



# Bacula Contra o Ransomware! Campus Party - 2021

Give me my files back.

Give me \$500 in Bitcoin.



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# Bacula LatAm



- Sede no Brasil, subsidiária nos Estados Unidos (FL)
- Distribuidor exclusivo da Bacula Systems LatAm e Brasil
- Nacionaliza licenças e serviços
- Equipe certificada pelo desenvolvedor
- Missão: *Fornecer o melhor e mais acessível Software de Backup e Restauração de Dados*



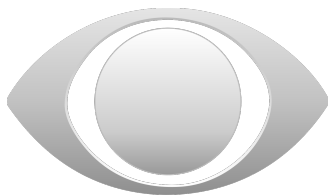
Hisense

Unimed



POUPEX

Algar  
Tech



LOCAWEB



TERESINA  
SHOPPING



StanleyBlack&Decker

DATACOM



Rio Energy



TRT MG  
TRIBUNAL REGIONAL DO  
TRABALHO DA 3ª REGIÃO



Binário  
Cloud



OABRJ



CÂMARA MUNICIPAL DE  
CAMPINAS



TRT  
15ª

- Udemy.com <<http://www.bacula.lat/community/treinamento-bacula-ed/>>
- YouTube <<https://www.youtube.com/user/heitorfaria>>
- Livro Bacula 4a Edição Brasport
- Telegram: @baculabr
- Meu contato: <[heitor@bacula.com.br](mailto:heitor@bacula.com.br)>
- Nosso site <<http://www.bacula.lat/>>

- Ransomware
- Backups
- Bacula
- Linux
- Regra 3-2-1
- Hardening
- Perguntas e Respostas

# Ransomware



De acordo com a Kaspersky [1], os Trojans Ransomware são um tipo de malware projetado para extorquir dinheiro de uma vítima. Em geral, ele vai exigir um pagamento em troca, prometendo reverter as alterações que o vírus trojan fez para o computador da vítima. Essas alterações podem incluir:

1. Criptografia de dados armazenados nas máquinas, para que as informações não possam mais ser acessadas.
2. Bloquear o acesso normal aos sistemas operacionais.



## Ransomware **Attack Process**



Figura 1. Processo de Ataque Ransomware

# Ransomware



Figura 2. Exemplo Tela Sistema Contaminado



# Ransomware

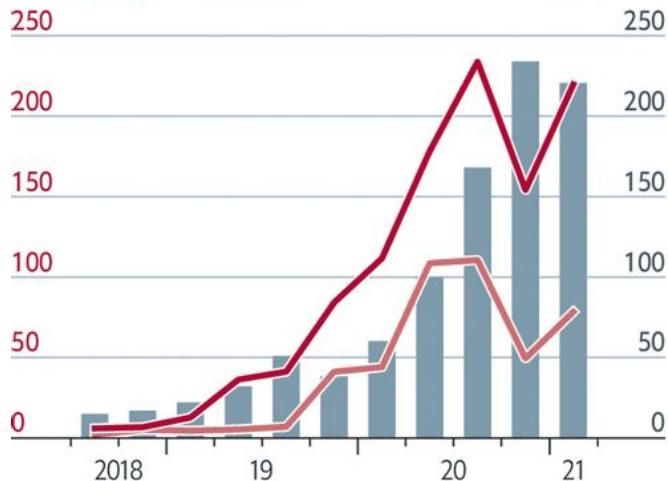


## Striking oil

United States

Ransom payments, \$'000

— Average — Median



Sources: Coveware; Colonial Pipeline Company

The Economist

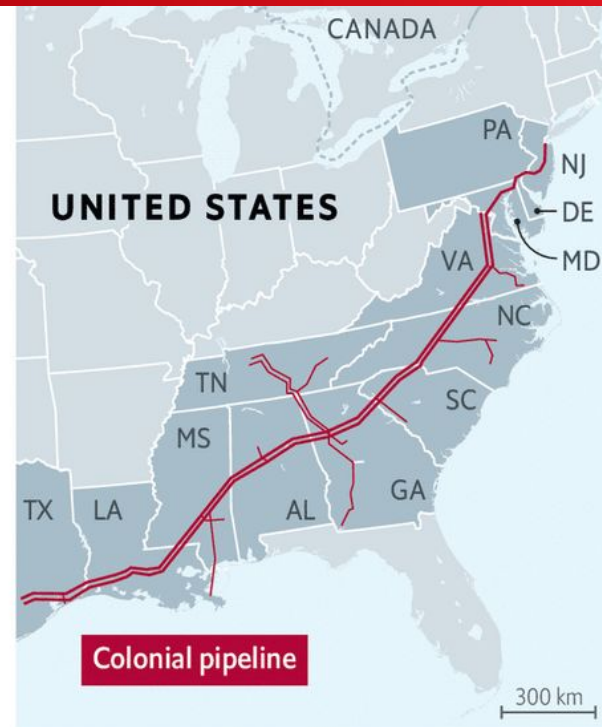


Figura 3. Evolução preço do resgate extensão do oleoduto da Colonial

# Ransomware



Mesmo com seguro contra cyber ataques, pagar o resgate nem sempre é uma boa opção:

1. Sem garantia de cooperação do atacante
2. Sem garantia de funcionamento da decryptografia
3. Não mitiga novos ataques posteriores
4. Restrições de compliance e de governo (ex.: embargos governamentais contra países)
5. Moralmente questionável pois incentiva a atividade criminosa

# Ransomware



Em linha com a AhnLab [2], patches de segurança e backups podem ser as únicas soluções eficazes para ataques de ransomware.

*Os últimos ataques de ransomware tendem a usar novos malwares e suas variantes para burlar programas antivírus. Uma vez que é basicamente impossível preventivamente prevenir e bloquear ransomware, só podemos estabelecer uma estratégia de resposta passiva para minimizar os danos.*

[2] Ransomware Response: Ideal versus



Reality. <<http://www.gartner.com/imagesrv/media-products/pdf/ahnlab/ahnlab-1-2VS6RBW.pdf>>

# Ransomware



*Infelizmente, alguns fornecedores de segurança induziram os clientes a pensar que suas soluções de segurança, como programas AV, podem impedir os ransomware. No entanto, todos os fornecedores de segurança enfatizam duas medidas de segurança básicas para evitar ataques de ransomware: **fazer backup de arquivos importantes** e aplicar os patches de segurança de sistemas mais recentes.*

Em outras palavras, a aplicação dos últimos patches do sistema pode prevenir a infecção (pré-resposta) e, mesmo se ela estiver infectada, os danos podem ser minimizados ao restaurar o último backup.

