

FUJITSU Enterprise Postgres 14 for Kubernetes Reference Guide

Linux



Preface

Purpose of this document

This document is a reference, and explains parameter.

Intended readers

This document is aimed at people who manage and operate.

Readers of this document are also assumed to have general knowledge of:

- Linux
- Kubernetes
- Containers
- Operators

Structure of this document

This document is structured as follows:

[Chapter 1 Custom Resource Parameters](#)

Explains the parameter.

[Appendix A Default Metrics Queries](#)

Explains the Default Metrics Queries

[Appendix B Default Alert Rules](#)

Explains the Default Alert Rules

Abbreviations

The following abbreviations are used in this manual:

Full Name	Abbreviations
FUJITSU Software Enterprise Postgres for Kubernetes FUJITSU Software Enterprise Postgres	FEP or FUJITSU Enterprise Postgres
Transparent Data Encryption	TDE
Custom Resource	CR
Custom Resource Definition	CRD
Persistent Volume	PV

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Chapter 1 Custom Resource Parameters

This chapter explains the parameter.

1.1 FEPCluster Parameter

Equivalent Kubernetes command: `kubectl apply -f FEPClusterCR.yaml`

This operation will create a FEPCluster with supplied information in FEPClusterCR.yaml.

Initial configuration and subsequent changes to FEP Cluster are done through FEP Cluster CR.

Field	Default	Details
metadata.name	new-fep	Name for the Cluster. FEP server container will use this value for Patroni scope. e.g. new-fep
spec.fep.autoPodRestart	<omitted>	Optional This parameter affects the behaviour when value(s) of CPU, memory and/or image for FEP and/or optional Backup container are updated in FEPCluster CR. If it is NOT defined and set to True, operator will automatically create an action CR to make values effective by restarting all pods in an orderly fashion to minimise outage. If it is set to False, automatic restart of PoDs will NOT happen. To make the changes effective, user must restart pods by creating action CR with type 'pod_restart' and arguments 'ALL'
spec.fep.fepVersion	<omitted>	Optional When deploying a new FEP cluster, this parameter controls which FEP major version will be used for the deployment. If not specified, Operator will use latest FEP version supported by the Operator. When fepVersion is defined but not spec.fep.image.image, Operator will deploy the specific version of FEP. When both fepVersion and image are defined, Operator will use the image and discard the value of fepVersion. Current support value: 12, 13, 14 Note: Changing fepVersion from one version to another version is not supported after deployment.
spec.fep.customAnnotation.allDeployments	{ } (*)	Contents under this are optional. User can remove { } and add multiple key-value pairs. All of these pair will be

Field	Default	Details
		added to annotations of FEP statefulSet and FEP Pods. If left at default, no annotation is added to Pods and statefulSets
spec.fep.image.image	<omitted>	FEP server container image to be used quay.io/fujitsu-enterprise-postgres-14-server@ubi8-14-0.0 It is optional Image line is omitted by default. This key has a higher precedence than fepVersion. If both fepVersion and image are omitted, Operator will use the latest FEP version that it supports. If both fepVersion and image are specified, Operator will use the specified image and ignore the value in fepVersion.
spec.fep.image.pullPolicy	IfNotPresent	
spec.fep.mcSpec.limits	cpu: 500m memory: 700Mi	
spec.fep.mcSpec.requests	cpu: 200m memory: 512Mi	
spec.fep.sysExtraLogging	false	To turn extra debugging on, set value to true It can be turned on/off at any time
spec.fep.instances	1	Number of nodes in the cluster, including both Master and Replicas. In Example CR, it is kept at 1 for certification. However, user can change it to 3 for 1 master and 2 replicas.
spec.fep.servicePort	27500	TCP port for FEP master service
spec.fep.syncMode	off	Replication Mode: off - async replication on - sync replication
spec.fep.forceSsl	true	Controls that the communication to the server should only be via SSL. Changes are reflected in pg_hba.conf
spec.fep.locale	<omitted> (*)	Optional Can only be specified when creating a FEPCluster. Database Cluster Locale Settings: ja_JP - Japanese locale Default - C

Field	Default	Details
spec.fep.monitoring		This is an Optional section. This defines whether monitoring enabled(true) or disabled(false) , MTLT enabled or disabled & Basic authentication enabled or not
spec.fep.monitoring.enable	false	If set true, the operator will create FEPEXporter with given spec
spec.fep.monitoring.fepExporter		This is Optional section. Exporter spec section applied only if enable: true
spec.fep.monitoring.fepExporter.authSecret		This is Optional section. Base Authentication secret to provide username & encrypted password of user
spec.fep.monitoring.fepExporter.authSecret.secretName	(created by user)	Mandatory Name of secret that contains username and password
spec.fep.monitoring.fepExporter.authSecret.userKey	(created by user)	Mandatory Key of username in specified secret
spec.fep.monitoring.fepExporter.authSecret.passwordKey	(created by user)	Mandatory Key of password in specified secret
spec.fep.monitoring.fepExporter.tls		This is optional section. FEPEXporter MTLT specs. Mandatory if tls specs defined for Prometheus specs
spec.fep.monitoring.fepExporter.tls.certificateName	(created by user)	Mandatory.This points to Kubernetes TLS secret that contains the certificate of FepExporter. Prometheus will use this for certificate authentication. The certificate itself is stored in the key tls.crt.
spec.fep.monitoring.fepExporter.tls.caName	(created by user)	Mandatory This points to Kubernetes configmap that contains additional CA the client use to verify a server certificate. The CA is stored in the key ca.crt.
spec.fep.monitoring.prometheus		This is Optional section. Prometheus specs are mandatory if tls specs defined for FEPEXporter
spec.fep.monitoring.prometheus.tls		Prometheus MTLT specs
spec.fep.monitoring.prometheus.tls.certificateName	(created by user)	This is an Optional parameter. These points to Kubernetes TLS secret that contains the certificate of Prometheus. FEPEXporter will use this for certificate authentication. The certificate itself is stored in the key tls.crt.
spec.fep.monitoring.prometheus.tls.caName	(created by user)	This is an Optional parameter. This point to Kubernetes configmap that contains additional CA the client use to verify a server certificate. The CA is stored in the key ca.crt.

Field	Default	Details
spec.fep.podAntiAffinity	false	Defines that all the pods should not run on same worker node
spec.fep.podDisruptionBudget	false	Allows to maintain minimum number of pods of an application even when some nodes are voluntarily drained for say, maintenance
spec.fep.replicationSlots		List of Patroni permanent replication slots.
spec.fep.replicationSlots.demo_subscription1		The 'demo_subscription1' is the slot name. This name cannot be same as any pod name (e.g., new-fep-sts-01) in the cluster. Otherwise, the slot will not be created.
spec.fep.replicationSlots.type	logical	Must be 'logical' for logical replication
spec.fep.replicationSlots.database	postgres	Specify the database name for logical replication
spec.fep.replicationSlots.plugin	pgoutput	FEP supports 'pgoutput' by default.
spec.fep.usePodName		Optional Setting this key to true will make internal POD communication, both Patroni and Postgres to use hostname, instead of IP address. This is important for TLS as the hostname of the POD is predictable and can be used to create Server Certificate, whereas IP address is unpredictable and cannot be used to create Certificate. There is no negative effect setting this key to true even if TLS (i.e. Server Certificate) is not used.
spec.fep.patroni.tls.certificateName	(created by user)	Optional This point to Kubernetes TLS secret that contains the certificate for Patroni. The certificate itself is stored in the key tls.crt. This field is optional. When this key is set, the Operator will ignore the value in systemCertificates
spec.fep.patroni.tls.caName	(created by user)	Optional This points to Kubernetes configmap that contains additional CA for Patroni to verify client. The CA is stored in the key ca.crt. This field is optional.
spec.fep.postgres.tls.certificateName	(created by user)	Optional This points to Kubernetes TLS secret that contains the certificate for Postgres. The certificate itself is stored in the key tls.crt. This field is optional. When this key is set, Operator will ignore the value in systemCertificates
spec.fep.postgres.tls.caName	(created by user)	Optional This point to Kubernetes configmap that contains additional CA for Postgres to

Field	Default	Details
		verify client. The CA is stored in the key ca.crt. This field is optional.
spec.fep.postgres.tls.privateKeyPassword	(created by user)	Optional This points to Kubernetes secret that contains the password for the above private key. This field is optional.
spec.fep.pgBadger.schedules.create		The 'create' schedule to create report and upload it to endpoint
spec.fep.pgBadger.schedules.cleanup		The 'cleanup' schedule to delete the report left in container
spec.fep.pgBadger.options.incremental	false	Default: false; When set to True: create incremental report in pgbadger
spec.fep.pgBadger.endpoint.authentication		a secret to contain authentication info to access endpoint support basic auth only
spec.fep.pgBadger.endpoint.customCertificateName		Client certificate reference in customCertificate CR
spec.fep.pgBadger.endpoint.fileUploadParameter		The file upload parameter defined by the web server Default: 'file'
spec.fep.pgBadger.endpoint.insecure		equivalent to curl -insecure option, default to false
spec.fep.pgBadger.endpoint.url		Web server url to upload the report file
spec.fepChildCrVal.customCertificates		Optional This is an optional parameter, which comprises of the parameters mentioned below. It is an array of elements to define certificates. Used to setup SSL connection between publisher and subscriber clusters for logical replication
spec.fepChildCrVal.customCertificates.userName		Optional This should be the username of the publisher database. When this parameter is specified, an empty folder is created under FEP Server Container- /tmp/custom_certs/<username>. The custom certificates are mounted in this empty folder. However, if this parameter is not specified, the section is ignored and folder is not created; hence the certificates are not mounted without it.
spec.fepChildCrVal.customCertificates.certificateName	(created by user)	Optional This points to Kubernetes TLS secret that contains the custom certificate. The certificate itself is stored in the key tls.crt.
spec.fepChildCrVal.customCertificates.caName	(created by user)	Optional This points to Kubernetes configmap

Field	Default	Details
		that contains CA certificate to verify server. The CA is stored in the key ca.crt.
spec.fepChildCrVal.backup		Optional This section is defined to enable febackup sidecar for cluster backup feature.
spec.fepChildCrVal.backup.image.image	<omitted>	FEP backup container image to be used quay.io/fujitsu/fujitsu-enterprise-postgres-13-backup@ubi8-13-0.0 It is optional. Image line is omitted by default. In such a case, it will pick up URL of image from operator container environment. If you specify the image, Operator will take that image to deploy backup container
spec.fepChildCrVal.backup.image.pullPolicy	IfNotPresent	
spec.fepChildCrVal.backup.mcSpec.limits	cpu: 0.2 memory: "300Mi"	
spec.fepChildCrVal.backup.mcSpec.requests	cpu: 0.1 memory: "200Mi"	
spec.fepChildCrVal.backup.pgbackrestParams	[global] repo1-retention-full=7 repo1-retention-full-type=time log-path=/database/log/backup	" " When nothing is specified, and the parameter set in pgbackrest.conf is described from the line below.
spec.fepChildCrVal.backup.pgbackrestKeyParams		Optional " " is fixed, and the following line describes the parameters to be set in pgbackrest.conf. The value described by this parameter is masked with *****.
spec.fepChildCrVal.backup.caName		Optional Set to use a CA file other than the system default. Specifies the name of the Configmap you created.
spec.fepChildCrVal.backup.repoKeySecretName		Optional Specifies the name of the Kubernetes Secret generated from the object storage key file. Specify in array format.
spec.fepChildCrVal.backup.schedule.num	0	Number of schedules to set The maximum number of backup schedules is 5.
spec.fepChildCrVal.backup.scheduleN.schedule	" "	Backup schedule in cron format.

Field	Default	Details
		The date and time is UTC time.
spec.fepChildCrVal.backup.scheduleN.type	" "	full: Perform a full backup (Back up the contents of the database cluster). incr – Perform an incremental backup (Back up only the database cluster files that were changed to the last backup migration).
spec.fepChildCrVal.backup.scheduleN.repo	1	Optional Gets a backup in the specified repository. The range is 1 to 256.
spec.fepChildCrVal.customCertificates		List of custom certificates.
spec.fepChildCrVal.customCertificates.userName		The username of the certificates. It is also the folder name in container to store the certificate files If not defined, the item on the list will be ignored.
spec.fepChildCrVal.customCertificates.certificateName		The secret name which contains the certificate files If not defined, a folder to store the certificate files will still be created by the name defined in spec.fepChildCrVal.customCertificates.userName
spec.fepChildCrVal.customCertificates.caName		The configmap of CA certificate
spec.fepChildCrVal.customCertificates.privateKeyPassword		The secret which contains the certificate key password
spec.fepChildCrVal.customPgAudit	[output] logger = 'auditlog' log_directory = '/database/log/audit' log_truncate_on_rotation = on log_filename = 'pgaudit-%a.log' log_rotation_age = 1d log_rotation_size = 0 [rule]	PgAudit file content
spec.fepChildCrVal.customPgHba	# define pg_hba custom rules here to be merged with default rules. # TYPE DATABASE USER ADDRESS METHOD	Entries to be inserted into pg_hba.conf
spec.fepChildCrVal.customPgParams	# define custom postgresql.conf parameters below to override defaults. # Current values are as per default FEP deployment	Postgres configuration in postgresql.conf

Field	Default	Details
	<pre> shared_preload_libraries='pgx_datamas king,pg_prewarm,pg_stat_statements' session_preload_libraries='pg_prewarm' max_prepared_transactions = 100 max_worker_processes = 30 max_connections = 100 work_mem = 1MB maintenance_work_mem = 12MB shared_buffers = 128MB effective_cache_size = 384MB checkpoint_completion_target = 0.8 # tcp parameters tcp_keepalives_idle = 30 tcp_keepalives_interval = 10 tcp_keepalives_count = 3 # logging parameters in default fep installation # if log volume is not defined, log_directory should be # changed to '/database/userdata/data/log' log_directory = '/database/log' log_filename = 'logfile-%a.log' log_file_mode = 0600 log_truncate_on_rotation = on log_rotation_age = 1d log_rotation_size = 0 log_checkpoints = on log_line_prefix = '%e %t [%p]: [%l-1] user=%u,db=%d,app=%a,client=%h' log_lock_waits = on log_autovacuum_min_duration = 60s logging_collector = on pgaudit.config_file='/opt/app-root/src/ pgaudit-cfg/pgaudit.conf' log_replication_commands = on log_min_messages = WARNING log_destination = stderr # wal_archive parameters in default fep installation archive_mode = on </pre>	

Field	Default	Details
	archive_command = 'pgbackrest --stanza=backupstanza --config=/database/userdata/pgbackrest.conf archive-push %p' wal_level = replica max_wal_senders = 12 wal_keep_segments = 64 track_activities = on track_counts = on	
spec.fepChildCrVal.storage.dataVol		Mandatory volume
spec.fepChildCrVal.storage.dataVol.size	2Gi (**)	Size of data volume. Data volume must be specified
spec.fepChildCrVal.storage.dataVol.storageClass	<omitted> (*)	StorageClass for data volume: When this line is omitted, the PV created will use default storage class in the Kubernetes cluster
spec.fepChildCrVal.storage.dataVol.accessModes	<omitted> (*)	accessModes for data volume: Specified as an array of accessModes e.g. [ReadWriteMany] If omitted, it will be treated as [ReadWriteOnce]
spec.fepChildCrVal.storage.walVol		Mandatory volume
spec.fepChildCrVal.storage.walVol.size	1200Mi (**)	Size of WAL volume. WAL volume must be specified
spec.fepChildCrVal.storage.walVol.storageClass	<omitted> (*)	StorageClass for WAL volume: When this line is omitted, the PV created will use default storage class in the Kubernetes cluster
spec.fepChildCrVal.storage.walVol.accessModes	<omitted> (*)	accessModes for WAL volume: Specified as an array of accessModes e.g. [ReadWriteMany] If omitted, it will be treated as [ReadWriteOnce]
spec.fepChildCrVal.storage.tablespaceVol		Optional volume
spec.fepChildCrVal.storage.tablespaceVol.size	512Mi (**)	Size of tablespace volume. This volume is optional and can be omitted
spec.fepChildCrVal.storage.tablespaceVol.storageClass	<omitted> (*)	StorageClass for tablespace volume: When this line is omitted, the PV created will use default storage class in the Kubernetes cluster
spec.fepChildCrVal.storage.tablespaceVol.accessModes	<omitted> (*)	accessModes for tablespace volume:

