Academic Database Design Project – Medical Center Chain DB

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Executive Summary

Dr. Robert Slate, owner and president of FirstCare Medical Centers, Inc in Alcoa, Florida requires an electronic, database driven system to take the place of the current manual paper system. The four FirstCare centers require center dependent tracking of patients, employees, nurses, pharmacists, contract physician scheduling, prescriptions, appointments and pharmaceutical inventory. The system must also be capable of reporting on physician assignments, daily appointments, revenue from medical care and pharmacy activity, vendor activity, daily dispensed drug log and a separate log of dispensed controlled substances. Appointments must be tracked, both by each physician's weekly schedule at the various centers and by each center's daily appointments.

Dr. Slate's only constraint is that the system should be able to print a profile card and prescription label in the same format as is in use now. He is not currently interested in tracking payroll, accounts payable, and all other financial transactions or non-pharmacy supplies. Prescription logs for each patient will be generated on demand, as will reports on daily pharmacy sales, with a special requirement of reporting all controlled substances dispensed daily as a separate report from non-controlled drugs.

Above all, the design will contribute to the productivity of each location, and will improve the overall success of the chain.

Entities and Attributes

APPOINTMENT (<u>AppointmentID</u>, *PatientID*, *CenterID*, Date, StartTime, *PhysicianID*, Reason, Fee, *ScheduleID*)

ADMIN (<u>*SSN*</u>, JobTitle)

CENTER (<u>CenterID</u>, CenterName, Street, City, State, Zip, Phone, Fax, *ManagerSSN*)

DRUG (<u>NDCID,</u> DrugName, Strength, PackageQty, Unit, LegalClass, PrincipalUse, AWP)

DRUG_INVENTORY (<u>*NDCID*</u>, <u>*CenterID*</u>, MinStockLvl, CurrentStockLvl)

DRUG_ORDER (<u>OrderID</u>, DatePlaced, DateArrived, TotalOrderCost, *VendorID, CenterID*)

DRUG_ORDERED (<u>*OrderID*</u>, <u>*DrugID*</u>, AmtOrdered, AmtArrived, DrugCostEach)

EMPLOYEE (<u>SSN</u>, FirstName, MiddleInitial, LastName, Street, City, State, Zip, Phone, *CenterID*, EmployeeType)

NURSE (<u>*SSN*</u>, LicenseNum, LicenseExp)

PATIENT (<u>PatientID</u>, FirstName, LastName, Street, City, State, Zip, Phone, InsuranceStatus)

PHARMACIST (<u>*SSN*</u>, LicenseNum, LicenseExp)