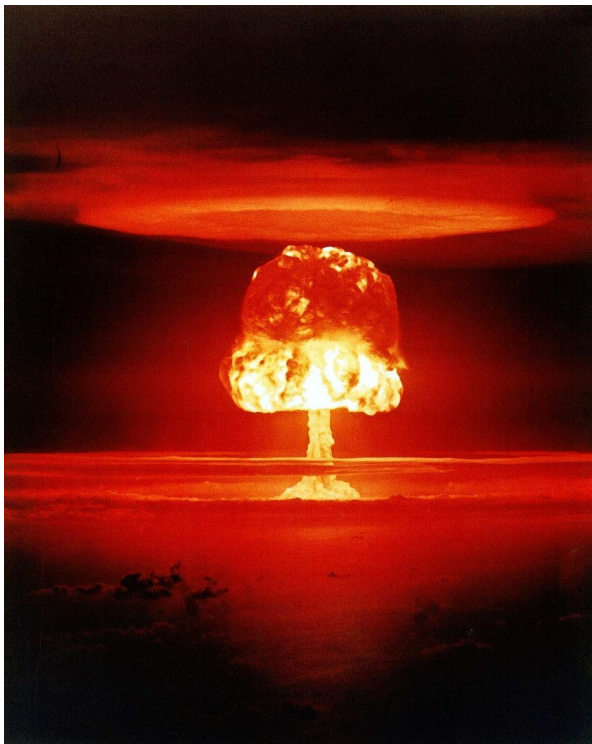


## RESOLUÇÃO STJ/GP N.25

- Suspensas as atividades judicantes até 9/11
- Regime de plantão funcionará para análise de pedidos urgentes

Figura 4. Mensagem sistemas STJ inativados por Ransomware

# Backups



- Redundância de dados com o propósito específico de restauração no caso de perda dos originais
- Falha de hardware; catástrofes físicas; atividade maliciosa; updates falhos de software; "eu não mexi em nada!"; update sem where; `rm -rf` errado; etc.
- Também precisa resistir ao Ransomware!

- Desde meados de 2000. **Cringe!**
- Requer Política de backup. Exemplo do Governo Federal:  
*Apesar de se tratar de um controle básico, **metade das organizações respondentes (208 de 410: 50,7%) ainda não possuem tal documento. Das 202 que o elaboraram, quase metade (98 de 202: 48,5%) ainda não formalizaram essa política.***

Ref.:

<<https://portal.tcu.gov.br/imprensa/noticias/tcu-verifica-politica-de-backup-em-422-organizacoes-federais.htm>>

# Backups



- 44 Zettabytes de dados a backupear em 2020  
[IDC]
- Armazenamento Conjuntos de Discos, Fitas  
Magnéticas Nuvem





## MULTI-LEVEL DISASTER RECOVERY



BACULA

## Os Três Níveis de DR

- **Nível de Dados.** Proteção dos dados de usuários e aplicações (dumps, cópia de arquivos)
- **Nível de Aplicação.** Continuidade da aplicação (PITR, CDP, plugins para aplicações)
- **Nível de SO.** Reduzir o tempo de recuperação do sistema para o menor possível (export de VM, CDP, snapshot de FS, Bare Metal)

