

# Space Control

or

how to stop loosing space and time and become living

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- working with Oracle since 2001
- Senior technical expert, Oracle DBA
- Oracle Database OCP 8i/9i/10g/11g,
- Oracle Application Server OCP 9i/10g
- IBM DB2 Database CA

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# Part I – Is it really actual?

# Space problems

Some **real** cases I was invited to solve (just in last year)

- Test server in one big bank was unusable for **~ 2 weeks!**
  - OS findings (82% of / (root) mountpoint!):
    - 7.3 GB – old backup
    - 6.6 GB – log-files
    - 2.57 GB – some business data dumps archive
    - 7.15 GB – 395 core-dump files
  - DB findings to free space (% of DB size):
    - 0.8 GB – unused redo-log files
    - 5 GB – re-create UNDO tablespace
    - 1.5 GB – re-create TEMP tablespace
    - 12-13 GB – by running SHRINK operation in 10g DB
    - Even more – by rebuilding indexes
- Perfstat tablespace fragmentation
  - ~ 417 MB of unusable space
    - filled with segments “free” extents < 64MB
- Regular shortage on development SPARC box – too expensive HDD to add more

# Space problems

We still have cases for manual work:

- Small problems/tasks at least once per month
- Big problems - once per 1-2 year(s), depending on count of managed servers

Why it sounds like a problem:

- It happens
- It happens at wrong time:
  - night
  - weekend
  - last day before upgrade (patching, migration, reorganisation, big data load....)
- “I am not guilty!” - in most cases problem is not due DB wrong configuration

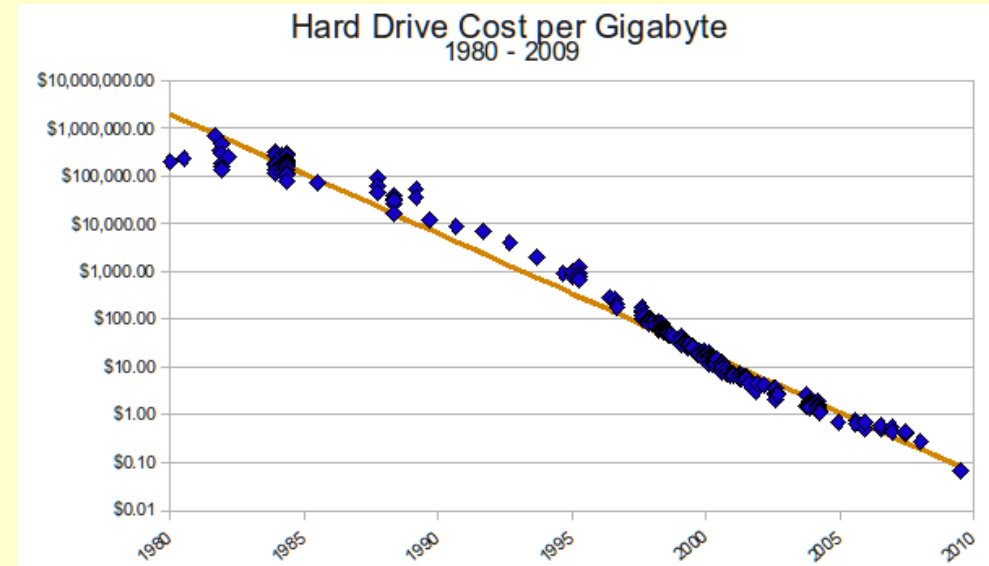
# Big deal?