PHYSICIAN (<u>DEAID</u>, FirstName, LastName, Pager)
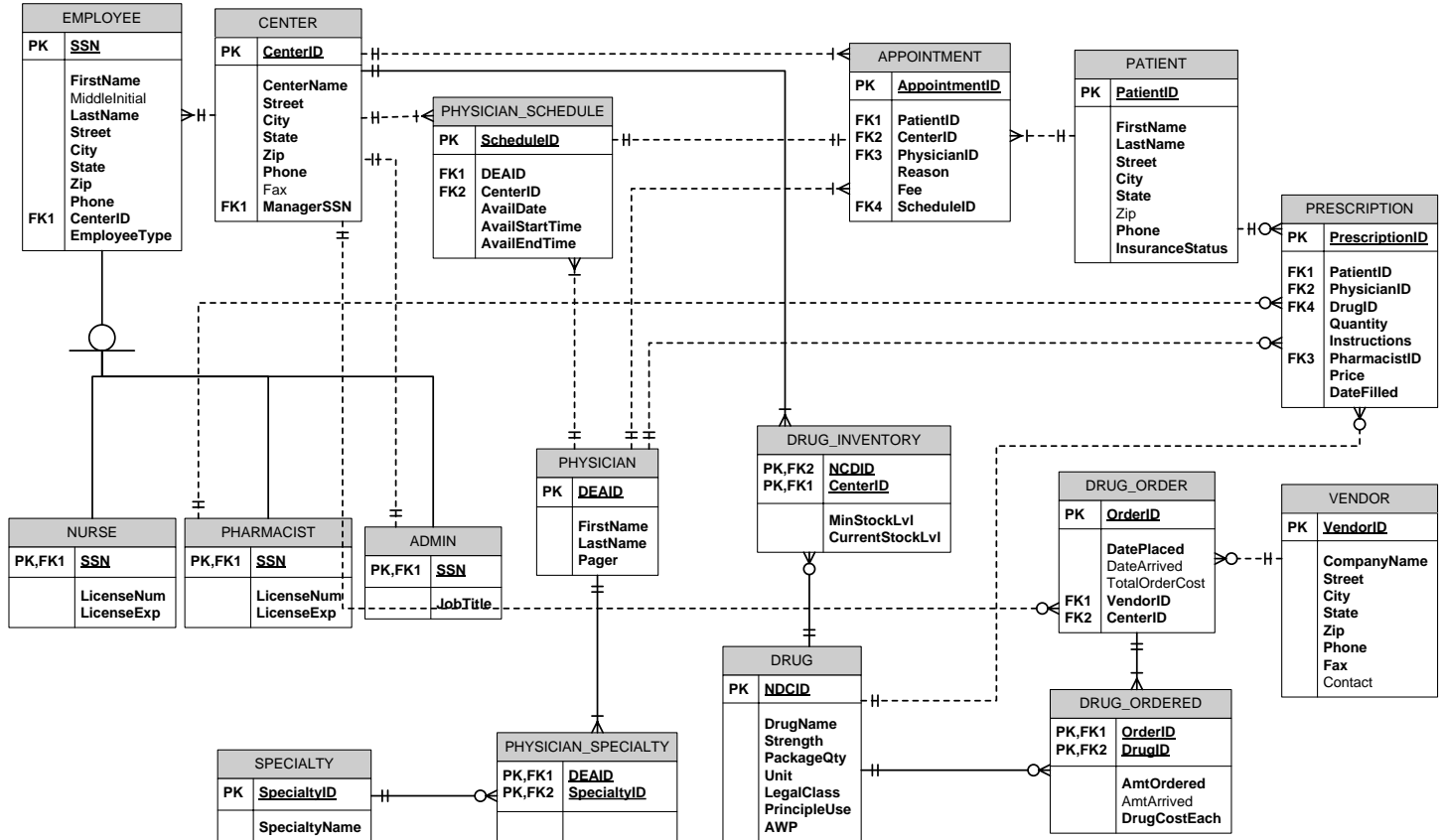
PHYSICIAN_SCHDEULE (<u>ScheduleID</u>, *DEAID*, *CenterID*, AvailDate, AvailStartTime, AvailEndTime)

PHYSICIAN_SPECIALTY (<u>*DEAID*</u>, <u>*SpecialtyID*</u>)

PRESCRIPTION (<u>PrescriptionID</u>, *PatientID, PhysicianID, DrugID,* Quantity, Instructions, *PharmacistID*, Price, DateFilled)

VENDOR (<u>VendorID</u>, CompanyName, Street, City, State, Zip, Phone, Fax, Contact)

Entity-Relationship Diagram

EMPLOYEE
PK	SSN
	FirstName
	MiddleInitial
	LastName
	Street
	City
	State
	Zip
	Phone
FK1	CenterID
	EmployeeType

CENTER
PK	CenterID
	CenterName
	Street
	City
	State
	Zip
	Phone
	Fax
FK1	ManagerSSN

PHYSICIAN_SCHEDULE
PK	ScheduleID
FK1	DEAID
FK2	CenterID
	AvailDate
	AvailStartTime
	AvailEndTime

APPOINTMENT
PK	AppointmentID
FK1	PatientID
FK2	CenterID
FK3	PhysicianID
	Reason
	Fee
FK4	ScheduleID

PATIENT
PK	PatientID
	FirstName
	LastName
	Street
	City
	State
	Zip
	Phone
	InsuranceStatus

PRESCRIPTION
PK	PrescriptionID
FK1	PatientID
FK2	PhysicianID
FK4	DrugID
	Quantity
	Instructions
FK3	PharmacistID
	Price
	DateFilled