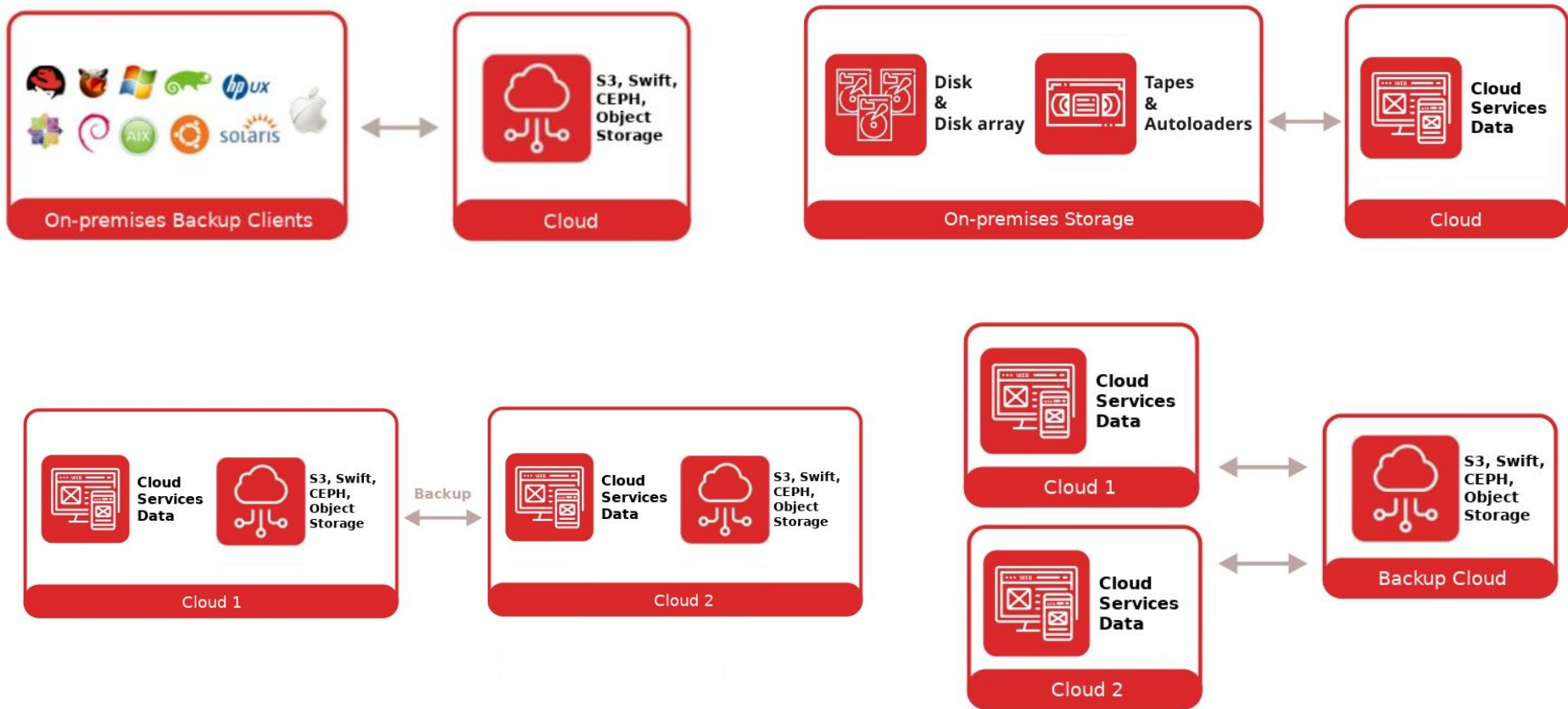


Figura 5. Principais Arquiteturas de Backup

# Bacula

BACULA



Figura 6. Backup + Drácula = Bacula

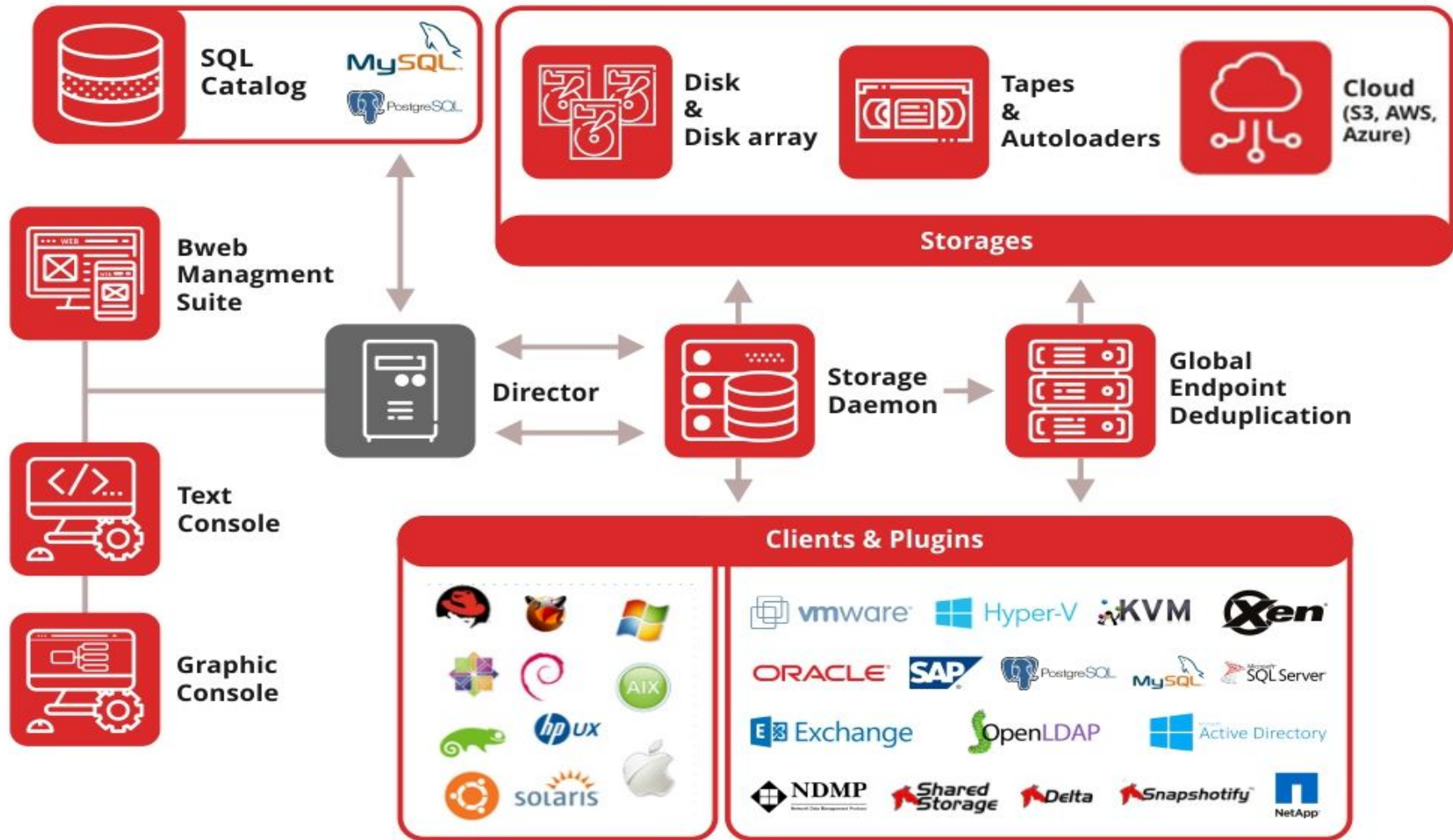
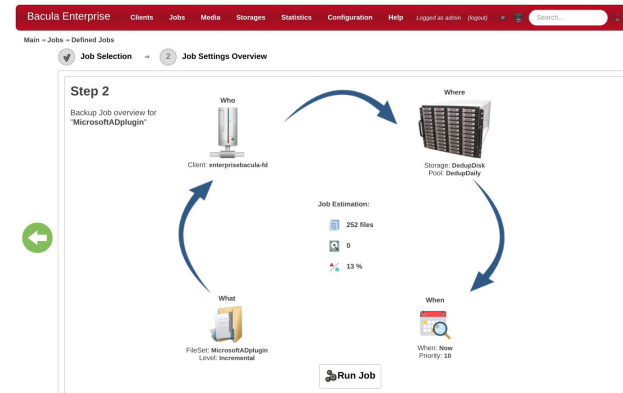


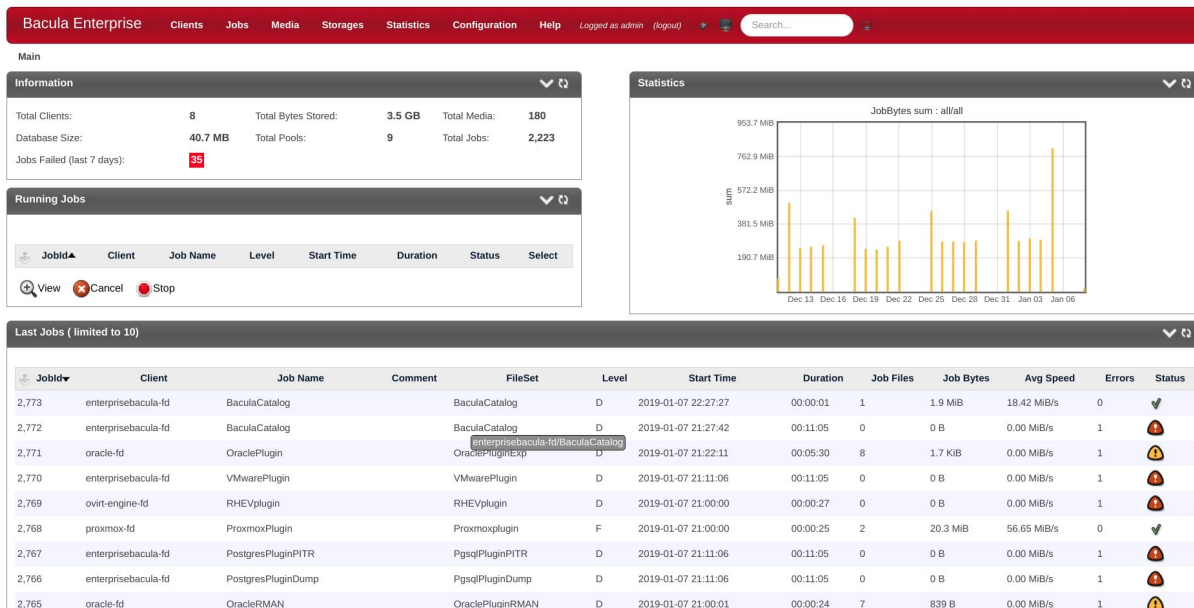
Figura 7. Arquitetura do Bacula. Também precisa ser resistente ao ransomware.