Field	Default	Details
		Specified as an array of accessModes e.g. [ReadWriteMany] If omitted, it will be treated as [ReadWriteOnce]
spec.fepChildCrVal.storage.archivewalVol		Mandatory if backup section is defined. Optional otherwise
spec.fepChildCrVal.storage.archivewalVol.size	1Gi (**)	Size of archivewal volume. This volume is optional and can be omitted
spec.fepChildCrVal.storage.archivewalVol.storageClass	<omitted> (*)	StorageClass for Archived WAL volume: When this line is omitted, the PV created will use default storage class in the Kubernetes cluster When the number of instance is more than 1 and backup is not done on S3, both archivewalVol and backupVol must be hosted on Shared storage such as NFS with respective storageClass
spec.fepChildCrVal.storage.archivewalVol.accessModes	<omitted> (*)	accessModes for Archived WAL volume: Specified as an array of accessModes e.g. [ReadWriteMany] If omitted, it will be treated as [ReadWriteOnce] When the number of instance is more than 1 and backup is not done on S3, both archivewalVol and backupVol must be hosted on Shared storage such as NFS with accessMode set to [ReadWriteMany]
spec.fepChildCrVal.storage.logVol		Optional volume
spec.fepChildCrVal.storage.logVol.size	1Gi (**)	Size of log volume. This volume is optional and can be omitted
spec.fepChildCrVal.storage.logVol.storageClass	<omitted> (*)	StorageClass for log volume: When this line is omitted, the PV created will use default storage class in the Kubernetes cluster
spec.fepChildCrVal.storage.logVol.accessModes	<omitted> (*)	accessModes for log volume: Specified as an array of accessModes e.g. [ReadWriteMany] If omitted, it will be treated as [ReadWriteOnce]
spec.fepChildCrVal.storage.backupVol		Mandatory if backup section is defined. Optional otherwise

Field	Default	Details
spec.fepChildCrVal.storage.backupVolume.size	2Gi (**)	Size of backup volume. This volume is optional and can be omitted
spec.fepChildCrVal.storage.backupVolume.storageClass	<omitted> (*)	StorageClass for backup volume: When this line is omitted, the PV created will use default storage class in the Kubernetes cluster When the number of instance is more than 1 and backup is not done on S3, both archivalVol and backupVol must be hosted on Shared storage such as NFS with respective storageClass
spec.fepChildCrVal.storage.backupVolume.accessModes	<omitted> (*)	accessModes for backup volume: Specified as an array of accessModes e.g. [ReadWriteMany] If omitted, it will be treated as [ReadWriteOnce] When the number of instance is more than 1 and backup is not done on S3, both archivalVol and backupVol must be hosted on Shared storage such as NFS with accessMode set to [ReadWriteMany]
spec.fepChildCrVal.sysUsers.pgAdminPassword	admin-password	Password for user "postgres"
spec.fepChildCrVal.sysUsers.pgdb	mydb (*)	Database to be created during provisioning
spec.fepChildCrVal.sysUsers.pguser	mydbuser (*)	Database user to be created during provisioning
spec.fepChildCrVal.sysUsers.pgpassword	mydbpassword	Password for database user pguser
spec.fepChildCrVal.sysUsers.pgrepluser	repluser (*)	Database user for replication
spec.fepChildCrVal.sysUsers.pgreplpassword	repluserpwd	Password for database user repluser
spec.fepChildCrVal.sysUsers.tdepassphrase	tde-passphrase	TDE keystore passphrase
spec.fepChildCrVal.sysUsers.pgRewindUser	rewind_user	Database user for Rewind
spec.fepChildCrVal.sysUsers.pgRewindUserPassword	rewind_password	Password for database user rewinduser
spec.fepChildCrVal.sysUsers.pgMetricsUser		Optional user for FEPEXporter connection. Can be defined afterwards
spec.fepChildCrVal.sysUsers.pgMetricsUserPassword		Optional

Field	Default	Details
		Password for metrics user. Can be defined afterwards
spec.fepChildCrVal.sysUsers.pgAdminTls.certificateName		This points to Kubernetes TLS secret that contains the certificate of Postgres user "postgres". Patroni will use this for certificate authentication. The certificate itself is stored in the key tls.crt. This field is optional.
spec.fepChildCrVal.sysUsers.pgAdminTls.caName		This points to Kubernetes configmap that contains additional CA the client use to verify a server certificate. The CA is stored in the key ca.crt. This field is optional.
spec.fepChildCrVal.sysUsers.pgAdminTls.sslMode	prefer	Specify the type of TLS negotiation with the server. <ul style="list-style-type: none"> - disable - allow - prefer - require - verify-ca - verify-full
spec.fepChildCrVal.sysUsers.pgreplUserTls.certificateName		This points to Kubernetes TLS secret that contains the certificate of Postgres user "repluser". Patroni will use this for certificate authentication. The certificate itself is stored in the key tls.crt. This field is optional.
spec.fepChildCrVal.sysUsers.pgreplUserTls.caName		This points to Kubernetes configmap that contains additional CA the client use to verify a server certificate. The CA is stored in the key ca.crt. This field is optional.
spec.fepChildCrVal.sysUsers.pgreplUserTls.sslMode	prefer	Specify the type of TLS negotiation with the server. <ul style="list-style-type: none"> - disable - allow - prefer - require - verify-ca - verify-full
spec.fepChildCrVal.sysUsers.pgRewindUserTls.certificateName		This points to Kubernetes TLS secret that contains the certificate of Postgres user "rewinduser". Patroni will use this for certificate authentication. The certificate itself is stored in the key tls.crt. This field is optional.

Field	Default	Details
spec.fepChildCrVal.sysUsers.pgRewindUserTls.caName		This points to Kubernetes configmap that contains additional CA the client use to verify a server certificate. The CA is stored in the key ca.crt. This field is optional.
spec.fepChildCrVal.sysUsers.pgRewindUserTls.sslMode	prefer	Specify the type of TLS negotiation with the server. <ul style="list-style-type: none"> - disable - allow - prefer - require - verify-ca - verify-full
spec.fepChildCrVal.sysUsers.pgMetricsUserTls.certificateName		Optional This points to Kubernetes TLS secret that contains the certificate of Postgres user defined by pgMetricsUser. FEPEXporter will use this for certificate authentication. The certificate itself is stored in the key tls.crt.
spec.fepChildCrVal.sysUsers.pgMetricsUserTls.caName		Optional This points to Kubernetes configmap that contains additional CA the client use to verify a server certificate. The CA is stored in the key ca.crt.
spec.fepChildCrVal.sysUsers.pgMetricsUserTls.sslMode	prefer	Optional Specify the type of TLS negotiation when FEPEXporter connects to FEP server. <ul style="list-style-type: none"> - disable - allow - prefer - require - verify-ca - verify-full
spec.fepChildCrVal.systemCertificates.key		Use spec.fep.postgres.tls specification instead.
spec.fepChildCrVal.systemCertificates.crt		Use spec.fep.postgres.tls specification instead.
spec.fepChildCrVal.systemCertificates.cacrt		Use spec.fep.postgres.tls specification instead.
spec.fepChildCrVal.autoscale.scaleout.policy	off	Specifies whether to use the automatic scale out feature and the metric to base on. Specify one of the following:

Field	Default	Details
		<ul style="list-style-type: none"> - cpu_utilization (if based on CPU utilization) - connection_number (if based on number of connections) - off (without automatic scale out) <p>If omitted, off is assumed.</p>
spec.fepChildCrVal.autoscale.scaleout.threshold	40	<p>Specifies an integer as the threshold for performing scale out.</p> <ul style="list-style-type: none"> - When cpu_utilization is specified for policy Specifies the average CPU utilization as a percentage for the threshold. If this option is omitted, 40 (40%) is assumed. - When connection_number is specified for policy Specifies the average value of the number of connections as a threshold. If you omit this option, 40 is assumed.
spec.fepChildCrVal.autoscale.scaleout.metricName	pg_capacity_connection_average	<p>Specify this parameter if policy is connection_number. Ignored if policy is cpu_utilization.</p> <p>The custom metrics server must publish the average number of connections in the FEP cluster under this name.</p> <p>If omitted, pg_capacity_connection_average is assumed.</p>
spec.fepChildCrVal.autoscale.scaleout.stabilizationWindowSeconds	0	<p>This parameter controls the stability of scaling (variation in the number of replicas). Scale out is not performed unless the metric exceeds the threshold for more than the number of seconds specified for this parameter.</p> <p>If omitted, 0 is assumed.</p>
spec.fepChildCrVal.autoscale.limits.maxReplicas	2	<p>Maximum number of replicas (0 to 15)</p> <p>(Value out of range)</p> <p>Do not perform auto scale out</p>
spec.fepChildCrVal.restore		<p>Optional</p> <p>Defines to restore specified backup data stored in object storage.</p>
spec.fepChildCrVal.restore.pgbackrestParams		<p>Optional</p> <p>" " is fixed, and the following line describes the parameters to be set in pgbackrest.conf.</p> <p>Specifies the object storage where the backup data is stored.</p> <p>If you need to use a root certificate other than the default, specify the following:</p>

Field	Default	Details
		<p>repo1-storage-ca-path =/pgbackrest/ storage-certs/filename</p> <p>The CA file is registered in ConfigMap and the ConfigMap name is listed in spec.fepChildCrVal.restore.caName.</p>
spec.fepChildCrVal.restore.pgbackrestKeyParams		<p>Optional</p> <p>" " is fixed, and the following line describes the parameters to be set in pgbackrest.conf. The value described by this parameter is masked with *****. Specify the parameter you want to mask, such as a password.</p>
spec.fepChildCrVal.restore.caName		<p>Optional</p> <p>Set to use a CA file other than the system default.</p> <p>Specifies the name of the ConfigMap created, in list format.</p> <p>The ConfigMap specified is mounted in /pgbackrest/storage-certs.</p>
spec.fepChildCrVal.restore.repoKeySecretName		<p>Optional</p> <p>Specifies the name of the Kubernetes Secret generated from the object storage key file.</p> <p>Specify in array format. The specified Secret will be mounted in /pgbackrest/storage-key.</p>
spec.fepChildCrVal.restore.mcSpec.limits	<p>cpu: 200m</p> <p>memory: 300Mi</p>	<p>Optional</p> <p>CPU and memory allocated to the container performing the restore</p>
spec.fepChildCrVal.restore.mcSpec.requests	<p>cpu: 100m</p> <p>memory: 200Mi</p>	<p>Optional</p> <p>CPU and memory allocated to the container performing the restore</p>
spec.fepChildCrVal.restore.restoretype	latest	<p>Optional</p> <p>Select the type of restore (latest or PITR).</p>
spec.fepChildCrVal.restore.restoredate		<p>Optional</p> <p>Specifies the date to restore when spec.fepChildCrVal.restore.restoretype is "PITR".</p>
spec.fepChildCrVal.restore.restoretime		<p>Optional</p> <p>Specifies the time to restore when spec.fepChildCrVal.restore.restoretype is "PITR".</p>
spec.fepChildCrVal.restore.image		<p>Optional</p> <p>Image of the container to perform the restore</p>

Field	Default	Details
		It is omitted by default. In this case, the URL for image is obtained from the operator container environment.
spec.fepChildCrVal.restore.imagePullPolicy	IfNotPresent	Optional
spec.fepChildCrVal.upgrade		Optional When this field is defined, a major version upgrade is performed. However, if spec.fepChildCrVal.restore is defined, the FEPCluster build stops.
spec.fepChildCrVal.upgrade.sourceCluster		Specifies the FEPClusterCR name from which to migrate data. Required if spec.fepChildCrVal.upgrade is defined.
spec.fepChildCrVal.upgrade.mcSpec.limits	cpu: 200m memory: 300Mi	Optional Specifies the maximum number of resources to allocate to the upgrade execution container.
spec.fepChildCrVal.upgrade.mcSpec.requests	cpu: 100m memory: 200Mi	Optional Specifies the lower limit of resources allocated to the upgrade execution container.
spec.fepChildCrVal.upgrade.image		Optional By default, the URL of image is obtained from the operator container environment.
spec.fepChildCrVal.upgrade.imagePullPolicy	IfNotPresent	Optional Specifies the pull policy for the container image. <ul style="list-style-type: none">- Always- IfNotPresent- Never
spec.fepChildCrVal.upgrade.source.pgAdminTls.certificateName		Optional If you do not define spec.fepChildCrVal.sysUsers.pgAdminTls.certificateName for the data source, it points to the Kubernetes TLS secret that contains the certificate for the Postgres user "postgres" in the data source. If the data source FEP has set the authentication method for the upgrade execution container to "cert", then the upgrade execution container uses the certificate defined as secret.
spec.fepChildCrVal.upgrade.destination.pgAdminTls.certificateName		Optional

Field	Default	Details
		<p>If you have not defined the <code>spec.fepChildCrVal.sysUsers.pgAdminTls.certificateName</code> of the newly created FEPCluster, it points to the Kubernetes TLS secret that contains the certificate of the Postgres user "postgres" in the data source.</p> <p>If you create a new FEP with the "cert" authentication method for the upgrade execution container, the upgrade execution container uses the certificate defined as secret.</p>
<code>spec.fepChildCrVal.upgrade.storage</code>		<p>Optional</p> <p>Defines the storage for storing dump files.</p>
<code>spec.fepChildCrVal.upgrade.storage.storageClass</code>		<p>Optional</p> <p>If omitted, the default storage class for your environment is used.</p>
<code>spec.fepChildCrVal.upgrade.storage.size</code>	2Gi	<p>Optional</p> <p>Specifies the size of the storage to store the dump file.</p>
<code>spec.fepChildCrVal.upgrade.storage.accessModes</code>	ReadWriteOnce	<p>Optional</p> <p>accessModes for store the dump file</p> <p>Specified as an array of accessModes e.g. [ReadWriteMany]</p> <p>If omitted, it will be treated as [ReadWriteOnce]</p>
<code>spec.fepLogging.image.image</code>		<p>Optional</p> <p>Fluentd Image of FEPLogging</p>
<code>spec.fepLogging.image.pullPolicy</code>	IfNotPresent	Fluentd Image pull policy of FEPLogging
<code>spec.fepLogging.mcSpec.limits.cpu</code>	500m	Max CPU allocated to fluentd container
<code>spec.fepLogging.mcSpec.limits.memory</code>	700Mi	Max memory allocated to fluentd container
<code>spec.fepLogging.mcSpec.requests.cpu</code>	200m	CPU allocation at start for fluentd container
<code>spec.fepLogging.mcSpec.requests.memory</code>	512Mi	Memory allocation at start for fluentd container
<code>spec.fepLogging.sysExtraLogging</code>	true	To turn on extra debugging messages for operator, set value to true. It can be turned on/off at any time
<code>spec.fepLogging.restartRequired</code>		To restart FEPLogging instance for applying any new configuration for example after certificate rotation
<code>spec.fepLogging.scrapeInterval</code>		Optional

Field	Default	Details
		Scrape interval for Prometheus to fetch metrics from FEPLogging instance
spec.fepLogging.scrapeTimeout		Optional Scrape Timeout for Prometheus to fetch metrics from FEPLogging instance
spec.fepLogging.elastic.host		Optional Target Elasticsearch host name
spec.fepLogging.elastic.port		Optional Target Elasticsearch port number
spec.fepLogging.elastic.authSecret.secretName		Optional Secret name which contains Elasticsearch authentication username & password
spec.fepLogging.elastic.authSecret.usernameKey		Optional Username key specified in Elasticsearch authentication secret
spec.fepLogging.elastic.authSecret.passwordKey		Optional Password key specified in Elasticsearch authentication secret
spec.fepLogging.elastic.logstashPrefix		Optional Logstash prefix to differentiate index pattern in elastic search. Default value is postgres
spec.fepLogging.elastic.scheme		Optional Connection scheme between FEPLogging & Elasticsearch. Possible options http & https
spec.fepLogging.elastic.sslVerify		Optional Set to true if you want to verify ssl certificate. If set to false then will not consider TLS certificate
spec.fepLogging.elastic.tls.certificateName		Optional Kubernetes secret name which holds fluentd certificate
spec.fepLogging.elastic.tls.caName		Optional Kubernetes configmap which holds cacert of Elasticsearch to verify Elasticsearch TLS connection
spec.fepLogging.tls.certificateName		Optional Kubernetes secret name which holds Fluentd certificate
spec.fepLogging.tls.caName		Optional Kubernetes configmap which holds cacert of Fluentd to configure MTLS between FEPLogging & Prometheus

Field	Default	Details
spec.prometheus.tls.certificateName		Optional Kubernetes secret name which holds Prometheus certificate
spec.prometheus.tls.caName		Optional Kubernetes configmap which holds cacert of Fluentd to configure MTLS between FEPLogging & Prometheus

Note

- (*) - These parameters can be specified only at creation time and should not be changed. Any change to these parameters will be ignored and will not have any effect on FEP cluster functioning.
- (**) - The storage volumes size can be increased provided underlying storage supports the operation. Optional volumes can be specified only at initial FEP cluster creation. If an optional volume is added later, operator will ignore it and no action will be taken.
- User should do or remove unsupported CR changes manually.
- spec.fep.postgres.tls CR specification should be used instead of spec.fepChildCrVal.systemCertificates. The lateral spec can still be used, however spec.fep.postgres.tls gives better flexibility to control MTLS access of the cluster.
- Either spec.fep.postgres.tls specification (old specification) or spec.fepChildCrVal.systemCertificates should be used. They should not be used interchangeable.
- Server certificate specified under spec.fep.postgres.tls can be rotated by changing the secret and executing reload (e.g. using FEPAAction); however for others specified in the CR, it is required to do restart of the PoDs

While in running state - following value will dynamically appear in the FEPCluster to reflect the cluster status

Field name	Details
status.fepStatus.fepClusterReady	Will be true or false to reflect if the whole cluster is ready. Kubernetes cluster information is fetched to check number of instances 'READY' & 'RUNNING' is equal to number of Configured instances.