NURSE
PK,FK1	SSN
	LicenseNum
	LicenseExp

PHARMACIST
PK,FK1	SSN
	LicenseNum
	LicenseExp

ADMIN
PK,FK1	SSN
	JobTitle

PHYSICIAN
PK	DEAID
	FirstName
	LastName
	Pager

DRUG_INVENTORY
PK,FK2	NCDID
PK,FK1	CenterID
	MinStockLvl
	CurrentStockLvl

DRUG_ORDER
PK	OrderID
	DatePlaced
	DateArrived
	TotalOrderCost
FK1	VendorID
FK2	CenterID

VENDOR
PK	VendorID
	CompanyName
	Street
	City
	State
	Zip
	Phone
	Fax
	Contact

DRUG
PK	NDCID
	DrugName
	Strength
	PackageQty
	Unit
	LegalClass
	PrincipleUse
	AWP

DRUG_ORDERED
PK,FK1	OrderID
PK,FK2	DrugID
	AmtOrdered
	AmtArrived
	DrugCostEach

SPECIALTY
PK	SpecialtyID
	SpecialtyName

PHYSICIAN_SPECIALTY
PK,FK1	DEAID
PK,FK2	SpecialtyID

Data Dictionary

ADMIN

Column Name	DataType	PK or FK	Required	Contents	Format
SSN	Char(11)	PK,FK	Yes	Administrative Personel SSN	999-99-9999
JobTitle	Char(20)	No	Yes	Employee job title	Xxxxxxx

Referential integrity – SSN in ADMIN must exist in SSN in EMPLOYEE.

APPOINTMENT

Column Name	DataType	PK or FK	Required	Contents	Format
AppointmentID	Char(7)	PK	Yes	Appointment ID#	9999999
PatientID	Char(6)	FK	Yes	Patient ID#	999999
CenterID	Char(1)	FK	Yes	Center ID#	9
Date	Date	No	Yes	Date of appt.	dd-mm-yyyy
StartTime	Time	No	Yes	Appt start time	99:99
PhysicianID	Char(9)	FK	Yes	MD Last Name, MDFirstName	Xxxxxx,Xxxxxx
Reason	Char(100)	No	Yes	Pt chief complaint	Xxxxxxx
Fee	Numeric(3,2)	No	Yes	Fee for visit	999.99
ScheduleID	Char(8)	FK	Yes	Schedule ID#	99999999

Referential integrity – PatientID in APPOINTMENT must exist in PatientID in PATIENT.
CenterID in APPOINTMENT must exist in CenterID in CENTER. PhysicianID in APPOINTMENT must exist in DEAID in PHYSICIAN. ScheduleID in APPOINTMENT must exist in ScheduleID in PHSYCIAN_SCHEDULE.

CENTER

Column Name	DataType	PK or FK	Required	Contents	Format
CenterID	Char(1)	PK	Yes	Center ID#	9
CenterName	Char(40)	No	Yes	Center Name	Xxxxxxxx
Street	Char(35)	No	Yes	Center Street	Xxxxxxxx
City	Char(35)	No	Yes	Center City	Xxxxxxxx
State	Char(2)	No	Yes	Center State	Xx
Zip	Char(10)	No	Yes	Center Zip	99999-9999
Phone	Char(12)	No	Yes	Center Phone	999-999-9999
Fax	Char(12)	No	No	Center Fax	999-999-9999
ManagerSSN	Char(11)	FK	Yes	Center Mgr SSN	999-99-9999

Referential Integrity – ManagerSSN in CENTER must exist in SSN in ADMIN.

DRUG

Column Name	DataType	PK or FK	Required	Contents	Format
NDCID	Char(13)	PK	Yes	Drug ID#	99999-9999-99
DrugName	Char(50)	No	Yes	Med Name	Xxxxxx
Strength	Char(10)	No	Yes	Med Strength	Xxxxxx
PackageQty	Numeric(3)	No	Yes	Amt in Pack	999
Unit	Char(5)	No	Yes	Med unit Measurement	Xxxx
LegalClass	Char(10)	No	Yes	Med Legal Class	Xxxxx
PrincipleUse	Char(30)	No	Yes	Med Therapeutic use	Xxxxx
AWP	Numeric(3,2)	No	Yes	Average Wholesale Price	999.99

DRUG_INVENTORY

Column Name	DataType	PK or FK	Required	Contents	Format
NDCID	Char(13)	PK,FK	Yes	Drug ID#	99999-9999-99
CenterID	Char(1)	PK,FK	Yes	Center ID#	9
MinStockLvl	Int	No	Yes	Min. Inventory	999
CurrentStockLvl	Int	No	Yes	Amount on Hand	999

Referential Integrity – DrugID in DRUG_INVENTORY must exist in NCDID in DRUG. CenterID in DRUG_INVENTORY must exist in CenterID in CENTER.