- Deduplicação Global (**na origem ou somente storage**: Windows, Unix, Linux etc.).  
*Até 99% de redução no tráfego e armazenamento.*
- CBT para outras Virtualizações (RHV, XEN etc.)
- Primeiros Plugins para **Docker, Kubernetes, Proxmox, Hadoop, PostgreSQL e MySQL**;
- Altíssima Escalabilidade (**poucas conseguem fazer backup de 10.000 hosts ou mais**).

- Mais avançadas Interfaces Web do Mercado, sem requerer **Java/Flash**. Deploy/update remoto de agentes, etc.
- Equipe de Desenvolvimento própria
- Não é uma suíte!
- Formato de Catálogo e de Backup Abertos (sem aprisionamento);
- Versão Livre/Enterprise



- ★ Sem plugins Java/Flash
- ★ Auditoria de Operações
- ★ Self-restore
- ★ Grupos de Clientes
- ★ ACLs de Usuário e Perfis
- ★ Gestão de Mídias e Armazenamento
- ★ Módulos de Monitoração, Estatística e Relatórios
- ★ Operação dos Plugins



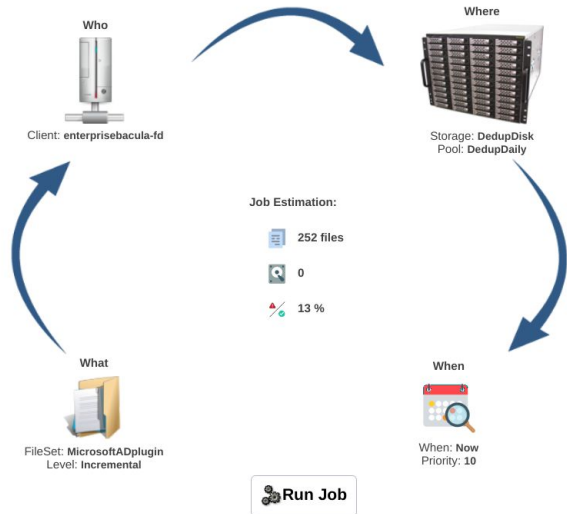
The screenshot displays the Bacula Enterprise BWeb interface. At the top, there is a navigation bar with tabs for Clients, Jobs, Media, Storages, Statistics, Configuration, and Help. The main content area is divided into several sections:

- Information:** Shows overall system statistics: Total Clients: 8, Total Bytes Stored: 3.5 GB, Total Media: 180, Database Size: 40.7 MB, Total Pools: 9, Total Jobs: 2,223, and Jobs Failed (last 7 days): 35.
- Running Jobs:** A table with columns for JobId, Client, Job Name, Level, Start Time, Duration, Status, and Select. It includes buttons for View, Cancel, and Stop.
- Statistics:** A bar chart titled "JobBytes sum : allfall" showing job bytes over time from Dec 13 to Jan 06. The y-axis represents the sum of bytes, ranging from 190.7 MB to 953.7 MB.
- Last Jobs ( limited to 10):** A table listing recent jobs with columns for JobId, Client, Job Name, Comment, FileSet, Level, Start Time, Duration, Job Files, Job Bytes, Avg Speed, Errors, and Status.

JobId	Client	Job Name	Comment	FileSet	Level	Start Time	Duration	Job Files	Job Bytes	Avg Speed	Errors	Status
2,773	enterprisebacula-fd	BaculaCatalog		BaculaCatalog	D	2019-01-07 22:27:27	00:00:01	1	1.9 MiB	18.42 MiB/s	0	✓
2,772	enterprisebacula-fd	BaculaCatalog		BaculaCatalog	D	2019-01-07 21:27:42	00:11:05	0	0 B	0.00 MiB/s	1	⚠
2,771	oracle-fd	OraclePlugin		OraclePluginExp	D	2019-01-07 21:22:11	00:05:30	8	1.7 KiB	0.00 MiB/s	1	⚠
2,770	enterprisebacula-fd	VMwarePlugin		VMwarePlugin	D	2019-01-07 21:11:06	00:11:05	0	0 B	0.00 MiB/s	1	⚠
2,769	ovirt-engine-fd	RHEVplugin		RHEVplugin	D	2019-01-07 21:00:00	00:00:27	0	0 B	0.00 MiB/s	1	⚠
2,768	proxmox-fd	ProxmoxPlugin		Proxmoxplugin	F	2019-01-07 21:00:00	00:00:25	2	20.3 MiB	56.65 MiB/s	0	✓
2,767	enterprisebacula-fd	PostgresPluginPITR		PgsqPluginPITR	D	2019-01-07 21:11:06	00:11:05	0	0 B	0.00 MiB/s	1	⚠
2,766	enterprisebacula-fd	PostgresPluginDump		PgsqPluginDump	D	2019-01-07 21:11:06	00:11:05	0	0 B	0.00 MiB/s	1	⚠
2,765	oracle-fd	OracleRMAN		OraclePluginRMAN	D	2019-01-07 21:00:01	00:00:24	7	839 B	0.00 MiB/s	1	⚠

## Step 2



Backup Job overview for "MicrosoftADplugin"



- ★ Operação 100% gráfica
- ★ Design Centrado no Usuário
- ★ Operações com Poucos Cliques
- ★ Integração com o AD/LDAP
- ★ Configuração e deploy de clients