Note

"fepClusterReady" flag will be set at first FEPCluster creation time only. fepClusterReady flag does not participate in the next reconciliation loop)

1.2 Custom Resource Parameters

This section explains the Custom Resource Parameters.

1.2.1 FEPCluster Custom Resource Parameters

Category	Details
CRD Name	FEPCluster
Definition	<pre> apiVersion: apiextensions.k8s.io/v1 kind: CustomResourceDefinition metadata: name: FEPClusters.fep.fujitsu.io spec: </pre>

Category	Details
	<pre> group: fep.fujitsu.io names: kind: FEPCluster listKind: FEPClusterList plural: fepclusters singular: fepcluster shortNames: - fac scope: Namespaced conversion: strategy: None versions: - name: v2 served: true storage: true schema: openAPIV3Schema: description: FEPCluster is the Schema for the fepclusters API properties: apiVersion: description: 'APIVersion defines the versioned schema of this representation of an object. Servers should convert recognized schemas to the latest internal value, and may reject unrecognized values. More info: https://git.k8s.io/community/ contributors/devel/sig-architecture/api- conventions.md#resources' type: string kind: description: 'Kind is a string value representing the REST resource this object represents. Servers may infer this from the endpoint the client submits requests to. Cannot be updated. In CamelCase. More info: https://git.k8s.io/community/ contributors/devel/sig-architecture/api- conventions.md#types-kinds' type: string metadata: type: object spec: description: Spec defines the desired state of FEPCluster type: object x-kubernetes-preserve-unknown-fields: true status: description: Status defines the observed state of FEPCluster type: object x-kubernetes-preserve-unknown-fields: true type: object subresources: status: {} </pre>
Operations	<pre> Create: kubectl create -f fepcluster.yaml Delete: kubectl delete fepcluster <clusername> Update: kubectl apply -f fepcluster.yaml List: kubectl get fepcluster </pre>

FEPCluster CR Example

```
apiVersion: fep.fujitsu.io/v2
kind: FEPCluster
metadata:
  name: new-fep
  namespace: new-fep
spec:
  fep:
    forceSsl: true
    image:
      image: 'quay.io/fujitsu/fep-server-test:ubi8-patroni_72'
      pullPolicy: IfNotPresent
    mcSpec:
      limits:
        cpu: 500m
        memory: 700Mi
      requests:
        cpu: 200m
        memory: 512Mi
    podAntiAffinity: true
    podDisruptionBudget: true
    instances: '3'
    servicePort: 27500
    syncMode: 'on'
    sysExtraLogging: false
    replicationSlots: |
      demo_subscription1:
        type: logical
        database: postgres
        plugin: pgoutput
      demo_subscription2:
        type: logical
        database: postgres
        plugin: pgoutput
      demo_subscription3:
        type: logical
        database: postgres
        plugin: pgoutput
  fepChildCrVal:
    customCertificates:
      - userName: my_cert_folder1
        certificateName: my_cert1_secret
        caName: my_ca_configmap
        privateKeyPassword: my_cert1_key_secret
      - userName: my_cert_folder2
        certificateName: my_cert2_secret
        caName: my_ca2_configmap
        privateKeyPassword: my_cert2_key_secret
    customPgAudit: |
      # define pg audit custom params here to override defaults.
      # if log volume is not defined, log_directory should be
      # changed to '/database/userdata/data/log'
      [output]
      logger = 'auditlog'
      log_directory = '/database/log/audit'
      log_truncate_on_rotation = on
      log_filename = 'pgaudit-%a.log'
      log_rotation_age = 1d
      log_rotation_size = 0
      [rule]
```

```

customPgHba: |
  # define pg_hba custom rules here to be merged with default rules.
  # TYPE      DATABASE      USER      ADDRESS      METHOD

customPgParams: |+
  # define custom postgresql.conf parameters below to override defaults.
  # Current values are as per default FEP deployment
  shared_preload_libraries='pgx_datamasking,vci,pgaudit,pg_prewarm, pg_stat_statements'
  session_preload_libraries='vci,pg_prewarm'
  max_prepared_transactions = 100
  max_worker_processes = 30
  max_connections = 100
  work_mem = 1MB
  maintenance_work_mem = 12MB
  shared_buffers = 128MB
  effective_cache_size = 384MB
  checkpoint_completion_target = 0.8
  pgx_global_metacache = 10MB

  # tcp parameters
  tcp_keepalives_idle = 30
  tcp_keepalives_interval = 10
  tcp_keepalives_count = 3

  # logging parameters in default fep installation
  # if log volume is not defined, log_directory should be
  # changed to '/database/userdata/data/log'
  log_directory = '/database/log'
  log_filename = 'logfile-%a.log'
  log_file_mode = 0600
  log_truncate_on_rotation = on
  log_rotation_age = 1d
  log_rotation_size = 0
  log_checkpoints = on
  log_line_prefix = '%e %t [%p]: [%l-1] user=%u,db=%d,app=%a,client=%h'
  log_lock_waits = on
  log_autovacuum_min_duration = 60s
  logging_collector = on
  pgaudit.config_file='/opt/app-root/src/pgaudit-cfg/pgaudit.conf'
  log_replication_commands = on
  log_min_messages = WARNING
  log_destination = stderr

  # vci parameters in default fep installation
  vci.enable = on
  vci.maintenance_work_mem = 256MB
  vci.max_local_ros = 64MB
  vci.force_max_parallelism = off

  # wal_archive parameters in default fep installation
  archive_mode = on
  archive_command = 'pgbackrest --stanza=backupstanza --config=/database/userdata/pgbackrest.conf
archive-push %p'
  wal_level = replica
  max_wal_senders = 10
  wal_keep_segments = 64
  wal_sender_timeout = 60s
  track_activities = on
  track_counts = on

backup:

```

```

image:
  image: 'quay.io/fujitsu/fep-backup@sha256:3434345'
  pullPolicy: IfNotPresent
mcSpec:
  limits:
    cpu: 200m
    memory: 300Mi
  requests:
    cpu: 100m
    memory: 200Mi
pgbackrestParams: |
  # define custom pgbackrest.conf parameters below to override defaults.
  [global]
  repol-retention-full = 30
  repol-retention-full-type = time
preScript: " "
postScript: " "
schedule:
  num: 2
schedule1:
  schedule: "15 0 * * 0"
  type: "full"
schedule2:
  schedule: "15 0 * * 1-6"
  type: "incr"
schedule3:
  schedule: " "
  type: " "
schedule4:
  schedule: " "
  type: " "
schedule5:
  schedule: " "
  type: " "

storage:
  dataVol:
    size: 2Gi
  tablespaceVol:
    size: 512Mi
  walVol:
    size: 1200Mi
  archivewalVol:
    size: 1Gi
  backupVol:
    size: 2Gi
  logVol:
    size: 1Gi

sysUsers:
  pgAdminPassword: admin-password
  pgdb: mydb
  pgpassword: mydbpassword
  pguser: mydbuser
  pgrepluser: repluser
  pgreplpassword: repluserpwd
  tdepassphrase: tde-passphrase

systemCertificates:
  key: |-
    -----BEGIN RSA PRIVATE KEY-----
    MIIEpAIBAAKCAQEAvhL4D/0lLmm/Ry3nu+jgLOdLYEEg0wqMxhsyPRb43paWSFlp
    gXlCNAPz1EtNs4LVGSd6n7TqV73MfZ4lNHpuVt jWVTS6wtf7dQj7bbKewQCDF5bK

```

QpekP5HAv/5uQ4Bx154FppJvmmMX6CtUBm9ici8X7M1GrPQ5uir7kj8SrUkSpXdkp
wgyuEufvbenayCI8KapBcTAsRIMjWufWngriln4b8ZYiVh0mcHLrX8HWTmQJvqBh
9laEwgn/KITpWQVp8dcZlilt+H6gBECd6n4q0/v1x0J2MoVK63Q+zZ7Y3ox5qSNN
+/Kgacht916AcEzIoJ52pA4vneLwErKX6kJMRwIDAQABoIBAF2vH9FRrlq4CGyR
6vw1Zfj776z7rOAYPRaP5Q0zO2sKsfvrBhOq12yn3fdj0bMq8zm4ubnqA+9HP31S
72eUSLpJmirZGIXcxDYFPVfuSBn6JKMF0Z9M+snSXzCfTqMHPb19LcLsJh0sq+Q
GYDLHRPpe2bqBarOCDIESK0j9IVRNItWozZCarjLzjlyNSS4vPaEjAySW/XxuRzi
A5smx2zXVm55+FjJpc2+H4Q+Rd+0AdLKrRAOyGCLMG3X5iYgwBTjzRKmdHJoIsnI
em+kJYxChSaJFK+2uzJ1+L1W9d+7CtEDxIyMKxv1TaF79agzJI7MvotGGvnnLaTP
KTTOAEcGYEA6h5h/OP9oB+1WM4xhQAmtnpwWohQPKjMAYI0XZfzWMKBrzEKKk8p
k1bzIM24xUzMSb/hKvcqcraxYN2lIUmGCDspbu0xMG6vNzqjAH0TtK8HhYoIhhKl
hGVYV3vToTeJns3SL391IedhCOgVx1bPkHDS61V97Hdd9WIanp/8RwECgYEaz9bC
A+aMbe3+1xLaoQ2j+54QaE/TbP+bbuP6Rc1H8OP1C1ZEPT1p3I4+mAlTyMq8Reit
4CmSvvpHWXpONnNVCyhHerWCySxyV5Mcp33RARX5xN109TTJEGqoH2daTieM/KY6
rakqerh7cwSGX0IXcB+N00ApBs7Bjph2g3FNm0cCgYEAjneot2TiLTO+fmkTd1UN
OdQuU9wJH5a0dmKOjTnvat8KXdrzgbhYm4GpJa4qt12xnl1toVjBawDz6dxW11M
g+vEneOXFtr0Iw66rIxwlm5Ajh37Q81LDdNCPBjTSVjr1Ui41BDZMRWFVg8tWZ25
N7OAlfsqYUCmu8tUWZ0PvWEcGYA7xefGd2erteaitCnUZ7fhhXPYjAKiNmDdY3N2
37Lw9J5kxEqbl0i2/4KjF0M7n0GaVNHXNIeyBQjAEWyrXD/5FXx5LfqPIN1Blm2H
Pgf95/QNSPz6CFRLfAUeAvtVvsotXyFBEIXHBYd7bLG4c6mJ9YkzqUjURL7pp1u
8AcBwQKBgQCi149QxQsbnakltQsYG5e+vo49GBjrpA7HeZDgq5oJGShAIMqOJSuv
t+dwgflOxaw65jkbH6hNqVLF4xdZPV6Ka2bHNCpGK7b0rWqQVvYjplM14dgIhPN6
tNZgz3cDtHwb3VCHN3APGLcIZDazZbjOMqLWBq/euhdcLnyuB9jBww==

-----END RSA PRIVATE KEY-----

crt: |-

-----BEGIN CERTIFICATE-----

MIIEHjCCAawagAwIBAgIJANroZLqsw8hNMA0GCSqGSIb3DQEBCwUAMBYxFDASBgNV
BAMMCzEwLjEzMS4wLjk5MjA4XDTIwMTEwODE0MzUyNl0XDTQ4MDMyNjE0MzUyNl0w
aDELMAkGA1UEBhMCOTExFDASBgNVBAGMC01haGFyYXNodHJmMQ0wCwYDVQQHDARQ
dW51MRAwDgYDVQKDAdGdWppdHh1MQwwCgYDVQQLDANDT0UxFTDASBgNVBAMMCzEw
LjEzMS4wLjk5MjA4XDTIwMTEwODE0MzUyNl0BAQEFAAOCAQ8AMIIBCgKCAQEAavl4D/01
Lmm/Ry3nu+jgLOdLYEEg0wqMxhsyPRb43paWSF1pgX1CNAPz1Etns4LVGSd6n7Tq
V73MfZ41NHpuVtjWVTS6wtf7dQj7bbKeWQCDF5bKQpekP5HAv/5uQ4Bx154FppJv
mMX6CtUBm9ici8X7M1GrPQ5uir7kj8SrUkSpXdkPwgyuEufvbenayCI8KapBcTAs
RIMjWufWngriln4b8ZYiVh0mcHLrX8HWTmQJvqBh9laEwgn/KITpWQVp8dcZlilt
+H6gBECd6n4q0/v1x0J2MoVK63Q+zZ7Y3ox5qSNN+/Kgacht916AcEzIoJ52pA4v
neLwErKX6kJMRwIDAQABo4IBGzCCARcwRgYDVR0jBD8wPYAUTx0d+PZMXgb1RMKW
4e0agmIUrjGhGqQYMBYxFDASBgNVBAMMCzEwLjEzMS4wLjk5ggkAtVepKtIe4D4w
CQYDVR0TBAIwADALBgNVHQ8EBAMCBDAwHQYDVR0lBBYIKwYBBQUHAWEGCCsG
AQUFBwMCMIGVbgNVHREegY0wgYqCmt1YmVybmV0ZX0XOCmt1YmVybmV0ZXMuZGVm
YXVsdIIWA3ViZXJlcy5kZWZhdWw0LnN2Y4Iea3ViZXJlcy5kZWZhdWw0LnN2Y4I
LnN2Y5jBHVzdGvgyjRrdWJlcm5ldGVzLmRlZmF1bHQuY3ZjLmNsdXN0ZXIubG9j
YWyHBAQDAG0HBKweVVKdQYJKoZIhvcNAQELBQADggEBADBIpMWGoidMARIpoFE/
f3Iwq2VMwr/NBg8ZgQd817+IIHooMP+1/nj2juy7enyrlFPiqRvhXADBkvZThro2
4c+1bDbEbW0HqdwUnRWwwBEeillXq4m6voWXXIA+At7fdiK7Dr7fo2OX5ndgW1Tw
btXCoqdUee/m9EgVhLMOLhuI3E1654zP6FVB2r1XN/oxeEzefPE18VqSvk7eZ/hr
adqpK3yt31LeFVQzqfXzcoxOCM7Bt0txVNN4a9NwBoF8abaHxVoKI3rZlxQFpkn+
RCHx6QtaVdnLJ8jlykXCv8i7Qz+3Nwh0zszl3aM8Rt3Pd+PRjc9VGg5kXBMoRzi2
xuo=