DRUG_ORDER

Column Name	DataType	PK or FK	Required	Contents	Format
OrderID	Char(6)	PK	Yes	Drug Order #	9-9999
DatePlaced	Date	No	Yes	Date of Order	dd-mm-yyyy
DateArrived	Date	No	No	Date Order Arrived	dd-mm-yyyy
TotalOrderCost	Numeric(5,2)	No	No	Total Cost of Order	99999.99
VendorID	Char(2)	FK	Yes	Vendor ID#	9
CenterID	Char(1)	FK	Yes	Center ID#	9

Referential Integrity – VendorID in DRUG_ORDER must exist in VendorID in VENDOR. CenterID in DRUG_ORDER must exist in CenterID in CENTER.

DRUG_ORDERED

Column Name	DataType	PK or FK	Required	Contents	Format
OrderID	Char(6)	PK,FK	Yes	Drug Order #	9-9999

Column Name	DataType	PK or FK	Required	Contents	Format
DrugID	Char(13)	PK,FK	Yes	Drug ID #	99999-9999-99
AmtOrdered	Numeric(5)	No	Yes	Amount of Med ordered	99999
AmtArrived	Numeric(5)	No	No	Amount of Med Received	99999
DrugCostEach	Numeric(3,2)	No	Yes	Cost Each Med	999.99

Referential Integrity – OrderID in DRUG_ORDERED must exist in OrderID in DRUG_ORDER. DrugID in DRUG_ORDERED must exist in NDCID in DRUG.

EMPLOYEE

Column Name	DataType	PK or FK	Required	Contents	Format
SSN	Char(11)	PK	Yes	Employee SSN	999-99-9999
FirstName	Char(25)	No	Yes	Employee First Name	Xxxxxxx
MiddleInitial	Char(1)	No	No	Middle Initial	X
LastName	Char(25)	No	Yes	Employee Last Name	Xxxxxxx
Street	Char(35)	No	Yes	Employee Street	Xxxxxxx
City	Char(35)	No	Yes	Employee City	Xxxxxxx
State	Char(2)	No	Yes	Employee State	Xx
Zip	Char(10)	No	Yes	Employee Zip	99999-9999
Phone	Char(12)	No	Yes	Employee Phone	999-999-9999
CenterID	Char(1)	FK	Yes	Center ID#	9
EmployeeType	Char(15)	No	Yes	Employee Job Type	X

Referential integrity – CenterID in EMPLOYEE must exist in CenterID in CENTER.

NURSE

Column Name	DataType	PK or FK	Required	Contents	Format
SSN	Char(11)	PK,FK	Yes	Employee SSN	999-99-9999
LicenseNumber	Char(09)	No	Yes	Nurse License #	Xxxxxxxxx
LicenseExp	Date	No	Yes	License Exp date	dd-mm-yyyy

Referential integrity – SSN in NURSE must exist in SSN in EMPLOYEE.

PATIENT

Column Name	DataType	PK or FK	Required	Contents	Format
PatientID	Char(6)	PK	Yes	Patient ID#	999999
FirstName	Char(25)	No	Yes	Pt First Name	Xxxxxx
LastName	Char(25)	No	Yes	Pt Last Name	Xxxxxx
Street	Char(35)	No	Yes	Pt Street	Xxxxxx
City	Char(35)	No	Yes	Pt City	Xxxxxx
State	Char(2)	No	Yes	Pt State	Xx

Zip	Char(10)	No	No	Pt Zip	99999
Phone	Char(12)	No	Yes	Pt Phone	999-999-9999
InsuranceStatus	Bool(1)	No	Yes	Pt insurance status	X

PHARMACIST

Column Name	DataType	PK or FK	Required	Contents	Format
SSN	Char(11)	PK,FK	Yes	Pharmacist SSN	999-99-9999
LicenseNumber	Char(09)	No	Yes	Pharmacist License#	Xxxxxxxxx
LicenseExp	Date	No	Yes	License Exp date	dd-mm-yyyy

Referential integrity – SSN in PHARMACIST must exist in SSN in EMPLOYEE.