Running Job OraclePlugin.2019-01-07\_22:29:58\_21 on oracle-fd

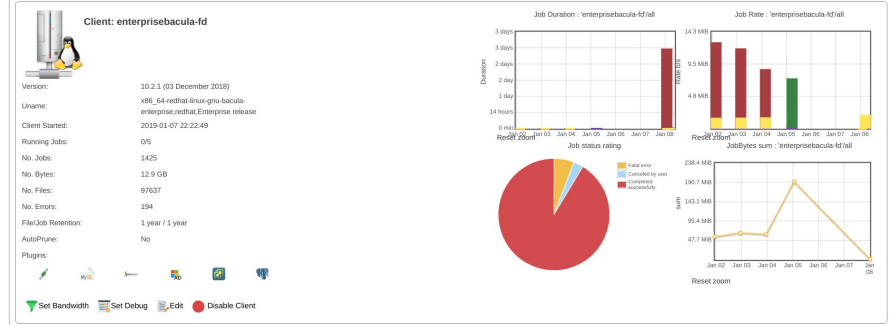
**Job Name:** OraclePlugin.2019-01-07\_22:29:58\_21 (2,774)  
**Processing file:** /@ORACLE/cdb1\APEX\_040200\user.sql  
**Speed:** 72 B/s  
**Files Examined:** 8  
**Files Backed up:** 8  
**Bytes done:**   
**Files done:**   
**Bytes:** 1,748

Job Report: OraclePlugin on oracle-fd (2774)

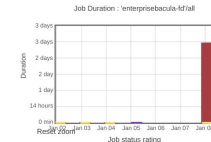
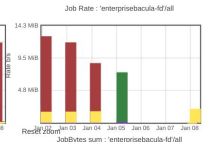
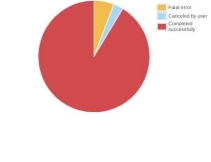
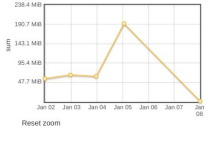
2019-01-07 22:29:50 oracle-fd JobId 2774: DIR and FD clocks differ by -9 seconds, FD automatically compensating.  
 2019-01-07 22:38:00 enterprisebacula-dir JobId 2774: Start Backup JobId 2774, Job=OraclePlugin.2019-01-07\_22:29:58\_21  
 2019-01-07 22:38:00 enterprisebacula-dir JobId 2774: Using Device "FileChgr1-Dev2" to write.  
 2019-01-07 22:38:00 enterprisebacula-dir JobId 2774: FD compression disabled for this Job because AllowCompress=No in Storage resource.  
 2019-01-07 22:38:00 enterprisebacula-sd JobId 2774: Volume "dedupDaily-74" previously written, moving to end of data.  
 2019-01-07 22:38:00 enterprisebacula-sd JobId 2774: Ready to append to end of Volume "dedupDaily-74" size=1,922,059

Main - Clients - Client Status enterprisebacula 3 minutes

Client: enterprisebacula-fd



**Version:** 10.2.1 (03 December 2018)  
**Uname:** x86\_64-redhat-linux-gnu-bacula-enterprise-redhat.Enterprise release  
**Client Started:** 2019-01-07 22:22:49  
**Running Jobs:** 0/5  
**No. Jobs:** 1425  
**No. Bytes:** 12.9 GB  
**No. Files:** 97637  
**No. Errors:** 194  
**FileJob Retention:** 1 year / 1 year  
**AutoPrune:** No  
**Plugins:**

**Job Duration:** 'enterprisebacula-fd'   
**Job Rate:** 'enterprisebacula-fd'   
**Job status rating:**   
**Jobilities sum:** 'enterprisebacula-fd' 

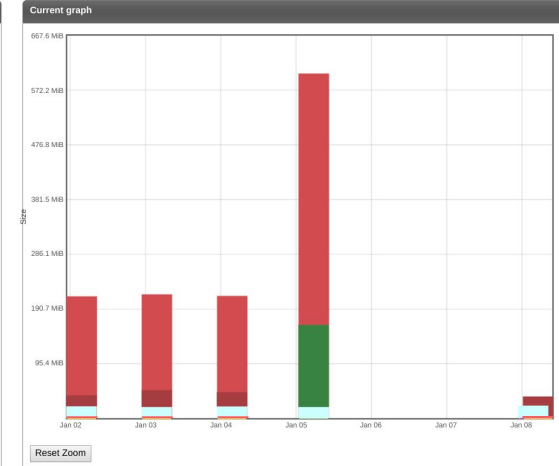
**Running Jobs**  
 No job running on the Client.  
**Terminated Jobs**

Main - Statistics - Statistics

Options

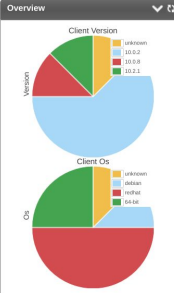
**Level:** Any **Status:** OK  
**Age:** This week **Size:** Width: 800 Height: 600  
**Clients:** enterprisebacula-fd, hyper-fd, mssql-fd, oracle-fd, ovirt-engine-fd, proxmox-fd, test, test-fd  
**Job Name:** BackupImages, BackupVideo, BaculaAdminTask, BaculaAudio, BaculaCatalog, BaculaConfigurations, BaculaFileCompressor, HyperVPlugin, LDAPPlugin, MicrosoftADplugin, mssqlPluginCluster, MySQLplugin, NewJob, OraclePlugin

**Groups:** databases, hypervisors

**Current graph**  


Main - Clients - Clients

Overview



**Client Version:** 10.2.1 (03 Dec 2018), 10.1.0.8, 10.1.0.9, 10.2.1.2  
**Client OS:** Unknown, Debian, Oracle, S4.14

Clients

Name	Select	Desc	Auto Prune	File Retention	Job Retention
enterprisebacula-fd	<input type="checkbox"/>	10.2.1 (03Dec18) x86_64-redhat-linux-gnu-bacula-enterprise-redhat.Enterprise release	0	365 days	365 days
hyper-fd	<input type="checkbox"/>	10.0.2 (30May18) Microsoft (build 9200), 64-bit,Cross-compile,Win64	0	365 days	365 days
mssql-fd	<input type="checkbox"/>	10.0.8 (22Oct18) Microsoft (build 9200), 64-bit,Cross-compile,Win64	0	365 days	365 days
oracle-fd	<input type="checkbox"/>	10.0.2 (30May18) x86_64-redhat-linux-gnu-bacula-enterprise-redhat,	0	365 days	365 days
ovirt-engine-fd	<input type="checkbox"/>	10.0.2 (30May18) x86_64-redhat-linux-gnu-bacula-enterprise-redhat,	0	365 days	365 days
proxmox-fd	<input type="checkbox"/>	10.0.2 (30May18) x86_64-pc-linux-gnu-bacula-enterprise,debian.9.0	0	365 days	365 days
test	<input type="checkbox"/>	10.0.2 (30May18) x86_64-pc-linux-gnu-bacula-enterprise,debian.9.0	0	365 days	365 days
test-fd	<input type="checkbox"/>	10.0.2 (30May18) x86_64-redhat-linux-gnu-bacula-enterprise-redhat,	0	365 days	365 days

