i IPv4 adresa virtualne mašine share-a NFS-a.

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Slika 22: prikaz konfiguriranog pristupa na NFS storage-u na ESXi 01

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Slika 23: prikaz konfiguriranog pristupa na NFS storage-u na ESXi 02

## 5.7. Kreiranje virtualnih preklopnika sa značajkom vMotion

Na ESXi 01 i ESXi 02 kreirati VMKernel adaptere nad vSwitch01 i vSwitch02, uključiti na njima vMotion i dati ima IP adresu iz mreže 192.168.40.0/24 i 192.168.50.0/24

Postupak je isti kao i kod poglavlja "Mrežna konfiguracija na ESXi hipervizor računala" samo što je sad na postojeći vSwitch potrebno dodati mrežne adaptere.



Slika 24: prikaz kreiranog VMKernel adaptera sa značajkom vMotion na ESXi 01

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Slika 25: prikaz kreiranog VMKernel adaptera sa značajkom vMotion na ESXi 02

## 5.8. Kreiranje management interface-a

Na ESXi 01 i ESXi 02 hipervizor računalu kreirati management interface IP adrese iz mreže 192.168.60.0/24.



Slika 26:kreiranje managemnt interface-a na ESXi 01

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Slika 27: Kreiranje management interface-a na ESXi 02

## 5.9. Kreiranje prazne virtualne mašine

Kreirati praznu virtualnu mašinu na ESXi s minimalnim diskom prostora 8GB, 1GB memorije i 1vCPU. Što se tiče diskovnog prostora, za diskovni prostor iskorišen je LUNO.

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Slika 28: prikaz novokreirane prazne virtualne mašine

#### 5.10. Kreiranje klastera I uključivanje značajke "High Availability"

U Dana centru napraviti klaster i dodati oba ESXi hipervizor računala u klaster. Pritom kod kreiranja klastera potrebno je omogućiti značajku "High Availability". Nakon kreiranog klastera potrebno je dodati ESXi hipervizor računala unutar novokreiranog klastera.

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Slika 29: prikaz kreiranog klastera s uključenom značajkom "High Availability"

#### 5.11. Kreiranje virtualnog preklopnika sa značajkom "Fault Tolerance"

Na ESXi 01 i ESXi 02 na vSwitch02 dodati još jedan VMKernel adapter s uključenom značajkom "Fault Tolerance" IP adrese iz mreže 192.168.70.0/24.

Postupak je isti kao i kod poglavlja "Mrežna konfiguracija na ESXi hipervizor računala" samo što je sad na postojeći vSwitch potrebno dodati mrežne adaptere.



Slika 30: prikaz kreiranog VMKernel adaptera s uključenom značajkom "Fault Tolerance"

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Slika 31: prikaz kreiranog VMKernel adaptera s uključenom značajkom "Fault Tolerance"

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## 7. Zaključak

Ovim projektom zaključno mogu preporučiti konfiguraciju virtualna računala, virtualnih diskova i mreža u skladu s najboljim preporukama proizvođača i zahtjevima korisnika. Definirati osnovne funkcije ESXi poslužitelja, virtualna računala, diskove i mrežnu infrastrukturu. Objasniti osnovne funkcije VMware hipervizora, vCenter Server-a, načine kreiranja resursa za virtualna računala i okolinu te upravljanje istima, procedure kreiranja snapshota, uzoraka virtualnih mašina, njihove replikacije i migracije u VMware okolinama, kao i napredne funkcionalnosti u VMware okolinama. Kao i preporuku konfiguraciju virtualne okoline pomoću vCenter Servera prema zadanim zahtjevima korisnika i najboljim praksama proizvođača softvera i aplikacija - konfiguraciju snapshote, uzoraka virtualnih mašina, replikacije i migracije u VMware okolinama, i klasteriranja.

#### 8. Literatura

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- [2.] VMware dokumentacija vSphere 6.5 https://docs.vmware.com/en/VMware-vSphere/index.html