## Is it big deal to resolve?

- In most cases short-term solutions can be found
- Not so easy in long-term
  - amount of data is rising exponentially
- Kill It With Iron (KIWI) – is still most popular

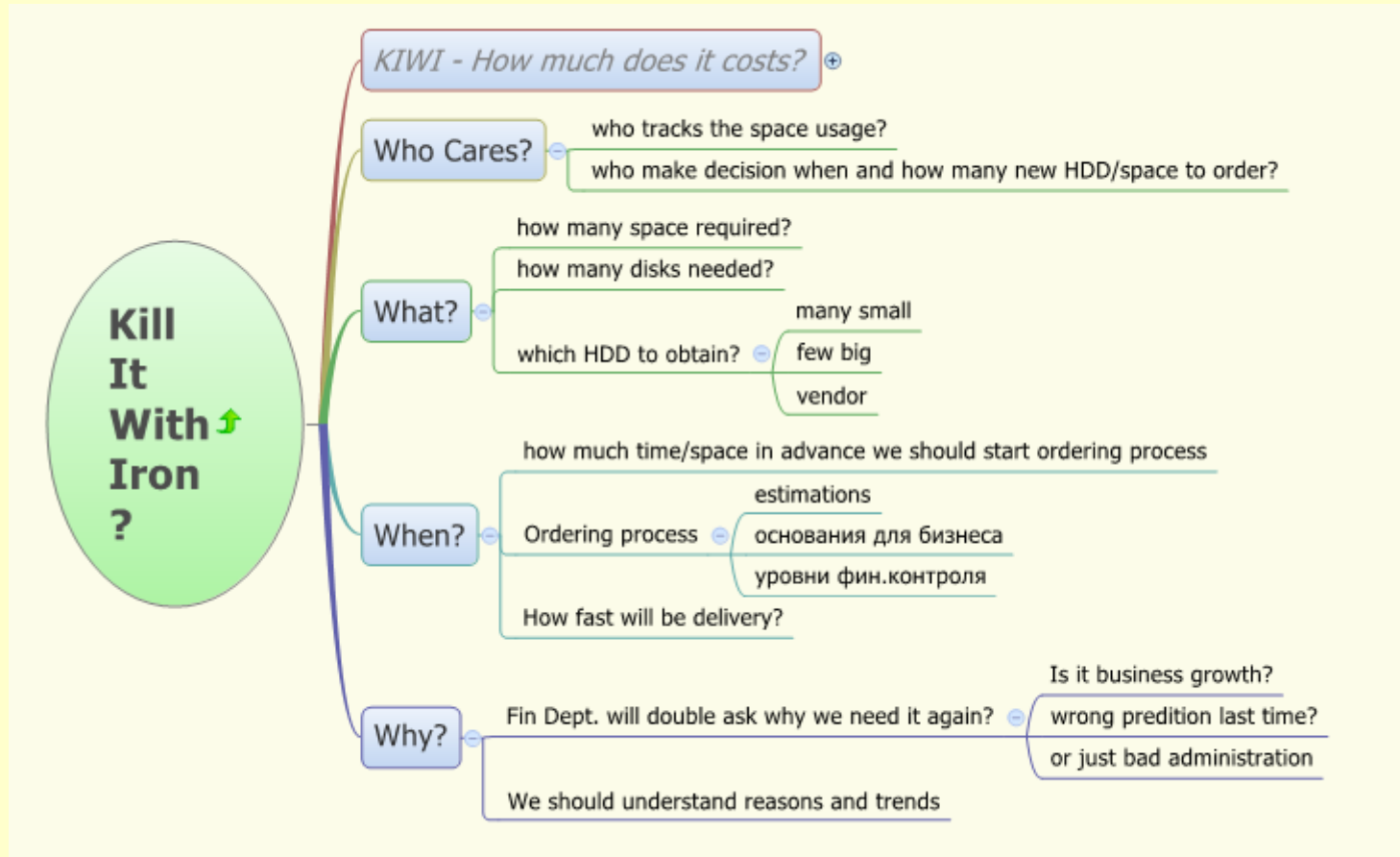
## KIWI costs:

- Just HDD prices
  - Cost per GB is falling
  - But can be exceptions like in 2011
- Disk array ( has physical limits on HDD count)
- Branded hardware expert service
  - Special price in remote DC!
- Sysadmins/DBA time to make new HDD space available for DB/APP
- **Business downtime – lost revenue + penalties.**