### Edit Fileset VMwarePlugin

Fileset Name: VMwarePlugin

Description:

Enable VSS:

Ignore Fileset Changes:

Enable Snapshot:

Include:   
[Compression Dedup Signature] Plugin: index

Exclude:

**VMware resource browser**

Path: /ha-datacenter/VMS

- [-] .
- [-] ..
- [-] centos7minimum
- [-] teste-restore

Cancel Apply selection

### Storage Overview

Storage: DedupDisk Refresh: 30 seconds

**Device: Single Device**

Legend: ■ Queued ■ Progress  Done Error Cancelled Unknown

Uploads: No upload transfer available

Downloads: No download transfer available

**Device Details:**

Device Type: Cloud

Media Type: CloudAWS

Device Status: Not running (Idle)

Cache (Free/Total): 272.81 GB / 369.98 GB

Status: ▲ Cloud Status

Device Name	Status	Loaded	Volume Name	Slot	Running Jobs/Max. Jobs	Speed
AWS						
0/20						
<b>Autochanger: FileChgr1</b>						
Device Details: Device Type: Dedup Media Type: Dedup Device Status: Not running (Idle) Space (Free/Total): 272.81 GB / 369.98 GB						
Device Name	Status	Loaded	Volume Name	Slot	Running Jobs/Max. Jobs	Speed
FileChgr1-Dev1	-	-	-	05	-	-
FileChgr1-Dev2	-	-	-	05	-	-
<b>Autochanger: FileChgr2</b>						
Device Details: Device Type: File						

### Main - Statistics - Dedup Usage

Global Endpoint Deduplication storage usage

Storage: DedupDisk Refresh interval: 5 minutes

**Deduplication Ratio:**

Ref ratio: 6.63

Size ratio: 14.13

**General:**

Version: 10.3

Hash Name: sha512/256

Hash ID: 1

Hole Size: 4.0 MB

Ideal Blocksize: 64.0 KiB

Max Blocksize: 65.0 KiB

**Statistics:**

Transaction: 2476

Hash Count: 1,205,527

Ref Count: 7,994,509

482.8 GiB

Dedupengine Errors: 0

Containers Errors: 0

**Containers statistics:**

Chunk Used: 1,205,527

Chunk Allocated: 1,889,390

Disk Space Used: 34.2 GiB

Disk Space Allocated: 71.4 GiB

Container Sum Bitarray Capacity: 33.0 MB

Read Chunk: 0

Calc Hash: 784

Update Refont: 0

Query Hash: 2138

New Hash: 681

**Vacuum:**

Start Time: 2018-10-29 17:14:48

End Time: 2018-10-29 17:14:55

Orphan Addr: undefined

Ref Count: 0

Ref Size: 0 B

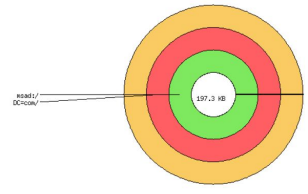
### Global Endpoint Deduplication storage containers

ID#	Block Used	Block Capacity	Unused Disk Space	Disk Space	Bitarray Capacity	Usage	Usage Map
1	3	4	1024 B	8.0 KiB	524288	75%	<span style="display: inline-block; width: 100%; height: 10px; background: repeating-linear-gradient(45deg, transparent, transparent 2px, red 2px, red 4px);"></span>
2	6,483	9,551	6.0 MiB	18.7 MiB	524288	67%	<span style="display: inline-block; width: 100%; height: 10px; background: repeating-linear-gradient(45deg, transparent, transparent 2px, red 2px, red 4px);"></span>
3	10,941	13,774	6.3 MiB	40.4 MiB	524288	79%	<span style="display: inline-block; width: 100%; height: 10px; background: repeating-linear-gradient(45deg, transparent, transparent 2px, red 2px, red 4px);"></span>
4	10,628	12,865	8.7 MiB	50.3 MiB	524288	82%	<span style="display: inline-block; width: 100%; height: 10px; background: repeating-linear-gradient(45deg, transparent, transparent 2px, red 2px, red 4px);"></span>
5	5,574	7,063	7.3 MiB	34.5 MiB	524288	78%	<span style="display: inline-block; width: 100%; height: 10px; background: repeating-linear-gradient(45deg, transparent, transparent 2px, red 2px, red 4px);"></span>

JobID	Client	Job Name	Comment	FileSet	Level	Start Time	Duration	Job Files	Job Bytes	Avg Speed	Errors	Status
2,784	enterprisebacula-td	MicrosoftADplugin		MicrosoftADplugin	F	2019-01-07 23:37:41	00:00:02	252	169.8 KiB	0.10 MiB/s	0	✔

Files usage

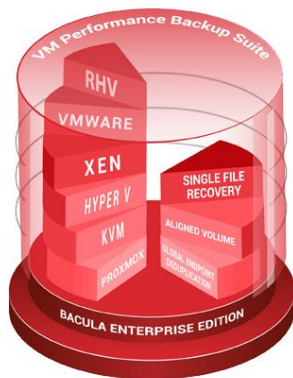
/ Size go go back



# Plugins



- VMware
- Hyper-v
- KVM
- Xen
- Proxmox
- RHEL/oVirt
- Nutanix\*



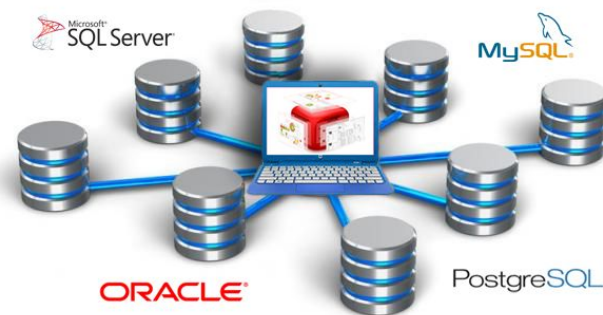
- ★ Backup sem Cliente
- ★ Auto-Descoberta de Novas Máquinas
- ★ Backup Diferencial no Nível de Bloco
- ★ Restauração Automática de VMs
- ★ Restauração granular de um arquivo
- ★ Instant Recovery

# Plugins



- MYSQL
- PostgreSQL
- Oracle DB
- SAP
- SAP Hana
- Sybase ASE
- MS SQL
- Active Directory
- LDAP
- MongoDB
- Hadoop
- DB2
- Cassandra\*

- ★ Auto-Descoberta de Novos Bancos
- ★ Backups Diferenciais e Incrementais
- ★ PITR / Archive Log
- ★ Restauração Granular e Automática
- ★ Backup de Clusters