-----END CERTIFICATE-----

ca.crt: |-

-----BEGIN CERTIFICATE-----

MIIC/zCCAeegAwIBAgIJALVXqSrShuA+MA0GCSqGSIb3DQEBCwUAMBYxFDASBgNV
BAMMCzEwLjEzMS4wLjk5MjA4XDTIwMTEwODE0MzUyOVoXDTQ4MDMyNjE0MzUyOVo
wFjEUMBIGALUEAwLMTAuMTMxLjAuOTkwgGEMIA0GCSqGSIb3DQEBAQUAA4IBDwAw
ggEKAoIBAQL7F1I69s5QY+NaZMEHVw4cKsMdmxNerSdBpZaHaTVLSGod5SeqK8
EGL0NPua2KcczJRitDLdYx8F1TrPqTie9N7Q1eDoiLi2AMrP8DEykGA304JtOXzs
yGGwmodgdqJORhcwmYefiKej6483Ahy3bXORG4WbmouId1Ou7CmrH6VXTcP8sgmc
OLEEc9n33C/Ymw1l1ggJk6fM/ysZKSic2wiePFPVo86tXJ5k8pRPGJZfqfGJ80Idx
EeyW1r7GRnNm1ZQVD7A4meNarA14Bc/6b/ubtL+WySW7wvqULua+e4Sp1X4mMbj8
IqZLEzsgvaKpDFT02+jQiVqMCD80G2jHAgMBAAGjUDBOMB0GA1UdDgQWBBS3HR34
9kxeBvVEwpph6hqcYhSuMTafBgNVHSMEGDAWBS3HR349kxeBvVEwpph6hqcYhSu
MTAMBgNVHRMERTADAQH/MA0GCSqGSIb3DQEBCwUAA4IBAQAiXOC/idXXeygT8UzH

```

k3biEs3iRwajDALWVONOpnj8q75F4zIaGhCKvU/kfdOg9cwVy3GJq5+1LhR8qtCC
5o5iOhtS+XqyDXiv52Xe+GyY6GVtVUMd/KSHSInF2xgPUdInWdggqnfHC5bwNF2r8
yxHuNzUzEuu9xVzaqi7Wxk8t+uiktS4GgtcK94Zk8EkAxfnQe5PGa2ijcOF90whX
OCmhcTlCBXu4jgO3kfnuJ8E3A3gaN5I+VnqvvnPxpbg3G0mMhxr3pruTuCOBGqFM
CUDBZqNBD5wezjJImdnvS50LGx1CKgelrxP2NAmzblgMAms7XZfKxa51Tszaeqna
wuC4
-----END CERTIFICATE-----

```

It should also be noted that all the passwords / passphrase and certificates will be masked after the creation of the CR. This includes

- Also, initial pgAdminPassword: admin-password
- pgpassword: mydbpassword
- pgreplpassword: repluserpwd
- tdepassphrase: tde-passphrase
- pgRewindPassword: rewind_password (Optional - if defined)
- pgMetricsPassword: metrics_password (Optional - if defined)
- certificate.key
- certificate.crt
- certificate.cacrt

Values of child CRs at the time of initial deployment of cluster, are stored in FEPCluster under fePChildCrVals, e.g. for Server certificates, Configuration of FEP, User details.

All fields for FEPCluster CR and its child CRs should be managed through FEPCluster CR only. Operator will reflect the changes to respective child CR to be processed. The fields that not allowed to change will not be reflected from parent to child CR and hence will not have any affect.

1.2.2 FEP Cluster Configuration

Configuration of all aspects of FEP Cluster is done through FEPCluster CR only.

All fields for FEPCluster CR and its child CRs should be managed through FEPCluster CR only. Operator will reflect the changes to respective child CR to be processed. The fields that not allowed to change will not be reflected from parent to child CR and hence will not have any affect. Refer to "1.1 FEPCluster Parameter" for details.

All child CRs are marked as internal objects in RedHat OCP and will not appear on console. However, it can be checked on command line using oc or kubectl commands.

Following table shows Child CRs of FEPCluster CR and respective sections in parent CR related to given child CR.

Configuration changes are made in these sections will update allowable fields only in corresponding child CR.

Child CR Name	Relevant sections in FEP Cluster CR
FEPBackup	spec.fepChildCrVal.backup
FEPcert	spec.fepChildCrVal.systemCertificates
FEPConfig	spec.fepChildCrVal.customPgAudit spec.fepChildCrVal.customPgHba spec.fepChildCrVal.customPgParams
FEPUser	spec.fepChildCrVal.sysUsers
FEPVolume	spec.fepChildCrVal.storage

1.2.3 FEPConfig Child Custom Resource Parameters

Field	Default	Details
metadata.name	<same-as-in-FEPCluster>	This value is inherited from parent FEPCluster CR
metadata.namespace	<same-as-in-FEPCluster>	This value is inherited from parent FEPCluster CR
spec.customPgAudit	All line specified in spec.fepChildCrVal.customPg Audit of FEPCluster CR	Audit rules can be updated in this section. Requires restart. Note: initial values inherited once only at start. Changes to FEPConfig directly
spec.customPgHba	All line specified in spec.fepChildCrVal.customPg Hba of FEPCluster CR	pg_hba rules can be added in this section Note: Inherited once at start. Changes to FEPConfig directly
spec.customPgParams	All line specified in spec.fepChildCrVal.customPg Params of FEPCluster CR	All postgres parameters are listed here to overwrite defaults. Note: Inherited once at start. Changes to FEPConfig directly
spec.replicationSlots		Optional: Details of replication slots if defined in FEPCluster

Example of FEPConfig CR created

```

apiVersion: fep.fujitsu.io/v1
kind: FEPConfig
metadata:
  name: new-fep-19ncfg
  namespace: cfg-expt
spec:
  sysExtraLogging: false
  customPgAudit: |
    # define pg audit custom params here to override defaults.
    # if log volume is not defined, log_directory should be
    # changed to '/database/userdata/data/log'
    [output]
    logger = 'auditlog'
    log_directory = '/database/log/audit'
    log_truncate_on_rotation = on
    log_filename = 'pgaudit-%a.log'
    log_rotation_age = 1d
    log_rotation_size = 0
    [rule]

  customPgHba: |
    # define pg_hba custom rules here to be merged with default rules.
    # TYPE      DATABASE      USER      ADDRESS      METHOD
  customPgParams: |+
    # define custom postgresql.conf parameters below to override defaults.
    # Current values are as per default FEP deployment
    shared_preload_libraries='pgx_datamasking,vci,pgaudit,pg_prewarm,pg_stat_statements'
    session_preload_libraries='vci,pg_prewarm'
    max_prepared_transactions = 100
    max_worker_processes = 20
    max_connections = 100
    work_mem = 1MB
    maintenance_work_mem = 20MB
    shared_buffers = 128MB

```

```

effective_cache_size = 384MB
checkpoint_completion_target = 0.8
pgx_global_metacache = 10MB
temp_buffers = 10MB

# tcp parameters
tcp_keepalives_idle = 30
tcp_keepalives_interval = 10
tcp_keepalives_count = 3

# logging parameters in default fep installation
# if log volume is not defined, log_directory should be
# changed to '/database/userdata/data/log'    log_directory = '/database/log'
log_filename = 'logfile-%a.log'
log_file_mode = 0600
log_truncate_on_rotation = on
log_rotation_age = 1d
log_rotation_size = 0
log_checkpoints = on
log_line_prefix = '%e %t [%p]: [%l-1] user=%u,db=%d,app=%a,client=%h'
log_lock_waits = on
log_autovacuum_min_duration = 60s
logging_collector = on
pgaudit.config_file= '/opt/app-root/src/pgaudit-cfg/pgaudit.conf'
log_replication_commands = on
log_min_messages = WARNING
log_destination = stderr

# vci parameters in default fep installation
vci.enable = on
vci.maintenance_work_mem = 256MB
vci.max_local_ros = 64MB
vci.force_max_parallelism = off

# wal_archive parameters in default fep installation
archive_mode = on
wal_level = replica
max_wal_senders = 10
wal_keep_segments = 64
wal_sender_timeout = 60s
track_activities = on
track_counts = on

```

1.2.4 FEPUser Child Custom Resource Parameters

Field	Default	Details
metadata.name	<same-as-in-FEPCluster>	This value is inherited from parent FEPCluster CR
metadata.namespace	<same-as-in-FEPCluster>	This value is inherited from parent FEPCluster CR
spec.pgAdminPassword	spec.fepChildCrVal.users.pgAdminPassword of FEPCluster CR	postgres superuser password. Masked once secret is created/changed Note: initial values inherited once only at start. Changes to FEPUser directly
spec.pgdb	spec.fepChildCrVal.users.pgdb of FEPCluster CR	Name of a user database Note: Created once only at start. Cannot be changed
spec.pgpassword	spec.fepChildCrVal.users.pgpassword	Password for superuser for user database pgdb. Masked once secret is created/changed

Field	Default	Details
	of FEPCluster CR	Note: initial values inherited once only at start. Changes to FEPUser directly
spec.pguser	spec.fepChildCrVal.users.pguser of FEPCluster CR	Name of a user database Note: Created once only at start. Cannot be changed
spec.pgrepluser	spec.fepChildCrVal.users.pgrepluser of FEPCluster CR	Name of a database user for replication
spec.pgreplpassword	spec.fepChildCrVal.users.pgreplpassword of FEPCluster CR	Password for pgrepluser
spec.tdepassphrase	spec.fepChildCrVal.users.tdepassphrase of FEPCluster CR	Passphrase for encrypting/decrypting keystore file which contains the TDE encryption key
spec.pgRewindUser	rewind_user	Database user for Rewind
spec.pgRewindUserPassword	rewind_password	Password for database user rewinduser
spec.pgMetricsUser	spec.fepChildCrVal.sysUsers.pgMetricsUser	Optional See details in FEPCluster CR
spec.pgMetricsPassword	spec.fepChildCrVal.sysUsers.pgMetricsPassword	Optional See details in FEPCluster CR
spec.pgAdminTls	spec.fepChildCrVal.sysUsers.pgAdminTls	Optional section See details in FEPCluster CR
spec.pgrepluserTls	spec.fepChildCrVal.sysUsers.pgrepluserTls	Optional section See details in FEPCluster CR
spec.pgRewindUserTls	spec.fepChildCrVal.sysUsers.pgRewindUserTls	Optional section See details in FEPCluster CR
spec.pgMetricsUserTls	spec.fepChildCrVal.sysUsers.pgMetricsUserTls	Optional section See details in FEPCluster CR

Example of FEPUser CR created

```

apiVersion: fep.fujitsu.io/v1
kind: FEPUser
metadata:
  name: new-fep-19n
  namespace: testswatiprject
spec:
  pgAdminPassword: '*****'
  pgdb: mydb
  pgpassword: '*****'
  pgreplpassword: '*****'
  pgrepluser: repluser
  pguser: mydbuser
  tdepassphrase: '*****'
  sysExtraLogging: false
  pgRewindUser: rewind_user
  pgRewindUserPassword: rewind_password

```



```

pgAdminTls:
  certificateName: admin-client-certs-secret
  caName: admin-ssl-rootcert-configmap
  sslMode: prefer
pgrepluserTls:
  certificateName: repluser-client-certs-secret
  caName: repluser-ca-name-configmap
  sslMode: prefer
pgRewindUserTls:
  certificateName: rewinduser-client-certs-secret
  caName: rewinduser-ca-name-configmap
  sslMode: prefer

```

Note

- Password and Passphrase are masked in output from CR. The original values can still be found in the respective Kubernetes secrets and configmaps.
- TDE is enabled by default with given tdepassphrase and must have a value.
- TDE is enabled by using the key tdepassphrase with the desired passphrase. Do not remove this key once TDE is enabled. Otherwise, the database may go into a crash loop. If the Cluster is running on Async Replication and a failover/switchover occurred during the crash loop, there could be data lost. The team is looking at preventing the deletion of this passphrase from Operator even if customer tries to remove it in customer resource.
- Database users and their passwords managed by the FEPUUser CR should not be changed in the SQL interface. Inconsistencies with the information managed by the operator can cause problems with operator operation. If you make changes in the SQL interface, use the SQL interface again to restore the original state.

1.2.5 FEPVolume Child Custom Resource Parameters

1.2.5.1 Create Volumes

Volumes for the cluster nodes(pods) are initially created in accordance with the values set in `fehChildCrVal`' storage section of the parent FEPCluster CR.

The parent FEPCluster CR creates a child FEPVolume CR with the respective startup values and the relevant controller(FEPColume Controller) takes care of creating the required volumes. After initial FEPCluster create, new volume cannot be added later and storageClass or accessModes can not be changed.

Only size of an initially created volume can be changed if and only if underlying storageClass supports dynamic change of size.

Below is the schema of the FEPVolume CR:

Field	Mandatory	Sub-Field	Default	Description
archivewalVol	No	size storageClass accessModes	1Gi Defaults to platform default if omitted Defaults to ReadWriteOnce if omitted	Size of the volume,expandable later SC is only set at start Access mode is only set at start Additional details in section 3.2
backupVol	No	size storageClass accessModes	2Gi Defaults to platform default if omitted	-do-

Field	Mandatory	Sub-Field	Default	Description
			Defaults to ReadWriteOnce if omitted	
dataVol	Yes	size storageClass accessModes	2Gi Defaults to platform default if omitted Defaults to ReadWriteOnce if omitted	-do-
logVol	No	size storageClass accessModes	1Gi Defaults to platform default if omitted Defaults to ReadWriteOnce if omitted	-do-
tablespaceVol	No	size storageClass accessModes	512Mi Defaults to platform default if omitted Defaults to ReadWriteOnce if omitted	-do-
walVol	Yes	Size storageClass accessModes	1200Mi Defaults to platform default if omitted Defaults to ReadWriteOnce if omitted	-do-

1.2.5.2 Delete Volumes

Equivalent Kubernetes command: `kubectl delete FEPVolume <cr_name>`

This operation will remove all the PVCs and possibly PVs depending on the default reclaimPolicy of the storageclass used per volume.

With right backup and restore integration by customer, they may not need volumes to be persisted.



Note

Do not delete this CR unless the Cluster has been removed.

Example of FEPVolume CR created

```
apiVersion: fep.fujitsu.io/v1
kind: FEPVolume
metadata:
  name: new-fep-19n
  namespace: testswatiprject
spec:
  archivewalVol:
    size: 1Gi
  backupVol:
    size: 2Gi
```

```

dataVol:
  size: 2Gi
logVol:
  size: 1Gi
tablespaceVol:
  size: 512Mi
walVol:
  size: 1Gi
selectedVolList:
- name: data
- name: tablespace
- name: wal
- name: log
sysExtraLogging: false

```

1.2.6 FEPCert Child Custom Resource Parameters

1.2.6.1 Create/ Update Certificates

Certificate secret for the FEP cluster is initially created in accordance with the values set in `fepChildCrVal`' `certs` section of the parent FEPCluster CR.

Below is the schema of the FEPCert CR:

Field	Default	Description
<code>cacrt</code>	Defaults to dummy self signed crt from parent FEPCluster CR	Can be replaced with customer's own CA cert
<code>crt</code>	Defaults to dummy self signed crt from parent FEPCluster CR	Can be replaced with customer's own trusted cert
<code>key</code>	Defaults to dummy key from parent FEPCluster CR	Can be replaced with customer's own key

By default, Operator will create Kubernetes secrets to store the CA Cert, Server Cert and Key file. These files are exposed under the mount point `/fep-certs` in the container. The default FEPCluster template will also set the following postgres parameters in `postgresql.conf`.

```

ssl = on
ssl_cert_file = '/fep-certs/fep.crt'
ssl_key_file = '/fep-certs/fep.key'
ssl_ca_file = '/fep-certs/ca.crt'

```

It should also be possible to change the certificates by end user, by changing ALL `key`, `crt` and `cacrt`. However, user will need to restart the cluster to let change take effect.

1.2.6.2 Delete Certificates

Equivalent Kubernetes command: `kubectl delete FEPCert <cr_name>`

This operation will remove the secret containing the TLS Certificates and keys for the cluster.