PHYSICIAN

Column Name	DataType	PK or FK	Required	Contents	Format
DEAID	Char(9)	PK	Yes	MD DEA#	Xxxxxxxxx
FirstName	Char(25)	No	Yes	MD First Name	Xxxxxx
LastName	Char(25)	No	Yes	MD Last Name	Xxxxxx
Pager	Char(12)	No	Yes	MD pager	999-999-9999

PHYSICIAN_SCHEDULE

Column Name	DataType	PK or FK	Required	Contents	Format
ScheduleID	Char(8)	PK	Yes	Schedule ID#	99999999
DEAID	Char(9	FK	Yes	MD DEA #	Xxxxxxxxx
CenterID	Char(1)	FK	Yes	Center ID#	9
AvailDate	Date	No	Yes	Available Date	dd-mm-yyyy
AvailStartTime	Time	No	Yes	Available Start Time	99:99
AvailEndTime	Time	No	Yes	Available End Time	99:99

Referential Integrity – DEAID in PHYSICIAN_SCHEDULE must exist in DEAID in PHYSICIAN. CenterId in PHYSICIAN_SCHEDULE must exist in CenterID in CENTER.

PHYSICIAN_SPECIALTY

Column Name	DataType	PK or FK	Required	Contents	Format
DEAID	Char(9)	PK, FK	Yes	MD DEA#	Xxxxxxxxx
SpecialtyID	Char(4)	PK, FK	Yes	MD Specialty ID#	9999

Referential Integrity –DEAID in PHYSICIAN_SPECIALTY must exist in DEAID in PHYSICIAN. SpecialtyID in PHYSICIAN_SPECIALTY must exist in SpecialtyID in SPECIALTY.

PRESCRIPTION

Column Name	DataType	PK or FK	Required	Contents	Format
PrescriptionID	Char(6)	PK	Yes	Prescription ID#	Xxxxxx
PatientID	Char(6)	FK	Yes	Patient ID#	999999
PhysicianID	Char(9)	FK	Yes	MD Last & First Name	Xxxxxx,Xxxxx
DrugID	Char(13)	FK	Yes	Drug ID#	99999-9999-99
Quantity	Numeric(3)	No	Yes	Amt ordered	999
Instructions	Char(200)	No	Yes	Med instructions	Xxxxxx
PharmacistID	Char(25)	FK	Yes	Pharmacist Last & First Name	Xxxxxxx,Xxxxxx
Price	Numeric(3,2)	No	Yes	Price of Med	999.99
DateFilled	Date Filled	No	Yes	Date Rx Ordered	dd-mm-yyyy

Referential Integrity – PatientID in PRESCRIPTION must exist in PatientID in PATIENT. PhysicianID in PRESCRIPTION must exist in DEAID in PHYSICIAN. DrugID in PRESCRIPTION must exist in NDCID in DRUG. DrugName in PRESCRIPTION must exist in DrugName in DRUG. PharmacistID in PRESCRIPTION must exist in SSN in PHARMACIST. CenterID in PRESCRIPTION must exist In CenterID in CENTER.

SPECIALTY

Column Name	DataType	PK or FK	Required	Contents	Format
SpecialtyID	Char(4)	PK	Yes	MD Specialty ID#	9999
SpecialtyName	Char(20)	No	Yes	MD Specialty Name	Xxxxxx

VENDOR

Column Name	DataType	PK or FK	Required	Contents	Format
VendorID	Char(1)	PK	Yes	Vendor ID #	9
CompanyName	Char(50)	No	Yes	Vendor Name	Xxxxxx
Street	Char(35)	No	Yes	Vendor Street	Xxxxxx
City	Char(35)	No	Yes	Vendor City	Xxxxxx
State	Char(2)	No	Yes	Vendor State	Xx
Zip	Char(5)	No	Yes	Vendor Zip	99999
Phone	Char(12)	No	Yes	Vendor Phone	999-999-9999
Fax	Char(12)	No	Yes	Vendor Fax	999-999-9999
Contact	Char(60)	No	No	Vendor Contact	Xxxxxx

Backup/Disaster Recovery Plan

PRELIMINARIES

This document contains disaster recovery procedures for recovery of the database Server that houses the database for FirstCare Medical Centers.