# Plugins



- CDP (replicação de arquivo e VMs\*)
- Docker, Kubernetes, OpenShift
- Hadoop
- Bare Metal Linux e Windows  
*(restauração e migração de máquinas completas físicas/virtuais/nuvem)*
- Zimbra, MS Exchange
- Sharepoint
- VSS
- Office 365\*
- Snapshot Linux
- bpipe
- Delta
- NDMP
- Shared Storage SAN
- Incremental Netapp
- Cloud (Oracle, Amazon Glacier, Google, Azure, Swift e S3)



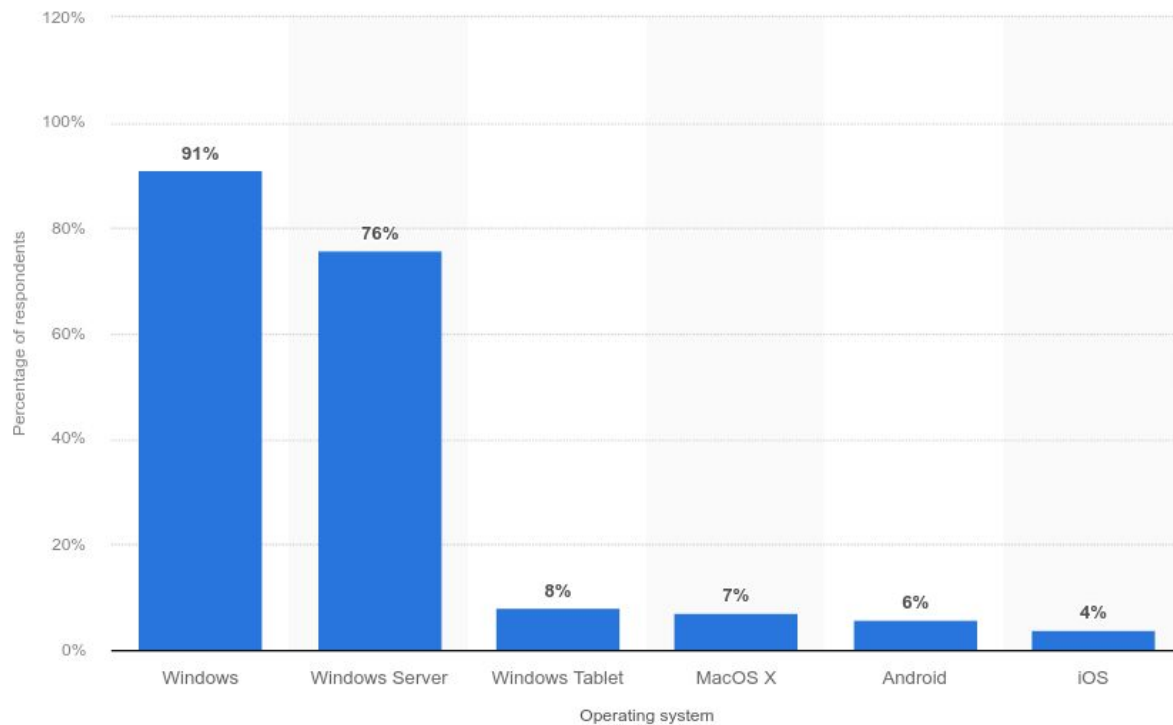


Figura 8. SOs que Usuários Reportaram Contaminação de Ransomware

1. In 2021, 100% of the world's top 500 supercomputers run on Linux.
2. Out of the top 25 websites in the world, only 2 aren't using Linux.
3. 96.3% of the world's top 1 million servers run on Linux.
4. 90% of all cloud infrastructure operates on Linux and practically all the best cloud hosts use it.

Ref.: <<https://hostingtribunal.com/blog/linux-statistics/>>



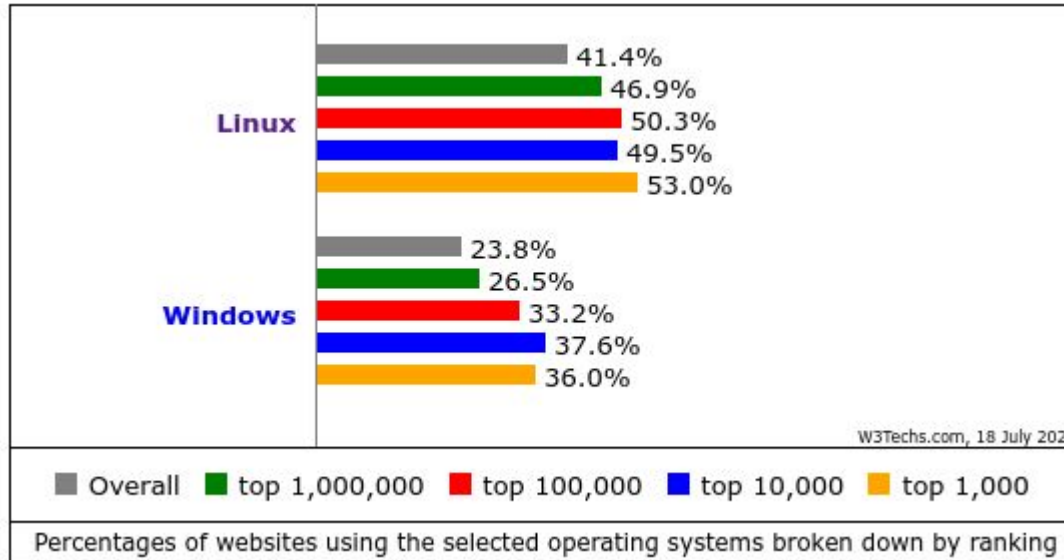


Figura 9. SO de Servidores WEB. Ref.:

<<https://w3techs.com/technologies/comparison/os-linux,os-windows>>



- ★ Bacula é pioneiro no Servidor primariamente em Linux, dentre os Líderes
- ★ Maior quantidade de plataformas Clientes, incluindo Windows, Mac OS, Linux, Unix, Android etc.



Figura 10. Clientes de Backup suportados pelo Bacula

# Regra 3-2-1



Using tape backup as part of an overall data management strategy allows use to follow best practices in data backup and compliance, specifically the widely known 3-2-1 rule, which is:

1. Maintain three separate copies of your data.
2. Store your data on at least two different types of storage media.
3. Keep one copy of your data in an off-site location.

Ref.:

<<https://searchstorage.techtarget.com/IronMountainCloud/A-New-Old-Weapon-Against-Ransomware-Tape-Backup>>

# Regra 3-2-1



- Suporte nativo desde a concepção de gravação direta em todas as fitas, cartuchos, VTL etc.
- Primeira a suportar driver de armazenamento em múltiplos provedores de Object Storage (**S3**, **Glacier**, **Oracle**, **Google**, **Azure**, **Swift** etc.).