Below is an example CR for certificates to be used by FEP server container

```

apiVersion: fep.fujitsu.io/v1
kind: FEPCert
metadata:
  name: new-fep
  namespace: ansible-operator-poc
spec:
  key: |-
    -----BEGIN RSA PRIVATE KEY-----

```

MIIEowIBAAKCAQEAAI33yvHZws+jta6qpV6wzJqF8odIfTIpCfbrVcUUtLfkj1I
2e4SceTKi603C/I1XuvWlPng5IO65+fQQL006z1/AuQT78YUn/WlM9x1aHVsv4AN
B5JWWqDOjrRT3o7nrPGXf1labP0rGE2mJcVR9nExJ3IeaktgT3sb8YlXvtchyYp
mjdbfxabTz07ig0+6/cwKoRRxOK8Uf7f5euE0cI/490J6r5Rs4lgD8sIQNCUFLTF
YvmAH7gcdssSFBt8NPLUATHEsoFmlW0DKCJWNhTLOht+s6L/1zwTHLjPG2pdkg6W
dgmU5H2pDml8CDNLDv98Aj7i+I5SRKKcVPlnuQIDAQABaoIBAFPPQYKlOzw/+BA0b
yMIUpdctIMb/54CR/xR0mVw1DbSjigNVPjHUQvB8YlB2FAITQ0bgJ006bAv0QdWN
Rb0/v/yYiNjDFjaLjaIAH10/2+oWrXbFaZqgpVDJhB+elxaZr2x7XGxm+p925k30
16pvIRY+I8JRkVziVlVZHwL/R3J0tPr++xMztLVjVOI+f+ySjQ+TzHuAjm49EKxj
cEmmJ28b7QcziXsvKy00f+zbqLIBKXQdZAFU5eEr1BsDRXdRW+Kf0XIVftuy4BJZ
voKT+VGHvEv/qysswL4+6IA06tpuYnnM0Y2d3sOGOWPkTcQK0MekYKzL/WmtCjNs
9hodJtECgYEA5EWYhEof4u0Ke5Tdp697UCUvXLoOr58FDe/S8XNvScn29jjOkqIg
OMoqo9xAKJTNTZqn5UUDt1x/pgM2NxlPLFiJrc0zQLX3SoO02ryDd9Wni7YKtN16
KJqa536WeZu20EbuAZ+S3GALVYlRPetNPNuOmKnF06DjDUGzLNCZy10CgYEA+zfw
952Dwuz1U0Z4wvAEqqcgUKXPKrkrTXV/iUnjkDkrLYVr0ZofDNTXrdHl+UedFmaOC
cieZn6DNhdz5tKtyysGMH3g/qs9PfoGungvcXsy0Egk04l3x1jc8TTCLqXZYyAQ
HMsx5ln+R58oncPtZYSUOr9qQ6Pbc2CstTbFJA0CgYEAjGESulIAB/jknfEzjXjP
PdhQUxb8Vye864Az2lhan9t/kJzFyIAziaeqZ5GE7t247AGFTBRTHHI8elQoemi3G
Wbc9GVlbfS1lIYbc1DpUIyrKPEP805QEXtoNLxXTFgAJRgk1VY87spjCAJ+W2ZhO
e/lit5GYXfgQCYQA2yuBmOUCgYANRkR2YR1axaCk+N1Su6oTdmPu6M5x7PNQE70
OtMaKjua9lppvIzFGADMDUteoeEAE7ZR1xnwfb6PDLUpJdIYAqgr1YfPt8qkjaZ
Tv56yZ7CwL0pbF8m6nwqRrZoDplwrraEvvvxFKFKGY/k3kCHlpTakdjEodjn3gDi
RnWeVQKBgCENEmsZucei5LRppRtRaJw/Bt1l8q1PMLX3W7dxQ3cLwpmLon0m51Fp
PIZ44zYK8R6fu4+/sRlfaIgr86Ugeufp6YNxyNROKxUGza5vDIu5OftwWtBeg+UK
Z8lLWNdX6pp7WmuJmF3H1DrkBBauYMUKZ4UxUYtelgHERMePIxwb
-----END RSA PRIVATE KEY-----

crt: |-

-----BEGIN CERTIFICATE-----
MIIDUTCCAjmGAWIBAgIRAMocW3qMoHrD6qRvMpppMkMwDQYJKoZIhvcNAQELBQAw
NzEQMA4GA1UECgwHRnVqaXRzdTEjMCEGA1UEAwwaRkVQIFJvb3QgQ0EgZm9yIEt1
YmVybmV0ZXMwHhcNMjEwMjM0ZmMjM2WncNMjEwMjM0ZmMjM2WjA/MRAwDgYD
VQQKEwdGdWppdHn1MSswKQYDVQDEYjGVUupJVFNvIEVudGVyCHJpc2UgUG9zdGdy
ZXMGU2VydmVyMIIBIjANBgkqhkiG9w0BAQEFAAOCAQ8AMIIBCgKCAQEAAI33yvH
Zws+jta6qpV6wzJqF8odIfTIpCfbrVcUUtLfkj1I2e4SceTKi603C/I1XuvWlPng
5IO65+fQQL006z1/AuQT78YUn/WlM9x1aHVsv4ANB5JWWqDOjrRT3o7nrPGXf1la
bP0rGE2mJcVR9nExJ3IeaktgT3sb8YlXvtchyYpmjdbfxabTz07ig0+6/cwKoRR
xOK8Uf7f5euE0cI/490J6r5Rs4lgD8sIQNCUFLTFYvmAH7gcdssSFBt8NPLUATHE
soFmlW0DKCJWNhTLOht+s6L/1zwTHLjPG2pdkg6WdgmU5H2pDml8CDNLDv98Aj7i
+I5SRKKcVPlnuQIDAQABolAwTjAdBgNVHSUEFjAUBGgrBgEFBQcDAQYIKwYBBQUH
AwIwDAYDVDR0TAQH/BAIwADAFBgNVHSMEGDAWgBQcwrrU00u+FhIUuVdrDRCQRsi6
ZjANBgkqhkiG9w0BAQsFAAOCAQEAm5dxBoI9pScOCvRACHg4CprdrRDSJb9K6yB30
nCAxnm47iHeXnY3WlnI388kHu8DU704balTjBgs3KY9KzioPk43pU12jWk01onoF
+mTDjx/EflcYWA9r5q/LtqTa6Q2sxV402x67QW82aAnaxO34dV5zWCPiVaovZBV
HRT+BgcG3r2vd1RGKK2nl1aYJtWh01SZubam+VttdZ/vbM9o0JctxmImsetBXjkY
KteePdQtLL5o03JhyXWyrshCq+HMMkf2KgyY8gvdyGcP4eLQdWBw40LcnVq6UJT
0kJycJEKngMvademq1ZWHGaiYB7hyT6GhgIcHUJ2cKrPgbEh1Q==
-----END CERTIFICATE-----

ca crt: |-

-----BEGIN CERTIFICATE-----
MIIDTzCCAjegAWIBAgIUySSQ8I74US5g+1+Z7ChuaDgkZnEwDQYJKoZIhvcNAQEL
BQAwNzEQMA4GA1UECgwHRnVqaXRzdTEjMCEGA1UEAwwaRkVQIFJvb3QgQ0EgZm9y
IEt1YmVybmV0ZXMwHhcNMjEwMjM0ZmMjM2WncNMjEwMjM0ZmMjM2WjA3MRaw
DgYDVQQKDAAdGdWppdHn1MSMwIQYDVQDDbGRVAgUm9vdCBDQSBmb3Igs3ViZXJu
ZXRlczczCCASlWdQYJKoZIhvcNAQEBBQADggEPADCCAQoCggEBAMs97gUF0xkUzCgL
7MiiDju9ySr/ziwjcYU7jA9ML+SlmftMs3HtcYbAmSntqI+MDBSR/FAJTOoytuT
pV+mCFcGj2YAjdpliHPeNcUpbryy4YMChF3+MovkIwGCKsxo5rhiWhGmoBYpA48P
4Xe8SP1zqMzhFvNeKzyiUhvjutS2Y1Ss381sTaurFPx64vQ2PaC54XzdwMptXtpb
tYmWSzCpJWwxZ61F3vitdA2w0tnBWNyctAd0+RIM/fvArxiIqseAux9t0uogm5to
lRihvekuxOpXBPeqtIYQ4j9XUW2JH8vUDnzPkPvjrq+A3Ug80yyfGVrW7+VYXozu
c4aP7P0CAwEAANtMFewHQYDVR0OBBYEFBzCutQ7S74WEhS5V2sNEJBGyLpmMB8G
A1UdIwQYMBaAFBzCutQ7S74WEhS5V2sNEJBGyLpmMA8GA1UdEWEB/wQFMAMBAf8w
DQYJKoZIhvcNAQELBQADggEBAMdW85RAaWEBptFgZKw+9xEUylvcZaonAuA1qc
T342XTueyAugxkC1lHwdCGGS34VycTfMGqj4AW6pA2ez4tLrbOps4DmV4sw8uBL

```

8pgRDgfly3ob9FEg2wa0hmrwX9jH5Bt4vySUE2785uPAqaspT2UNtTBxS85BUi1T
sKId2Rtil6an281Z81wyWVI6Jm2D4MG0mbsiGcTP1Ctdg/U1jvDYmXlAvd4vNhl
k9hDal3TgDqJKgKdTIcmZoNQdpEVgFc00h9AEUy5AuLqxHq60dLfZ6ESGP1MI7Lm
i4PzYbCnBmOe+7TnHcPSyrnehs66Ik+oifrD82eYS7vKjFw=
-----END CERTIFICATE-----

```

Note

This approach of specifying FEPCerts is getting deprecated. Should follow Secrets as referred in section to configure Certs for Server, Patroni and Users.

1.2.7 FEPBackup Child Custom Resource Parameters

Field	Default	Details
apiVersion	fep.fujitsu.io/v1	Fixed
kind	FEPBackup	Fixed
metadata.name	<clustername>	Enter the CR name.
spec.pgbackrestParams	" "	" " It is fixed, and the parameter set in pgbackrest.conf is described from the line below.
spec.schedule.num	Integer	Number of schedules to set The maximum number of backup schedules is 5.
spec.scheduleN.schedule	-	Write the date and time of the Nth schedule in cron format. The date and time is UTC time.
spec.scheduleN.type	full/incr	full: Perform a full backup (Back up the contents of the database cluster). incr – Perform an incremental backup (Back up only the database cluster files that were changed to the last backup migration).
spec.preScript	" "	This parameter must specify a default value.
spec.postScript	" "	This parameter must specify a default value.

Example of FEPBackup CR created

```

apiVersion: fep.fujitsu.io/v1
kind: FEPBackup
metadata:
  name: fepcluster-backup
spec:
  schedule:
    num : 2
  schedule1:
    schedule : "0 0 1 * *"
    type : "full"
  schedule2:
    schedule : "0 0 1-6 * *"
    type : "incr"
  preScript: " "
  postScript: " "
  pgbackrestParams: |
    # define custom pgbackrest.conf parameters below to override defaults.
    [global]
    rep1-retention-full = 30

```

```
repol-retention-full-type = time
```

```
...
```

1.2.8 FEPRestore Custom Resource Parameters

Field	Default	Details
apiVersion	fep.fujitsu.io/v1	Fixed
kind	FEPRestore	Fixed
metadata.name	-	Enter the CR name.
spec.fepVersion		Optional To use FEPRestore image of given version. Possible values: 12, 13 & 14
spec.image	<current-released-image>	FEP restore container image to be used quay.io/fujitsu/fujitsu-enterprise-postgres-12-restore:ubi8-12-1.1 It is optional. Image is left blank by default. In such a case, it will pick up URL of image from operator container environment. If you specify the image, Operator will take that image to deploy container
spec.imagePullPolicy	IfNotPresent	
spec.mcSpec.limits	cpu: 0.2 memory: "300Mi"	
spec.mcSpec.requests	cpu: 0.1 memory: "200Mi"	
spec.fromFEPcluster	<from_clustername>	The name of the FEPcluster from which to restore
spec.toFEPcluster	<to_clustername>	Specifies the name of the FEP cluster to restore to. When restoring to an existing cluster, do not specify the line of this parameter.
spec.restoretype	latest/PITR	latest - Restore Latest State PITR - Date-Time Restore
spec.restoredate	-	If spec.restoretype is PITR, specify the day of PITR (UTC) in YYYY-MM-DD format Example) "2020-11-25"
spec.restoretime	-	If spec.restoretype is PITR, specifies the PITR time (UTC) in HH: MM: SS format Example) "02:50:43"
spec.restoreTargetRepo		Optional If you are using multiple repositories, specify the repository from which to restore. If not specified, "1" is substituted.
spec.changeParams.fepChildCrVal.backup.pgbackrestParams		Optional

Field	Default	Details
		Specify this to change the spec.fepChildCrVal.backup.pgbackrestParams setting in FEPClusterCR when restoring to a new DB cluster.
spec.changeParams.fepChildCrVal.backup.pgbackrestKeyParams		Optional Specify this to change the spec.fepChildCrVal.backup.pgbackrestKeyParams setting in FEPClusterCR when restoring to a new DB cluster.
spec.changeParams.fepChildCrVal.backup.caName		Optional Specify if you want to change the spec.fepChildCrVal.backup.caName setting of FEPClusterCR when restoring to a new DB cluster.
spec.changeParams.fepChildCrVal.backup.repoKeySecretName		Optional Specify if you want to change the spec.fepChildCrVal.backup.repoKeySecretName setting of FEPClusterCR when restoring to a new DB cluster.
spec.changeParams.fepChildCrVal.storage.backupVol		Optional Specify this to change the spec.fepChildCrVal.storage.backupVol setting in FEPClusterCR when restoring to a new DB cluster.
spec.changeParams.fepChildCrVal.storage.archivewalVol		Optional Specify this option to change the spec.fepChildCrVal.storage.archivewalVol setting for FEPClusterCR when restoring to a new DB cluster.
spec.changeParams.fepChildCrVal.storage.dataVol		Optional Specify this to change the spec.fepChildCrVal.storage.dataVol setting for FEPClusterCR when restoring to a new DB cluster.
spec.changeParams.fepChildCrVal.storage.walVol		Optional Specify this to change the spec.fepChildCrVal.storage.walVol setting for FEPClusterCR when restoring to a new DB cluster.
spec.changeParams.fepChildCrVal.storage.logVol		Optional Specify this to change the spec.fepChildCrVal.storage.logVol setting for FEPClusterCR when restoring to a new DB cluster.
spec.changeParams.fepChildCrVal.storage.tablespaceVol		Optional Specify this to change the spec.fepChildCrVal.storage.tablespaceVol setting for FEPClusterCR when restoring to a new DB cluster.

Example of FEPRestore CR created

```

apiVersion: fep.fujitsu.io/v1
kind: FEPRestore
metadata:
  name: feprestore
spec:

```

```

mcSpec:
  limits:
    cpu: 200m
    memory: 300Mi
  requests:
    cpu: 100m
    memory: 200Mi
fromFEPcluster: fepcluster1
toFEPcluster: fepcluster2
restoretype: latest
imagePullPolicy: IfNotPresent

```

Example of Point-In-Time-Recovery using FEPRestore CR

```

apiVersion: fep.fujitsu.io/v1
kind: FEPRestore
metadata:
  name: feprestore
spec:
  mcSpec:
    limits:
      cpu: 300m
      memory: 700Mi
    requests:
      cpu: 200m
      memory: 512Mi
  fromFEPcluster: fepclusterA
  toFEPcluster: fepclusterB
  restoretype: PITR
  restoredate: 2020-11-25
  restoretime: 02:50:43
  imagePullPolicy: IfNotPresent

```



Note

Upon successful completion, custom resources in FEPRestore are automatically deleted.

1.2.9 FEPPgpool2 Custom Resource Parameters

Equivalent Kubernetes command: `kubectl create FEPPgpool2`

This operation will create a PGPool2 with supplied information.

Field	Default	Details
apiVersion	fep.fujitsu.io/v1	Fixed
kind	FEPPgpool2	Fixed
metadata.name	-	List the name of the FEP Pgpool2 container.
metadata.namespace	-	Specify the namespace of the environment where you want to deploy the operator.
spec.fepVersion		Optional To use FEPPgpool2 image of given version. Possible values: 12, 13 & 14
spec.image	<current-released-image>	FEPPgpool2 container image to be used quay.io/fujitsu/fujitsu-enterprise-postgres-12-pgpool2:ubi8-12-1.1

Field	Default	Details
		It is optional. Image is left blank by default. In such a case, it will pick up URL of image from operator container environment. If you specify the image, Operator will take that image to deploy container.
spec.count	2	List the number of FEP Pgpool2 containers to create.
spec.serviceport	9999	Describes the TCP port for connecting to the FEP Pgpool2 container.
spec.statusport	9898	Identifies the TCP port for connecting to the PCP process.
spec.limits.cpu	400m	List the number of CPUs (restriction) to allocate to resources.limits.cpu.
spec.limits.memory	512Mi	Specifies the memory size (restriction) to allocate to resources.limits.memory.
spec.requests.cpu	200m	List the number of CPUs (request) to allocate to resources.requests.cpu.
spec.requests.memory	256Mi	Specifies the memory size (request) to allocate to resources.requests.memory
spec.fepclustername	new-fep	Enter the FEPCluster name to connect to.
spec.customhba		If you want to use pool_hba.conf, describe what pool_hba.conf should contain from the line below.
spec.customparams	listen_addresses = '*' pcp_listen_addresses = '*' num_init_children = 32 reserved_connections = 0 enable_pool_hba = off allow_clear_text_frontend_auth = off authentication_timeout = 80 backend_weight0 = 1 backend_weight1 = 1 backend_flag0 = 'ALWAYS_PRIMARY' backend_flag1 = 'DISALLOW_TO_FAILOVER' connection_cache = on max_pool = 4 listen_backlog_multiplier = 2 serialize_accept = off child_life_time = 300 client_idle_limit = 0 child_max_connections = 0 connection_life_time = 0	" " and the Pgpool-II parameters. Refer to " Pgpool-II parameters " for detail.