This document assumes that we are using SQL 2005 Server as our RDBMS. There is also a backup Server used to backup the database using an SMB backup application (Veritas Backup Exec). See figure 1-1. An automatically scheduled database "dump" occurs via a SQL maintenance plan and is copied to a locally attached disk array on DB1. An automatically scheduled backup job is used to backup the "dumps" from DB1 and are copied to tape with the backup application. Full tapes are rotated out by local administration staff using a "How-to" document.

A complete list of operating system and database passwords is kept in the fire safe in the storage room in FirstCare Medical Center building 1 along with a copy of the Windows 2003 Server and SQL 2005 installation media. Contact Security if you need help with the door keys or alarm code.

The core admin systems are currently SQL Server 2005, and run on a Windows Server 2003 called DB1 in a storage room in FirstCare Medical Center building 1. There is a single database (FMC) on the DB1 Server. Development and testing takes place on DB2, which is the standby database Server in the FirstCare Medical Center building 2 and can be used as a backup database Server in case DB1 has hardware failures. DB2 has SQL Server 2005 and has a "shell" database named "FMC" also, the same name as the production Server's database. See Figure 1-2.
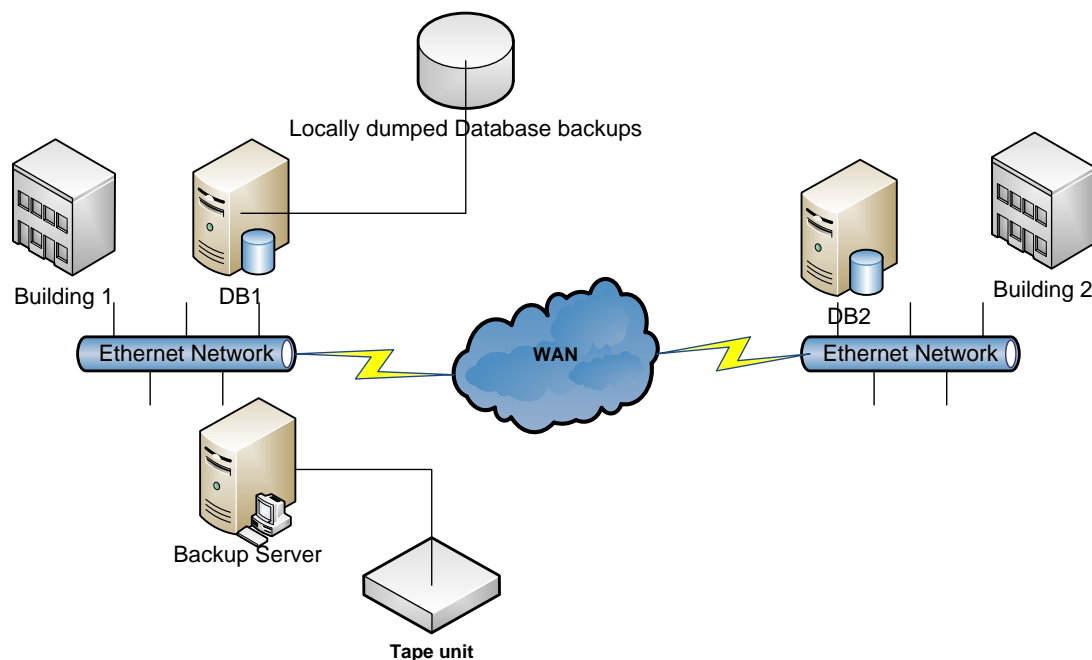

FIGURE 1-2

Recovery Models

In order to begin working on backups, the business needs define a database recovery model. In essence, a **recovery model** defines what you're going to do with the transaction log data.

- **Full** – in full recovery mode you backup the database and the transaction log so that you can recover the database to any point in time.

We will be using a Full recovery model, which will enable us to recover the database to any point in time. The Full backup will be stored on a dedicated RAID storage array attached to the database Server (DB1). The backup Server will then run a scheduled backup session to backup the locally dumped database export (BAK file) to a locally attached tape drive unit.

