Solution 5

NOTE: My interpretation of the context is that date and time distinguishes records by highly finite amounts, such as nanoseconds, rather than being grouped into a single time for the whole of a scan.

Records / Rows:

Scanned Area Count (SAC)	= (Single area = 20,000m * 100,000m) * 10 scans
	= 20,000,000,000 (20 billion measurements)
Co-ordinates Size (COS)	= 8 bytes
Measurement Description (MD)	= 100 bytes
Measurement Size (MS)	= SAT * (CO + MD)
	= 20,000,000,000 * (8 + 100) bytes
	= 2,160,000,000,000 bytes
	= 2,109,375,000 kilobytes
	= 2,059,936.5234375 megabytes
	= 2,011.656761169434 gigabytes
	= 1.964508555829525 terabytes

Data:

Date and Time (DT)	= 10 bytes
Laser Description (LD)	= 5 bytes
Airplane Description (AD)	= 15 bytes

Storage:

Disk Block (DB)	= 16 kilobytes
	= 16384 bytes
Block Header (BH)	= 80 bytes
Table Header (TH)	= 0 bytes
Row Directory Entry (RDE)	= 4 bytes

Solutions:

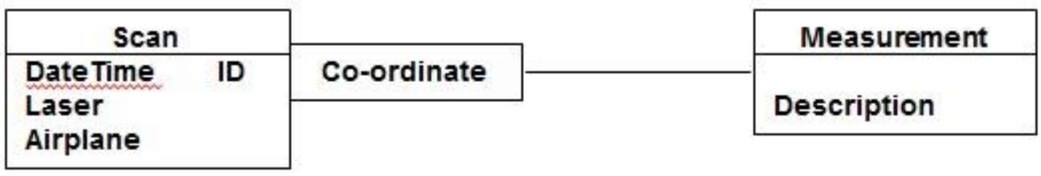
Method 1

Tables:

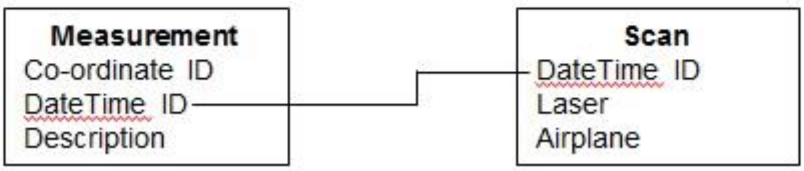
Measurement: Co-ordinate ID, DateTime ID, Description

Scan: DateTime ID, Laser, Airplane

Conceptual Schema:



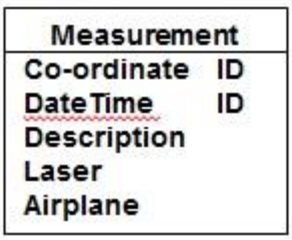
Relational Schema:



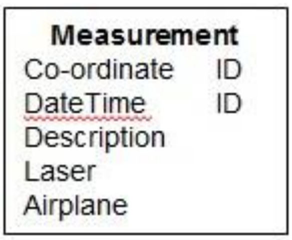
Method 2

Measurement: Co-ordinate ID, DateTime ID, Description, Laser, Airplane

Conceptual Schema:



Relational Schema:



Calculations for Method 1:

Measurement Table:

Average rows per Block (R)	$= ?$
Total Block Header (TBH)	$= BH + RDE * R$
	$= 80 + 4 * ?$
PCTFREE = 0 (assumed)	
Available Data Space per Block (ADS)	$= (DB - TBH) * (100 - PCTFREE) / 100$
	$= (16384 - (80 + 4 * R)) * (100-0)/100$
	$= (16304 - 4 * R) * 1 \approx$
	$= 16304 - 4 * R$
RowSize (RSize)	$= MD + COS + DT$
	$= (100 + 8 + 10)$ bytes
	$= 118$ bytes
R	$= ADS / RSize$
	$= (16304 - 4 * R) / 118$
	$\approx 138 - 0.04 * R$
hence	$138 - 0.04 * R = R \Rightarrow R \approx 137.96$
Blocks	$= SAC / R$
	$= 20{,}000{,}000{,}000 / 137.96$
	≈ 144969556 blocks
Bytes	$=$ Blocks $* DB$
	$= (144{,}969{,}556 * 16384)$ bytes
	≈ 2.16021 terabytes

Scan Table:

Average rows per Block (R)	= ?
Total Block Header (TBH)	= 80 + 4 * ? (solved previously)
PCTFREE = 0 (assumed)	
Available Data Space per Block (ADS)	= 16304 – 4 * R (solved previously)
RowSize (RSize)	= DT + LD + AD
	= (10 +5 + 15) bytes
	= 30 bytes
R	= ADS / RSize
	= (16304 – 4 * R) / 30
	≈ 543 – 0.13 * R
hence	543 – 0.13 * R = R => R ≈ 542.87
Blocks	= SAC / R
	= 20,000,000,000 / 542.87
	≈ 36841233 blocks
Bytes	= Blocks * DB
	= (36841233 * 16384) bytes
	≈ 0.54898 terabytes

Total Size of Calculations for Method 1:

Storage Size = (2.16021 + 0.54898) terabytes

= 2.70919 terabytes

Calculations for Method 2:

Measurement Table:

Average rows per Block (R)	= ?
Total Block Header (TBH)	= 80 + 4 * ? (solved previously)
PCTFREE = 0 (assumed)	
Available Data Space per Block (ADS)	= 16304 – 4 * R (solved previously)
RowSize (RSize)	= MD + COS + DT + LD + AD
	= (100 + 8 + 10 + 5 + 15) bytes
	= 138 bytes
R	= ADS / RSize
	= (16304 – 4 * R) / 138
	≈ 118 – 0.03 * R
hence	118 – 0.03 * R = R => R ≈ 117.97
Blocks	= SAC / R
	= 20,000,000,000 / 117.97
	≈169,534,627 blocks
Bytes	= Blocks * DB
	= (144,969,556 * 16384) bytes
	≈ 2.52626 terabytes

Total Size of Calculations for Method 2:

Storage Size = 2.52626 terabytes

Result:

Storage size for method 2 is less than method 1:

(2.52626 terabytes < 2.70919 terabytes)

As such, storage method 2 is more optimal, due to storage concerns.