Field	Default	Details
	<pre> reset_query_list = 'ABORT; DISCARD ALL' client_min_messages = info log_min_messages = debug1 log_statement = on log_per_node_statement = on log_client_messages = on log_hostname = on log_connections = on log_line_prefix = '%t: pid %p: ' load_balance_mode = on ignore_leading_white_space = on white_function_list = " black_function_list = 'currval,lastval,nextval,setval' black_query_pattern_list = " database_redirect_preference_ list = " app_name_redirect_preferenc e_list = " allow_sql_comments = off disable_load_balance_on_writ e = 'transaction' statement_level_load_balance = on sr_check_period = 0 sr_check_user = 'postgres' delay_threshold = 0 log_standby_delay = 'none' ssl = on ssl_ciphers = 'HIGH:MEDIUM:+3DES:! aNULL' ssl_prefer_server_ciphers = off ssl_ecdh_curve = 'prime256v1' ssl_dh_params_file = " relcache_expire = 0 relcache_size = 256 check_temp_table = catalog check_unlogged_table = on enable_shared_relcache = on </pre>	

Field	Default	Details
	relcache_query_target = primary wd_port0 = 9000	
spec.custompcp	" "	If you use the pcp command, " " and the contents of pcp.conf from the line below.
spec.customsslkey	" "	If you want to do it, " " and the Beethoven key content in the line below.
spec.customsslcert	" "	If you want to do it, " " and the contents of the public x 509 certificate from the line below.
spec.customsslca-cert	" "	If you want to do it, " " and the following lines describe the contents of the CA root certificate in PEM format.
spec.customlogsize	100 Mi	Specifies the persistent volume size for log output.
spec.storageclassname		Specifies the storage class for log output.

Pgpool-II parameters

The parameters that can be specified are shown in the table below. For details on the parameters, refer to the Pgpool-II manual.

Category	Parameter name (Specified format)	Restart required after change
Connection settings	listen_addresses (string)	Y
	pcp_listen_addresses (string)	Y
	num_init_children (integer)	Y
	reserved_connections (integer)	Y
Authentication settings	enable_pool_hba (boolean)	
	allow_clear_text_frontend_auth (boolean)	
	authentication_timeout (integer)	
Backend settings	backend_weight0 (floating point)	
	backend_weight1 (floating point)	
	backend_flag0	
	backend_flag1	
Connection pooling	connection_cache (boolean)	Y
	max_pool (integer)	Y
	listen_backlog_multiplier (integer)	Y
	serialize_accept (boolean)	Y
	child_life_time (integer)	Y
	client_idle_limit (integer)	
	child_max_connections (integer)	Y
	connection_life_time (integer)	Y
reset_query_list (string)		
Error reporting and log acquisition	client_min_messages (enum)	
	log_min_messages (enum)	
	log_statement (boolean)	

Category	Parameter name (Specified format)	Restart required after change
	log_per_node_statement (boolean)	
	log_client_messages (boolean)	
	log_hostname (boolean)	
	log_connections (boolean)	
	log_error_verbosity (enum)	
	log_line_prefix (string)	
Load sharing settings	load_balance_mode (boolean)	Y
	ignore_leading_white_space (boolean)	
	white_function_list (string)	
	black_function_list (string)	
	black_query_pattern_list (string)	
	database_redirect_preference_list (string)	
	app_name_redirect_preference_list (string)	
	allow_sql_comments (boolean)	
	disable_load_balance_on_write (string)	Y
	statement_level_load_balance (boolean)	
Health check	connect_timeout (integer)	
Streaming replication check	sr_check_period (integer)	
	sr_check_user (string)	
	sr_check_password (string)	
	sr_check_database (string)	
	delay_threshold (integer)	
	log_standby_delay (string)	
Secure Socket Layer (SSL)	ssl (boolean)	Y
	ssl_ciphers (string)	Y
	ssl_prefer_server_ciphers (boolean)	Y
	ssl_ecdh_curve (string)	Y
	ssl_dh_params_file (string)	Y
Other parameters	relcache_expire (integer)	Y
	relcache_size (integer)	Y
	enable_shared_relcache (boolean)	Y
	relcache_query_target (enum)	
	check_temp_table (enum)	
	check_unlogged_table (boolean)	

1.2.10 FEPAAction Custom Resource Parameters

Specify parameters in the format described below.

Custom resource spec	Default	Change effect
.spec.targetClusterName		Must specify target FEP Cluster name within namespace mentioned in metadata.
.spec.targetPgpool2Name		Must specify target FEPPgpool2 name within namespace mentioned in metadata when using pgpool2_restart.
.spec.fepAction.type		Must specify action type. Supported action types are: restart pod_restart reload list switchover failover pgpool2_restart backup
.spec.fepAction.args		Must specify arguments needed for given action. For details of args corresponding to each action refer to " 1.2.10.1 FEPAction Specific Operation Details ".
.spec.fepAction.backupType	full	Options If you specify backup for fepAction.type, the type of backup is used. full : Performs a full backup (backs up the contents of the database cluster). incr : Perform an incremental backup (Back up only the database cluster files that were changed during the last backup migration).
.spec.fepAction.backupRepo	1	Options Gets a backup in the specified repository. The range is 1 to 256.
.spec.sysExtraLogging		To turn extra debugging on, set value to true. It can be turned on/off at any time.

After execution of FEPAction CR, status is reflected in fepStatus field that is dynamically inserted in current FEPAction CR as needed. fepStatus field used for FEPAction CR are described here

fepStatus (with possible values)	Remarks
fepActionStatus:	fepStatus is inserted at the top of FEPAction CR
fepActionCondition: Success Failure	This flag is inserted in fepAction CR to reflect success or failure of requested action
fepActionResult: > "details"	The result contains verbose details corresponding to the specific action been executed. Should be noted that it is either plain text of HTTP output.
processedTimestamp: <time stamp>	Denotes time of action execution by the Operator

```
apiVersion: fep.fujitsu.io/v1
kind: FEPAction
fepActionStatus:
```

```
fepActionCondition: Success
metadata:
  name: new-fep-reload-action
  namespace: myns
spec:
  fepAction:
    args:
      - new-fep-sts-0
      - new-fep-sts-1
    type: reload
  sysExtraLogging: false
  targetClusterName: new-fep
```

Note

- Please do not use the FEPAction to perform a switchover or restart while executing backup. Failed to get the backup.
- You must create a new FEPAction custom resource for each operation.

1.2.10.1 FEPAction Specific Operation Details

Action type - reload

The reload action will manually reload the FEP database on the targeted FEPCluster.

“reload” action type expects users to specify the name of individual FEP pods that they want to run the database reload operation on. They specify that in the args section under the FEPAction CR spec as below :

```
spec:
  fepAction:
    args:
      - nf-131851-sts-0
      - nf-131851-sts-1
    type: reload
  targetClusterName: nf-131851
```

Action type - restart

The restart action will manually restart the FEP database on the targeted FEPCluster.

“restart” action type expects users to specify the name of individual FEP pods that they want to run the database restart operation on. They specify that in the args section under the FEPAction CR spec as below:

```
spec:
  fepAction:
    args:
      - nf-131851-sts-0
      - nf-131851-sts-1
    type: restart
  targetClusterName: nf-131851
```

Action type - pod_restart

The pod_restart action will restart specified list of POD for given target cluster. User can specify key word ‘ALL’ under ‘args’ section to restart all pods in target cluster. Alternatively, user can give the list of pods to be started in target cluster. User should either give ALL or the list of the pods.

This action restarts the replica pods first. Once all replicas have been restarted, it switches over the mastership to one of the replica before restarting old master pod. If it is a single node cluster, master will be restarted in its current state. This action is automatically created to restart pods when image or machine specs are changed for fep or backup container depending on autoPodRestart flag in FEPCluster CR (see more details in FEPCluster CR section):

```
spec:
  fepAction:
  args:
  - nf-131851-sts-0
  - nf-131851-sts-1
  type: pod_restart
  targetClusterName: nf-131851
```

Action type - list

The list action will return the status of the targeted FEPCluster.

“list” action type expects users to specify just the target cluster name to list the details of the same. Looks like below:

```
spec:
  fepAction:
  type: list
  targetClusterName: nf-131851
```

Action type - switchover

The switchover action performs a manually switchover of the current leader/primary database from one pod to another pod of the targeted FEPCluster.

“switchover” action type expects users to specify the name of the target cluster that they want to perform switchover. args section is not required for switchover as FEPACTION operator code will internally find it and promote new master. FEPACTION CR spec as below:

```
spec:
  fepAction:
  type: switchover
  targetClusterName: nf-131851
```

Action type - failover

The failover action performs a manually failover of the current primary database from one pod to another pod of the targeted FEPCluster. The difference between switchover and failover is that, switchover expects the primary database is running at the time whereas failover can force switchover of primary role from a non-responding pod to another pod. Note that failover is a disruptive action and may cause data lost.

“failover” action type expects users to specify the names of the candidate pods that they want to failover to. They specify that in the args section under the FEPACTION CR spec as below:

```
spec:
  fepAction:
  args:
  - nf-131851-sts-1
  - nf-131851-sts-2
  type: failover
  targetClusterName: nf-131851
```

Here, nf-131851-sts-1 and nf-131851-2 are the candidate pods to failover to. In this example, the current primary pod would be nf-131851-sts-0.

Action type - pgpool2_restart

“pgpool2_restart” action type expects users to specify the name of individual FEPPgpool2 resource that they want to restart operation on. They specify that in the targetPgpool2Name section under the FEPACTION CR spec as below:

```
spec:
  fepAction:
  type: pgpool2_restart
  targetPgpool2Name: nf-131851-pgpool2
```

Action type - backup

The "backup" action performs a backup on the target FEPCluster.

The "backup" action type requires you to specify the type of backup and the repository in which to store the data.

In the `fepAction` section of the FEPAAction custom resource specification, specify the following:

```
spec:
  targetClusterName: new-fep
  fepAction:
    type: backup
    backupType: full
    backupRepo: 1
```



Note

- Regardless of how the backup was performed (scheduled or FEPAAction), if backups were performed at the same time by the same FEPCluster, subsequent backups will fail.
- If the backup repository Retention Option is specified in the FEPCluster custom resource `spec.fepChildCrVal.backup.pgbackrestParams`, the backup files obtained by the FEPAAction are also deleted as specified by the option.

1.2.11 FEPEXporter Custom Resource

Field	Default	Details
<code>apiVersion</code>	<code>fep.fujitsu.io/v1</code>	Mandatory as it is
<code>kind</code>	<code>FEPEXporter</code>	Mandatory as it is
<code>metadata.name</code>	<code>fep-monitor</code>	Name of FEPEXporter CR - must be unique in namespace
<code>metadata.namespace</code>	<code>fep-ns</code>	Namespace - OCP populates it as current
<code>spec.prometheus</code>		Optional Prometheus MTLS spec section
<code>spec.prometheus.tls</code>		
<code>spec.prometheus.tls.certificateName</code>		Optional This points to Kubernetes TLS secret that contains the certificate of Prometheus ServiceMonitor. FEPEXporter will use this for certificate authentication. The certificate itself is stored in the key <code>tls.crt</code> .
<code>spec.prometheus.tls.caName</code>		Optional This points to Kubernetes configmap that contains additional CA the client use to verify a server certificate. The CA is stored in the key <code>ca.crt</code> .
<code>spec.fepExporter.</code>		Exporter spec section
<code>spec.fepExporter.authSecret</code>		Optional Base Authentication secret to provide username & encrypted password of user
<code>spec.fepExporter.authSecret.secretName</code>		Secret name
<code>spec.fepExporter.authSecret.usernameKey</code>		Key of username in specified secret
<code>spec.fepExporter.authSecret.passwordKey</code>		Key of password in specified secret

Field	Default	Details
spec.fepExporter.tls		FEPEXporter MTLS specs
spec.fepExporter.tls.certificateName		Optional This point to Kubernetes TLS secret that contains the certificate of FepExporter. Prometheus will use this for certificate authentication. The certificate itself is stored in the key tls.crt.
spec.fepExporter.tls.caName		Optional This points to Kubernetes configmap that contains additional CA the client use to verify a server certificate. The CA is stored in the key ca.crt.
spec.fepExporter.disableDefaultQueries	false	Optional Not defined or set to false => Create default queries Defined and set to true => Do not create default queries.
spec.fepExporter.disableDefaultAlertRules	false	Optional Not defined or set to false => Create default alert rules Defined and set to true => Do not create default alert rules. If Default queries are disabled => Do not create default alert rule.
spec.fepExporter.exporterLogLevel	error	Set logging level: one of debug, info, warn, error
spec.fepExporter.fepClusterList		Array of FEPCluster to monitor
spec.fepExporter.image.image		quay.io/fujitsu/fep-exporter-test:v1.0.0 Optional If not specified; image name is picked up from operator environment variable
spec.fepExporter.image.pullPolicy	IfNotPresent	Always or IfNotPresent
spec.fepExporter.mcSpec.limits	cpu: 500m memory: 700Mi	Max CPU allocated to exporter container Max memory allocated to exporter container
spec.fepExporter.mcSpec.requests	cpu: 200m memory: 512Mi	CPU allocation at start for exporter container memory allocation at start for exporter container
spec.fepExporter.scrapeInterval	30s	Optional This parameter may be specified to change statistics scraping frequency. If specified, Prometheus will poll FEPEXporter at given interval. CHANGE THIS PARAMETER ONLY IF REALLY REQUIRED
spec.fepExporter.scrapeTimeout	30s	Optional This parameter may be specified to change statistics scraping timeout. If specified, Prometheus will wait for FEPEXporter for maximum this given period to return statistics. CHANGE THIS PARAMETER ONLY IF REALLY REQUIRED

Field	Default	Details
spec.fepExporter.sysExtraLogging	true	To turn on extra debugging messages for operator, set value to true <i>It can be turned on/off at any time</i>
spec.fepExporter.restartRequired	false	True: To restart FEPEXporter, when there is any change found in CR or FEPCluster False: Will not restart FEPEXporter
spec.fepExporter.userCustomQueries		Optional Section Example user's custom query to extract additional metrics.

```
usr_example:
  query: "SELECT EXTRACT(EPOCH FROM (now() - pg_last_xact_replay_timestamp())) as lag"
  master: true
  metrics:
    - lag:
        usage: "GAUGE"
        description: "Replication lag behind master in seconds"
```

1.2.12 FEPAutoscale Custom Resource

When FEPClusterCR is defined, FEPAutoscaleCR is defined.

The parameters are as follows:

Configuration changes are made in FEPClusterCR.

Field	Default	Details
apiVersion	fep.fujitsu.io/v1	Fixed
kind	FEPAutoscale	Fixed
metadata.name	Same as FEPClusterCR	Fixed
metadata.namespace	Same as FEPClusterCR	Fixed
spec.scaleout.policy	off	[cpu_utilization/connection_number/off]
spec.scaleout.threshold	cpu_utilization: 40 connection_number: 40	Threshold
spec.scaleout.metricName	pg_capacity_connection_average	Specify this parameter if policy is connection_number. The custom metrics server must publish the average number of connections in the FEP cluster under this name.
spec.scaleout.stabilizationWindowSeconds	0	If the duration (seconds) threshold of this parameter has been exceeded continuously, a scale out is performed.
spec.limits.maxReplicas	2	Maximum number of replicas (0 to 15) If the value is out of range, no automatic scale out is performed.

1.2.13 FEPUUpgrade Custom Resource

If "spec.fepChildCrVal.upgrade" is defined for the FEPCluster custom resource, the FEPUUpgrade custom resource is defined.