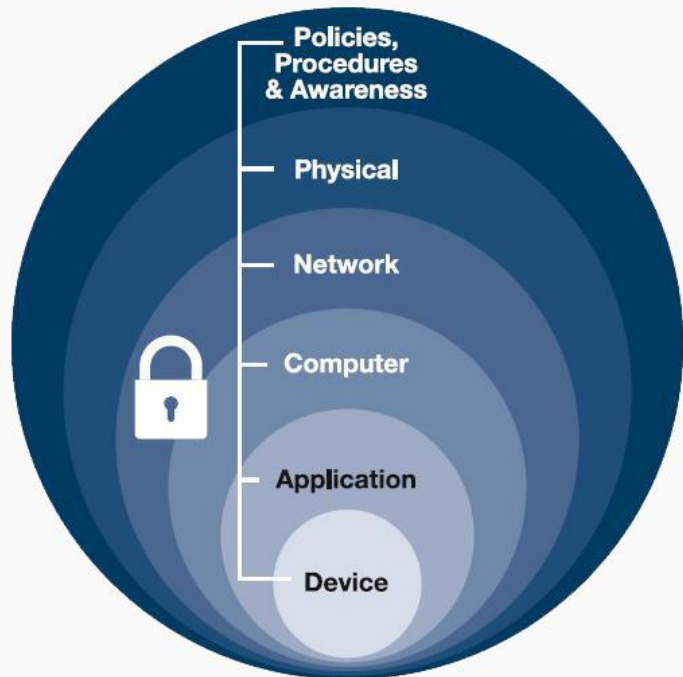
Figura 11. Plugins de Nuvem do Bacula

# Hardening



*Systems hardening is a collection of tools, techniques, and best practices to reduce vulnerability in technology applications, systems, infrastructure, firmware, and other areas. The goal of systems hardening is to reduce security risk by eliminating potential attack vectors and condensing the system's attack surface. By removing superfluous programs, accounts functions, applications, ports, permissions, access, etc. attackers and malware have fewer opportunities to gain a foothold within your IT ecosystem.*

Ref.: <<https://www.beyondtrust.com/resources/glossary/systems-hardening>>



- ★ Protocolos de conexão socket exclusivo e nunca violado. Todas comunicações criptografadas automaticamente com certificado FIPS.
- ★ Apenas o usuário bacula do sistema de arquivos precisa ter acesso de escrita nos volumes de backup em disco, fita, nuvem e catálogo de backup.

# Hardening



```
[root@enterprisebacula ~]# ls -lah /mnt/dedup/Dedup*  
-rw-r----- 1 bacula disk 4,7M Mai 4 18:01 /mnt/dedup/DedupArchive-0  
-rw-r----- 1 bacula disk 4,7M Mai 4 19:37 /mnt/dedup/DedupArchive-2-49  
-rw-r----- 1 bacula disk 4,8M Mai 4 19:47 /mnt/dedup/DedupArchive-2-50  
-rw-r----- 1 bacula disk 4,6M Mai 4 19:53 /mnt/dedup/DedupArchive-2-51  
-rw-r----- 1 bacula disk 4,2M Mai 4 20:10 /mnt/dedup/DedupArchive-2-52  
-rw-r----- 1 bacula disk 4,7M Mai 4 17:52 /mnt/dedup/DedupArchive-47  
-rw-r----- 1 bacula disk 14M Jun 8 11:11 /mnt/dedup/DedupDaily-0  
-rw-r----- 1 bacula disk 3,1M Jun 3 15:39 /mnt/dedup/DedupDaily-1  
-rw-r----- 1 bacula disk 215M Mai 4 15:37 /mnt/dedup/DedupDaily-10  
-rw-r----- 1 bacula disk 5,9M Mai 6 11:11 /mnt/dedup/DedupDaily-11  
-rw-r----- 1 bacula disk 5,0M Abr 6 11:10 /mnt/dedup/DedupDaily-12  
...
```

- ★ Possibilidade de imutabilizar os volumes de backups em disco ou em nuvem encerrados para gravação. Ex. disco:

```
# Seta o atributo imutável no volume de disco:  
chattr +i <volume_bacula>
```

```
# Remove o atributo imutável no volume de disco:  
chattr -i <volume_bacula>
```

```
# Arquivo sem flag de imutabilidade:
```

```
hfaria@hfaria-P65:/tmp$ lsattr arq
```

```
-----e----- arq
```

```
# Arquivo com flag de imutabilidade:
```

```
hfaria@hfaria-P65:/tmp$ lsattr arq
```

```
----i-----e----- arq
```

```
# Nesse estado nem o root pode alterar!
```

```
hfaria@hfaria-P65:/tmp$ sudo echo dados > arq
```

```
bash: arq: Operation not permitted
```



- ★ Esquema GFS com Pool Off-site. Ou uso de fitas WORM (Ref.: <<https://techmonitor.ai/technology/data/could-worm-help-build-local-govt-resilience-to-ransomware>>).

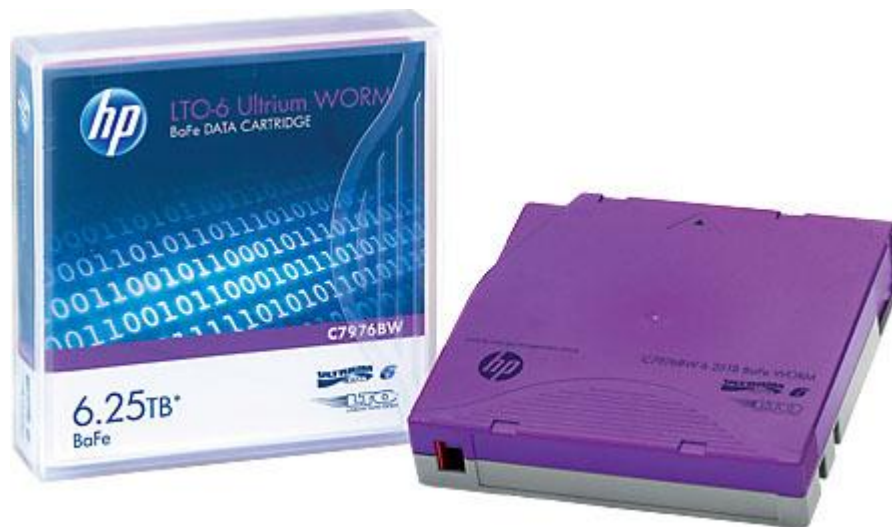


Figura 13. Foto de Fita WORM LTO-6

# Perguntas e Respostas





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