Backups are performed using a pre configured maintenance plan within SQL Server Management Studio. Tape backups are scheduled nightly, a full once a week on Sundays, and differential backups every other night. Tapes used for differential backups are recycled on a monthly cycle and full backups are sent offsite for 1 year. Backup tapes from DB1 are sent offsite to Iron Mountain (http://www.ironmountain.com/dataprotection/vault/) for secure storage. In the event that a restore needs to be performed using tapes that have been sent offsite, tapes can be retrieved within the hour using Iron Mountains online tape retrieval system.

Recovery Time Objectives (RTO)

2 hours, in case of standard failure, and a 24 hour RTO for a complete site failure.

Database Backup Schedule

Full (level 0) backup weekly (every Sunday)
Differential (level 2) every other day (Monday to Saturday)
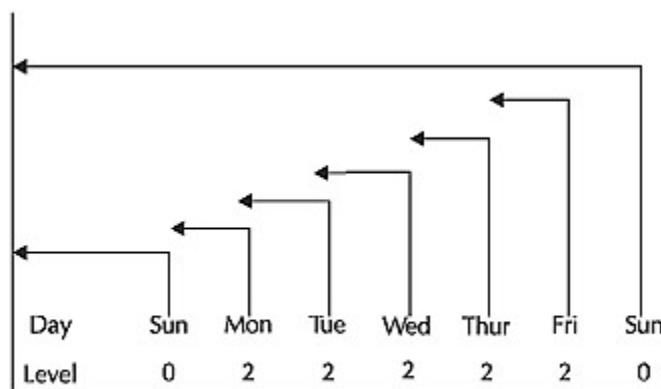Approximate backup window <= 8 hours.

FIGURE 1–2: Differential backups

RECOVERING A CORRUPT DATABASE ON DB1

In cases of database corruption, you can restore the database to a prior state, the last successful backup.

Recovery with database export(s)
Full exports of all the live databases are written to disk every night in a .BAK file format. These files will be used to recover the database to the point in time of the last successful backup. If the local disk array on DB1 is accessible you may use this procedure.

1. Locate the relevant export file on disk. The files are named by date. i.e.: month_day_year.BAK. Copy the .BAK file to a folder on DB2. If recovering a full backup, copy the full backup file. If recovering from a differential backup, copy the last full backup and the most recetn differential backup file.
2. Shutdown the database.
3. Use SQL Server Management Studio to restore the database to the existing FMC database from the backup file (BAK file). Use the "Overwrite the existing database" option.

RECOVERING TO THE DB2 SERVER

In cases of data corruption, disk failure or other problems on DB1 that cannot be easily repaired, you may restore to the standby Server, DB2.

Recovery with database export(s)
Full exports of all the live databases are written to disk every night in a .BAK file format. These files will be used to recover the database to the point in time of the last successful backup. If the local disk array on DB1 is accessible you may use this procedure.

1. Locate the relevant export file (.BAK file) on disk. The files are named by date. i.e.: month_day_year.BAK. Copy the .BAK file to the c:\recovery folder on DB2. If recovering a full backup, copy the full backup file. If recovering from a differential backup, copy the last full backup and the most recent differential backup file.
2. Shutdown the database.
3. Use SQL Server Management Studio to restore the database to the existing FMC database from the backup file (BAK file). Use the "Overwrite the existing database" option.

Recovery from cold backup(s)
If you've completely lost all the locally backed up .BAK files stored on the locally attached RAID array on DB1, you will need to restore the backup file from tape to DB2 to recover the database.

1. Make a note of the files to be restored, and check that it's possible to restore them to their exact original locations.
2. If they're still up, shut down the affected databases. If in doubt, shut down all the live databases.

3. Get the required tape from storage.
4. Load the tape into the tape changer.
5. Each backup tape holds several backup sets, each of which corresponds to a backup on any given day. Locate the file and restore if to C:\recovery on DB2.
6. Use SQL Server Management Studio to restore the database to the existing FMC database from the backup file (BAK file). Use the "Overwrite the existing database" option.

TEST

Once the recovery process is complete, connect to the database and verify that all data is intact. Run through a test procedure of creating and modifying entries in each table. If no issues are encountered, then the recovery was successful.