The parameters are as follows:

Field	Default	Details
apiVersion	fep.fujitsu.io/v1	Fixed
kind	FEPUpgrade	Fixed
metadata.name	Same as FEPClusterCR	Fixed
metadata.namespace	Same as FEPClusterCR	Fixed
spec.upgrade		
spec.upgrade.sourceCluster		Specifies the FEPClusterCR name from which to migrate data. Required.
spec.upgrade.mcSpec.limits	cpu: 200m memory: 300Mi	Optional Specifies the maximum number of resources to allocate to the upgrade execution container.
spec.upgrade.mcSpec.requests	cpu: 100m memory: 200Mi	Optional Specifies the lower limit of resources allocated to the upgrade execution container.
spec.upgrade.image		Optional If omitted, the URL for image is obtained from the operator container environment.
spec.upgrade.imagePullPolicy	IfNotPresent	Optional Specifies the pull policy for the container image. - Always - IfNotPresent - Never
spec.upgrade.source.pgAdminTls.certificateName		Optional If you do not define spec.fepChildCrVal.sysUsers.pgAdminTls.certificateName for the data source, it points to the Kubernetes TLS secret that contains the certificate for the Postgres user "postgres" in the data source. If the data source FEP has set the authentication method for the upgrade execution container to "cert", then the upgrade execution container uses the certificate defined as secret.
spec.upgrade.destination.pgAdminTls.certificateName		Optional If you have not defined the spec.fepChildCrVal.sysUsers.pgAdminTls.certificateName of the newly created FEPCluster, it points to the Kubernetes TLS secret that contains the certificate of the Postgres user "postgres" in the data source. If you create a new FEP with the "cert" authentication method for the upgrade execution container, the upgrade execution container uses the certificate defined as secret.
spec.upgrade.storage		Optional Defines the storage for storing dump files.
spec.upgrade.storage.storageClass		Optional

Field	Default	Details
		If omitted, the default storage class for your environment is used.
spec.upgrade.storage.size	2Gi	Optional Specifies the size of the storage to store the dump file.
spec.upgrade.storage.accessModes	ReadWriteOnce	Optional accessModes for store the dump file Specified as an array of accessModes e.g. [ReadWriteMany] If omitted, it will be treated as [ReadWriteOnce]

1.2.14 FEPLogging Custom Resources

The fepLogging section needs to be added under spec to define required parameters for FEPLogging configuration.

Following is a sample template :

```
spec:
  fepLogging:
    elastic:
      authSecret:
        secretName: elastic-auth
        passwordKey: password
        userKey: username
      host: elastic-passthrough.apps.openshift.com
      logstashPrefix: postgres
      port: 443
      scheme: https
      sslVerify: true
      tls:
        certificateName: elastic-cert
        caName: elastic-cacert
    image:
      pullPolicy: IfNotPresent
    mcSpec:
      limits:
        cpu: 500m
        memory: 700Mi
      requests:
        cpu: 200m
        memory: 512Mi
      restartRequired: false
      sysExtraLogging: false
      scrapeInterval: 30s
      scrapeTimeout: 30s
      tls:
        certificateName: fluentd-cert
        caName: cacert
    prometheus:
      ...
```

Below is the list of all parameters defined in the fepLogging section, along with their brief description

Custom Resource spec	Required/ Optional	Change Effect	Updating value allowed
spec.fepLogging.image.image	Optional	Fluentd Image of FEPLogging	Yes
spec.fepLogging.image.pullPolicy	Required	Fluentd Image pull policy of FEPLogging	Yes
spec.fepLogging.mcSpec.limits.cpu	Required	Max CPU allocated to fluentd container	Yes
spec.fepLogging.mcSpec.limits.memory	Required	Max memory allocated to fluentd container	Yes
spec.fepLogging.mcSpec.requests.cpu	Required	CPU allocation at start for fluentd container	Yes
spec.fepLogging.mcSpec.requests.memory	Required	Memory allocation at start for fluentd container	Yes
spec.fepLogging.sysExtraLogging	Required	To turn on extra debugging messages for operator, set value to true. It can be turned on/off at any time	Yes
spec.fepLogging.restartRequired	Required	To restart FEPLogging instance for applying any new configuration for example after certificate rotation	Yes
spec.fepLogging.scrapeInterval	Optional	Scrape interval for Prometheus to fetch metrics from FEPLogging instance	Yes
spec.fepLogging.scrapeTimeout	Optional	Scrape Timeout for Prometheus to fetch metrics from FEPLogging instance	Yes
spec.fepLogging.elastic.host	Optional	Target Elasticsearch host name	Yes
spec.fepLogging.elastic.port	Optional	Target Elasticsearch port number	Yes
spec.fepLogging.elastic.authSecret.secretName	Optional	Secret name which contains Elasticsearch authentication username & password	Yes
spec.fepLogging.elastic.authSecret.userKey	Optional	Username key specified in Elasticsearch authentication secret	Yes
spec.fepLogging.elastic.authSecret.passwordKey	Optional	Password key specified in Elasticsearch authentication secret	Yes
spec.fepLogging.elastic.logstashPrefix	Optional	Logstash prefix to differentiate index pattern in elastic search. Default value is postgres	Yes
spec.fepLogging.elastic.scheme	Optional	Connection scheme between FEPLogging & Elasticsearch. Possible options http & https	Yes
spec.fepLogging.elastic.sslVerify	Optional	Set to true if you want to verify ssl certificate. If set to false then will not consider TLS certificate	Yes
spec.fepLogging.elastic.tls.certificateName	Optional	Kubernetes secret name which holds fluentd certificate	Yes
spec.fepLogging.elastic.tls.caName	Optional	Kubernetes configmap which holds cacert of Elasticsearch to verify Elasticsearch TLS connection	Yes
spec.fepLogging.tls.certificateName	Optional	Kubernetes secret name which holds Fluentd certificate	Yes
spec.fepLogging.tls.caName	Optional	Kubernetes configmap which holds cacert of Fluentd to configure MTLs between FEPLogging & Prometheus	Yes
spec.prometheus.tls.certificateName	Optional	Kubernetes secret name which holds Prometheus certificate	Yes

Custom Resource spec	Required/ Optional	Change Effect	Updating value allowed
spec.prometheus.tls.caName	Optional	Kubernetes configmap which holds cacert of Fluentd to configure MTLs between FEPLogging & Prometheus	Yes

1.2.15 FEP Custom Resources - spec.fep.pgBadger

Custom Resource spec	Change Effect
pgBadger.schedules.create	The 'create' schedule to create report and upload it to endpoint
pgBadger.schedules.cleanup	The 'cleanup' schedule to delete the report left in container
pgBadger.options.incremental	Default: false; When set to True: create incremental report in pgbadger
pgBadger.endpoint.authentication	a secret to contain authentication info to access endpoint support basic auth only
pgBadger.endpoint.customCertificateName	Client certificate reference in customCertificate CR
pgBadger.endpoint.fileUploadParameter	The file upload parameter defined by the web server Default: 'file'
pgBadger.endpoint.insecure	equivalent to curl -insecure option, default to false
pgBadger.endpoint.url	Web server url to upload the report file

Appendix A Default Metrics Queries

```
pg_capacity_connection:
  query: |
    select sys, idle, idleintx, idleintxl0min, idleintxlhour, idleintxlday, idleintxlweek,
    (curr.idle + curr.idleintx + curr.active) total, s.setting "max" from
    (
      select
        count(CASE WHEN a.state is null THEN 1 END) sys,
        count(CASE WHEN a.state='idle' THEN 1 END) idle,
        count(CASE WHEN a.state='idle in transaction' OR a.state='idle in transaction (aborted)' THEN
1 END) idleintx,
        count(CASE WHEN (a.state='idle in transaction' OR a.state='idle in transaction (aborted)') AND
age(now(), state_change) > interval '10 min' THEN 1 END) idleintxl0min,
        count(CASE WHEN (a.state='idle in transaction' OR a.state='idle in transaction (aborted)') AND
age(now(),state_change) > interval '1 hour' THEN 1 END) idleintxlhour,
        count(CASE WHEN (a.state='idle in transaction' OR a.state='idle in transaction (aborted)') AND
age(now(),state_change) > interval '1 day' THEN 1 END) idleintxlday,
        count(CASE WHEN (a.state='idle in transaction' OR a.state='idle in transaction (aborted)') AND
age(now(),state_change) > interval '1 week' THEN 1 END) idleintxlweek,
        count(CASE WHEN a.state='active' THEN 1 END) active
      from pg_stat_activity a
    ) curr, pg_settings s where name = 'max_connections'
  master: true
  metrics:
    - sys:
      usage: 'GAUGE'
      description: 'Number of system connections.'
    - idle:
      usage: 'GAUGE'
      description: 'Number of idle connections.'
    - idleintx:
      usage: 'GAUGE'
      description: 'Number of idle in transaction connections.'
    - idleintxl0min:
      usage: 'GAUGE'
      description: 'Number of idle in transaction connections running longer than 10 min.'
    - idleintxlhour:
      usage: 'GAUGE'
      description: 'Number of idle in transaction connections running longer than 1 hour.'
    - idleintxlday:
      usage: 'GAUGE'
      description: 'Number of idle in transaction connections running longer than 1 day.'
    - idleintxlweek:
      usage: 'GAUGE'
      description: 'Number of idle in transaction connections running longer than 1 week.'
    - total:
      usage: 'GAUGE'
      description: 'Number of total connections.'
    - max:
      usage: 'GAUGE'
      description: 'Max number of connections.'

pg_capacity_schema:
  query: |
    SELECT current_database() AS database_name, table_schema,
    COALESCE(SUM(pg_total_relation_size('' || table_schema || ''.''' || table_name || ''')), 0) AS size
    FROM information_schema.tables GROUP BY table_schema
  master: true
  metrics:
    - database_name:
      usage: 'LABEL'
```

```

        description: 'Database name.'
- table_schema:
    usage: 'LABEL'
    description: 'Table schema name.'
- size:
    usage: 'GAUGE'
    description: 'Disk space of schema.'

pg_capacity_tblspace:
query: |
    SELECT pg_tablespace.spcname AS tablespace_name, pg_tablespace_size(pg_tablespace.spcname) AS
tablespace_size FROM pg_tablespace
master: true
metrics:
- tablespace_name:
    usage: 'LABEL'
    description: 'Table space name.'
- tablespace_size:
    usage: 'GAUGE'
    description: 'Disk space of table space.'

pg_capacity_tblvacuum:
query: |
    SELECT current_database() datname, t.table_schema, count(t.table_name) table_count
    FROM information_schema.tables t
    INNER JOIN pg_catalog.pg_stat_user_tables tu on t.table_schema::text=tu.schemaname::text and
t.table_name::text=tu.relname::text
    and
    age(now(),greatest(COALESCE(last_vacuum, '1970-01-01Z'), COALESCE(last_autovacuum,
'1970-01-01Z'))) > interval '1 day'
    GROUP BY t.table_schema
master: true
metrics:
- datname:
    usage: 'LABEL'
    description: 'Database name.'
- table_schema:
    usage: 'LABEL'
    description: 'Table schema name.'
- table_count:
    usage: 'GAUGE'
    description: 'Number of tables without vacuum for more than a day.'

pg_capacity_longtx:
query: |
    with xact_count as (
    SELECT COALESCE(datname, '') datname, count(1)
    FROM pg_stat_activity
    where backend_type='client backend' and age(now(), COALESCE(xact_start, '1970-01-01Z')) >
interval '5 minutes'
    group by datname
    )
    select d.datname, coalesce(xc.count, 0) as count from pg_database d left join xact_count xc on
d.datname=xc.datname
master: true
metrics:
- datname:
    usage: 'LABEL'
    description: 'Database name.'
- count:
    usage: 'GAUGE'
    description: 'Number of transactions running longer than 5 minutes.'

```



```

pg_capacity_tblbloat:
query: |
    SELECT DISTINCT
        current_database() as datname, schemaname, tablename as relname, /*reltuples::bigint,
relpages::bigint, otta,*/
        CASE WHEN relpages < otta THEN 0 ELSE bs*(sml.relpages-otta)::BIGINT END AS wastedbytes
    FROM (
        SELECT
            schemaname, tablename, cc.reltuples, cc.relpages, bs,
            CEIL((cc.reltuples*((datahdr+ma-
                (CASE WHEN datahdr%ma=0 THEN ma ELSE datahdr%ma END))+nullhdr2+4))/(bs-20::float)) AS otta,
            COALESCE(c2.relname,'?') AS iname, COALESCE(c2.reltuples,0) AS ituples, COALESCE(c2.relpages,
0) AS ipages,
            COALESCE(CEIL((c2.reltuples*(datahdr-12))/(bs-20::float)),0) AS iotta -- very rough
approximation, assumes all cols

        FROM (
            SELECT
                ma,bs,schemaname,tablename,
                (datawidth+(hdr+ma-(case when hdr%ma=0 THEN ma ELSE hdr%ma END))):numeric AS datahdr,
                (maxfracsum*(nullhdr+ma-(case when nullhdr%ma=0 THEN ma ELSE nullhdr%ma END))) AS nullhdr2
            FROM (
                SELECT
                    schemaname, tablename, hdr, ma, bs,
                    SUM((1-null_frac)*avg_width) AS datawidth,
                    MAX(null_frac) AS maxfracsum,
                    hdr+(
                        SELECT 1+count(*)/8
                        FROM pg_stats s2
                        WHERE null_frac<>0 AND s2.schemaname = s.schemaname AND s2.tablename = s.tablename
                    ) AS nullhdr
                FROM pg_stats s, (
                    SELECT
                        (SELECT current_setting('block_size')::numeric) AS bs,
                        CASE WHEN substring(v,12,3) IN ('8.0','8.1','8.2') THEN 27 ELSE 23 END AS hdr,
                        CASE WHEN v ~ 'mingw32' THEN 8 ELSE 4 END AS ma
                    FROM (SELECT version() AS v) AS foo
                ) AS constants
                GROUP BY 1,2,3,4,5
            ) AS foo
        ) AS rs
        JOIN pg_class cc ON cc.relname = rs.tablename
        JOIN pg_namespace nn ON cc.relnamespace = nn.oid AND nn.nspname = rs.schemaname AND nn.nspname
<> 'information_schema'
        LEFT JOIN pg_index i ON indrelid = cc.oid
        LEFT JOIN pg_class c2 ON c2.oid = i.indexrelid
    ) AS sml
    ORDER BY wastedbytes DESC
master: true
metrics:
- datname:
    usage: 'LABEL'
    description: 'Database name.'
- schemaname:
    usage: 'LABEL'
    description: 'Schema name.'
- relname:
    usage: 'LABEL'
    description: 'Name of this table.'
- wastedbytes:
    usage: 'GAUGE'
    description: 'Number of bytes wasted for table.'

```

pg_performance_locking_detail:

```
query: |
    SELECT blocked_locks.pid AS blocked_pid,
           blocked_activity.username AS blocked_user,
           blocking_locks.pid AS blocking_pid,
           blocking_activity.username AS blocking_user,
           blocked_activity.query AS blocked_statement,
           1 locks
    FROM pg_catalog.pg_locks blocked_locks
    JOIN pg_catalog.pg_stat_activity blocked_activity ON blocked_activity.pid = blocked_locks.pid
    JOIN pg_catalog.pg_locks blocking_locks
    ON blocking_locks.locktype = blocked_locks.locktype
    AND blocking_locks.DATABASE IS NOT DISTINCT FROM blocked_locks.DATABASE
    AND blocking_locks.relation IS NOT DISTINCT FROM blocked_locks.relation
    AND blocking_locks.page IS NOT DISTINCT FROM blocked_locks.page
    AND blocking_locks.tuple IS NOT DISTINCT FROM blocked_locks.tuple
    AND blocking_locks.virtualxid IS NOT DISTINCT FROM blocked_locks.virtualxid
    AND blocking_locks.transactionid IS NOT DISTINCT FROM blocked_locks.transactionid
    AND blocking_locks.classid IS NOT DISTINCT FROM blocked_locks.classid
    AND blocking_locks.objid IS NOT DISTINCT FROM blocked_locks.objid
    AND blocking_locks.objsubid IS NOT DISTINCT FROM blocked_locks.objsubid
    AND blocking_locks.pid != blocked_locks.pid
    JOIN pg_catalog.pg_stat_activity blocking_activity ON blocking_activity.pid = blocking_locks.pid
    WHERE NOT blocked_locks.GRANTED
```

master: true

metrics:

- blocked_pid:
 - usage: 'LABEL'
 - description: 'Blocked process id.'
- blocked_user:
 - usage: 'LABEL'
 - description: 'Blocked user.'
- blocking_pid:
 - usage: 'LABEL'
 - description: 'Blocking process id.'
- blocking_user:
 - usage: 'LABEL'
 - description: 'Blocking user.'
- blocked_statement:
 - usage: 'LABEL'
 - description: 'Blocked statement.'
- locks:
 - usage: 'GAUGE'
 - description: 'Number of processes in blocked state.'

pg_performance_locking:

```
query: |
    WITH
    locks as (
        SELECT blocked_locks.DATABASE, count(blocked_locks.pid) locks
        FROM pg_catalog.pg_locks blocked_locks
        JOIN pg_catalog.pg_stat_activity blocked_activity ON blocked_activity.pid = blocked_locks.pid
        JOIN pg_catalog.pg_locks blocking_locks
        ON blocking_locks.locktype = blocked_locks.locktype
        AND blocking_locks.DATABASE IS NOT DISTINCT FROM blocked_locks.DATABASE
        AND blocking_locks.relation IS NOT DISTINCT FROM blocked_locks.relation
        AND blocking_locks.page IS NOT DISTINCT FROM blocked_locks.page
        AND blocking_locks.tuple IS NOT DISTINCT FROM blocked_locks.tuple
        AND blocking_locks.virtualxid IS NOT DISTINCT FROM blocked_locks.virtualxid
        AND blocking_locks.transactionid IS NOT DISTINCT FROM blocked_locks.transactionid
        AND blocking_locks.classid IS NOT DISTINCT FROM blocked_locks.classid
        AND blocking_locks.objid IS NOT DISTINCT FROM blocked_locks.objid
        AND blocking_locks.objsubid IS NOT DISTINCT FROM blocked_locks.objsubid
```

```

        AND blocking_locks.pid != blocked_locks.pid
        JOIN pg_catalog.pg_stat_activity blocking_activity ON blocking_activity.pid =
blocking_locks.pid
        WHERE NOT blocked_locks.GRANTED group by blocked_locks.DATABASE
    ),
    dbs as (
        select * from pg_catalog.pg_database
    )
    select dbs.datname, coalesce(locks.locks, 0) locks from dbs left join locks on dbs.oid=DATABASE
master: true
metrics:
  - datname:
      usage: 'LABEL'
      description: 'Database name'
  - locks:
      usage: 'GAUGE'
      description: 'Number of processes in blocked state.'

pg_replication:
  query: |
    SELECT CASE WHEN pg_last_wal_receive_lsn() = pg_last_wal_replay_lsn() THEN 0 ELSE GREATEST (0,
EXTRACT(EPOCH FROM (now() - pg_last_xact_replay_timestamp()))) END AS lag
  master: true
  metrics:
    - lag:
        usage: "GAUGE"
        description: "Replication lag behind master in seconds"

pg_postmaster:
  query: |

    SELECT pg_postmaster_start_time as start_time_seconds from pg_postmaster_start_time()
  master: true
  metrics:
    - start_time_seconds:
        usage: "GAUGE"
        description: "Time at which postmaster started"

pg_stat_user_tables:
  query: |
    SELECT
      current_database() datname,
      schemaname,
      relname,
      seq_scan,
      seq_tup_read,
      idx_scan,
      idx_tup_fetch,
      n_tup_ins,
      n_tup_upd,
      n_tup_del,
      n_tup_hot_upd,
      n_live_tup,
      n_dead_tup,
      n_mod_since_analyze,
      last_vacuum,
      last_autovacuum,
      last_analyze,
      last_autoanalyze,
      vacuum_count,
      autovacuum_count,
      analyze_count,
      autoanalyze_count

```

```

FROM
  pg_stat_user_tables
master: true
metrics:
  - datname:
      usage: "LABEL"
      description: "Name of current database"
  - schemaname:
      usage: "LABEL"
      description: "Name of the schema that this table is in"
  - relname:
      usage: "LABEL"
      description: "Name of this table"
  - seq_scan:
      usage: "COUNTER"
      description: "Number of sequential scans initiated on this table"
  - seq_tup_read:
      usage: "COUNTER"
      description: "Number of live rows fetched by sequential scans"
  - idx_scan:
      usage: "COUNTER"
      description: "Number of index scans initiated on this table"
  - idx_tup_fetch:
      usage: "COUNTER"
      description: "Number of live rows fetched by index scans"
  - n_tup_ins:
      usage: "COUNTER"
      description: "Number of rows inserted"
  - n_tup_upd:
      usage: "COUNTER"
      description: "Number of rows updated"
  - n_tup_del:
      usage: "COUNTER"
      description: "Number of rows deleted"
  - n_tup_hot_upd:
      usage: "COUNTER"
      description: "Number of rows HOT updated (i.e., with no separate index update required)"
  - n_live_tup:
      usage: "GAUGE"
      description: "Estimated number of live rows"
  - n_dead_tup:
      usage: "GAUGE"
      description: "Estimated number of dead rows"
  - n_mod_since_analyze:
      usage: "GAUGE"
      description: "Estimated number of rows changed since last analyze"
  - last_vacuum:
      usage: "GAUGE"
      description: "Last time at which this table was manually vacuumed (not counting VACUUM FULL)"
  - last_autovacuum:
      usage: "GAUGE"
      description: "Last time at which this table was vacuumed by the autovacuum daemon"
  - last_analyze:
      usage: "GAUGE"
      description: "Last time at which this table was manually analyzed"
  - last_autoanalyze:
      usage: "GAUGE"
      description: "Last time at which this table was analyzed by the autovacuum daemon"
  - vacuum_count:
      usage: "COUNTER"
      description: "Number of times this table has been manually vacuumed (not counting VACUUM
FULL)"
  - autovacuum_count:

```

```

        usage: "COUNTER"
        description: "Number of times this table has been vacuumed by the autovacuum daemon"
    - analyze_count:
        usage: "COUNTER"
        description: "Number of times this table has been manually analyzed"
    - autoanalyze_count:
        usage: "COUNTER"
        description: "Number of times this table has been analyzed by the autovacuum daemon"

pg_statio_user_tables:
    query: |
        SELECT current_database() datname, schemaname, relname, heap_blks_read, heap_blks_hit,
        idx_blks_read, idx_blks_hit, toast_blks_read, toast_blks_hit, tidx_blks_read, tidx_blks_hit FROM
        pg_statio_user_tables
    metrics:
        - datname:
            usage: "LABEL"
            description: "Name of current database"
        - schemaname:
            usage: "LABEL"
            description: "Name of the schema that this table is in"
        - relname:
            usage: "LABEL"
            description: "Name of this table"
        - heap_blks_read:
            usage: "COUNTER"
            description: "Number of disk blocks read from this table"
        - heap_blks_hit:
            usage: "COUNTER"
            description: "Number of buffer hits in this table"
        - idx_blks_read:
            usage: "COUNTER"
            description: "Number of disk blocks read from all indexes on this table"
        - idx_blks_hit:
            usage: "COUNTER"
            description: "Number of buffer hits in all indexes on this table"
        - toast_blks_read:
            usage: "COUNTER"
            description: "Number of disk blocks read from this table's TOAST table (if any)"
        - toast_blks_hit:
            usage: "COUNTER"
            description: "Number of buffer hits in this table's TOAST table (if any)"
        - tidx_blks_read:
            usage: "COUNTER"
            description: "Number of disk blocks read from this table's TOAST table indexes (if any)"
        - tidx_blks_hit:
            usage: "COUNTER"
            description: "Number of buffer hits in this table's TOAST table indexes (if any)"

pg_database:
    query: |

        SELECT pg_database.datname, pg_database_size(pg_database.datname) as size_bytes FROM pg_database
    master: true
    cache_seconds: 30
    metrics:
        - datname:
            usage: "LABEL"
            description: "Name of the database"
        - size_bytes:
            usage: "GAUGE"
            description: "Disk space used by the database"

```

```

pg_stat_statements:
  query: |
    SELECT t2.rolname, t3.datname, queryid, calls, total_plan_time / 1000 as
total_plan_time_seconds, total_exec_time / 1000 as total_exec_time_seconds, min_plan_time / 1000 as
min_plan_time_seconds, min_exec_time / 1000 as min_exec_time_seconds, max_plan_time / 1000 as
max_plan_time_seconds, max_exec_time / 1000 as max_exec_time_seconds, mean_plan_time / 1000 as
mean_plan_time_seconds, mean_exec_time / 1000 as mean_exec_time_seconds, stddev_plan_time / 1000 as
stddev_plan_time_seconds, stddev_exec_time / 1000 as stddev_exec_time_seconds, rows, shared_blks_hit,
shared_blks_read, shared_blks_dirtied, shared_blks_written, local_blks_hit, local_blks_read,
local_blks_dirtied, local_blks_written, temp_blks_read, temp_blks_written, blk_read_time / 1000 as
blk_read_time_seconds, blk_write_time / 1000 as blk_write_time_seconds FROM pg_stat_statements t1
JOIN pg_roles t2 ON (t1.userid=t2.oid) JOIN pg_database t3 ON (t1.dbid=t3.oid) WHERE t2.rolname !=
'rdsadmin'
  master: true
  metrics:
    - rolname:
      usage: "LABEL"
      description: "Name of user"
    - datname:
      usage: "LABEL"
      description: "Name of database"
    - queryid:
      usage: "LABEL"
      description: "Query ID"
    - calls:
      usage: "COUNTER"
      description: "Number of times executed"
    - total_plan_time_seconds:
      usage: "COUNTER"
      description: "Total plan time spent in the statement, in milliseconds"
    - total_exec_time_seconds:
      usage: "COUNTER"
      description: "Total exec time spent in the statement, in milliseconds"
    - min_plan_time_seconds:
      usage: "GAUGE"
      description: "Minimum plan time spent in the statement, in milliseconds"
    - min_exec_time_seconds:
      usage: "GAUGE"
      description: "Minimum exec time spent in the statement, in milliseconds"
    - max_plan_time_seconds:
      usage: "GAUGE"
      description: "Maximum plan time spent in the statement, in milliseconds"
    - max_exec_time_seconds:
      usage: "GAUGE"
      description: "Maximum exec time spent in the statement, in milliseconds"
    - mean_plan_time_seconds:
      usage: "GAUGE"
      description: "Mean plan time spent in the statement, in milliseconds"
    - mean_exec_time_seconds:
      usage: "GAUGE"
      description: "Mean exec time spent in the statement, in milliseconds"
    - stddev_plan_time_seconds:
      usage: "GAUGE"
      description: "Population standard deviation of plan time spent in the statement, in
milliseconds"
    - stddev_exec_time_seconds:
      usage: "GAUGE"
      description: "Population standard deviation of exec time spent in the statement, in
milliseconds"
    - rows:
      usage: "COUNTER"
      description: "Total number of rows retrieved or affected by the statement"
    - shared_blks_hit:

```

```

        usage: "COUNTER"
        description: "Total number of shared block cache hits by the statement"
- shared_blks_read:
    usage: "COUNTER"
    description: "Total number of shared blocks read by the statement"
- shared_blks_dirtied:
    usage: "COUNTER"
    description: "Total number of shared blocks dirtied by the statement"
- shared_blks_written:
    usage: "COUNTER"
    description: "Total number of shared blocks written by the statement"
- local_blks_hit:
    usage: "COUNTER"
    description: "Total number of local block cache hits by the statement"
- local_blks_read:
    usage: "COUNTER"
    description: "Total number of local blocks read by the statement"
- local_blks_dirtied:
    usage: "COUNTER"
    description: "Total number of local blocks dirtied by the statement"
- local_blks_written:
    usage: "COUNTER"
    description: "Total number of local blocks written by the statement"
- temp_blks_read:
    usage: "COUNTER"
    description: "Total number of temp blocks read by the statement"
- temp_blks_written:
    usage: "COUNTER"
    description: "Total number of temp blocks written by the statement"
- blk_read_time_seconds:
    usage: "COUNTER"
    description: "Total time the statement spent reading blocks, in milliseconds (if
track_io_timing is enabled, otherwise zero)"
- blk_write_time_seconds:
    usage: "COUNTER"
    description: "Total time the statement spent writing blocks, in milliseconds (if
track_io_timing is enabled, otherwise zero)"

```

Appendix B Default Alert Rules

```
apiVersion: monitoring.coreos.com/v1
kind: PrometheusRule
metadata:
  name: {{ ansible_operator_meta.name }}-{{ item.name }}-alertrules
  namespace: {{ ansible_operator_meta.namespace }}
  labels:
    app: prometheus-postgres-exporter-alertrules
    name: {{ ansible_operator_meta.name }}-{{ item.name }}-alertrules
spec:
  groups:
    - name: fep-container
      rules:
        - alert: ContainerDisappeared
          annotations:
            description: {{ 'Container {{$labels.container}}/{{$labels.pod}} from
            {{$labels.namespace}} has been disappeared' }}
            summary: Container Pod disappeared.
          expr: time() -
            container_last_seen{ container="fep-patroni",
            namespace="{{ ansible_operator_meta.namespace }}", pod=~"^{item.name}-sts-.*" } > 60
          labels:
            severity: warning
        - alert: ContainerHighCPUUsage
          annotations:
            description: {{ 'Container {{$labels.container}}/{{$labels.pod}} from
            {{$labels.namespace}} has been high on CPU usage(>80%) for 5 mins' }}
            summary: High Container CPU usage.
          expr:
            (sum(node_namespace_pod_container:container_cpu_usage_seconds_total:sum_rate{pod=~"{{ item.name }}-
            sts.*", namespace="{{ ansible_operator_meta.namespace }}", container="fep-patroni"}) by
            (pod,namespace,container)/sum(kube_pod_container_resource_limits_cpu_cores) by
            (pod,namespace,container))*100 > 80
          for: 5m
          labels:
            severity: warning
        - alert: ContainerHighRAMUsage
          annotations:
            description: {{ 'Container {{$labels.container}}/{{$labels.pod}} from
            {{$labels.namespace}} has been high on RAM usage(>80%) since 30 mins' }}
            summary: High container memory usage.
          expr: sum(container_memory_working_set_bytes{pod=~"{{ item.name }}-sts.*",
            namespace="{{ ansible_operator_meta.namespace }}", container="fep-patroni" } /
            container_spec_memory_limit_bytes * 100) by (pod, container, instance) > 80
          for: 30m
          labels:
            severity: warning
        - alert: PVCLowDiskSpace
          annotations:
            description: {{ 'Found low disk space on {{$labels.persistentvolumeclaim}} in
            {{$labels.namespace}} namespace.' }}
            summary: {{ 'Found low disk space on {{$labels.persistentvolumeclaim}} in
            {{$labels.namespace}} namespace.' }}
          expr:
            kubelet_volume_stats_available_bytes{namespace="{{ ansible_operator_meta.namespace }}",
            persistentvolumeclaim=~"fep.*{item.name}.*"} / (kubelet_volume_stats_capacity_bytes) * 100 < 10
          for: 5m
          labels:
            severity: warning
    - name: postgres
      rules:
```



```

- alert: PostgresqlDown
  annotations:
    description: "Postgresql one or more instances are down in FEPCluster {{ item.name }} in
  {{ ansible_operator_meta.namespace }} namespace. Please check the FEP pods in this cluster"
    summary: "Postgresql FEPCluster {{ item.name }} in {{ ansible_operator_meta.namespace }}
  namespace is degraded"
    expr: count(pg_static{ namespace="{{ ansible_operator_meta.namespace }}",
  service="{{ ansible_operator_meta.name }}-service", server=~"{{item.name}}-sts.*" }) <
  {{item.instances | length}}
    labels:
      severity: error
- alert: PostgresqlTooManyConnections
  annotations:
    description: {{ 'PostgreSQL instance has too many connections on server
  {{ $labels.server }} in {{ $labels.namespace }} namespace.' }}
    summary: {{ 'Postgresql too many connections (FEPCluster server {{ $labels.server }})' }}
    expr: pg_capacity_connection_total{namespace="{{ ansible_operator_meta.namespace }}",
  service="{{ ansible_operator_meta.name }}-service", server=~"{{ item.name }}-sts.*"}/
  pg_settings_max_connections > 0.9
    labels:
      severity: warning

```