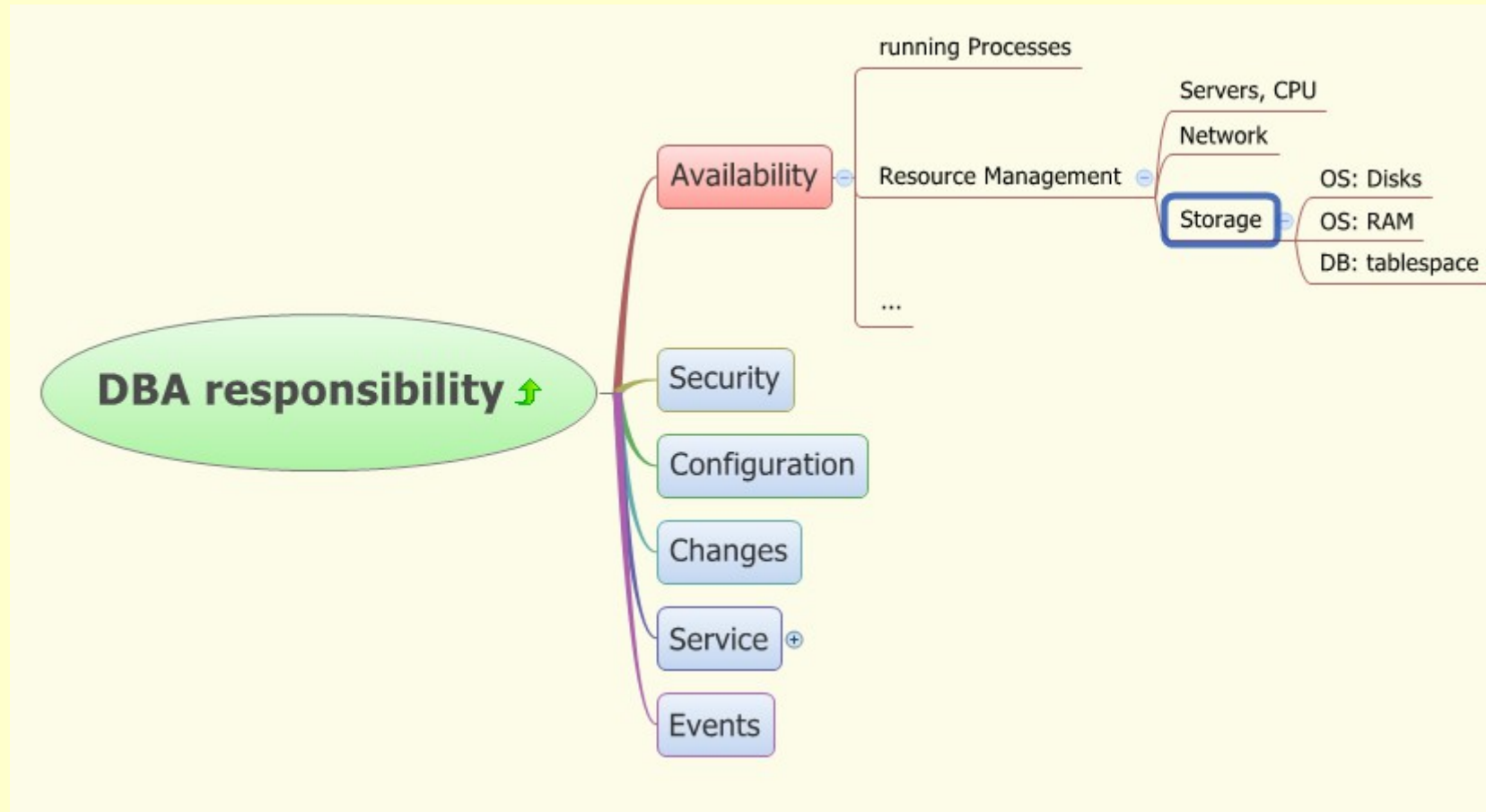
# Big deal?

## KIWI – other factors



# Who cares?

Why me?



# Resolve or not resolve?!

## Why to resolve it in some other way?

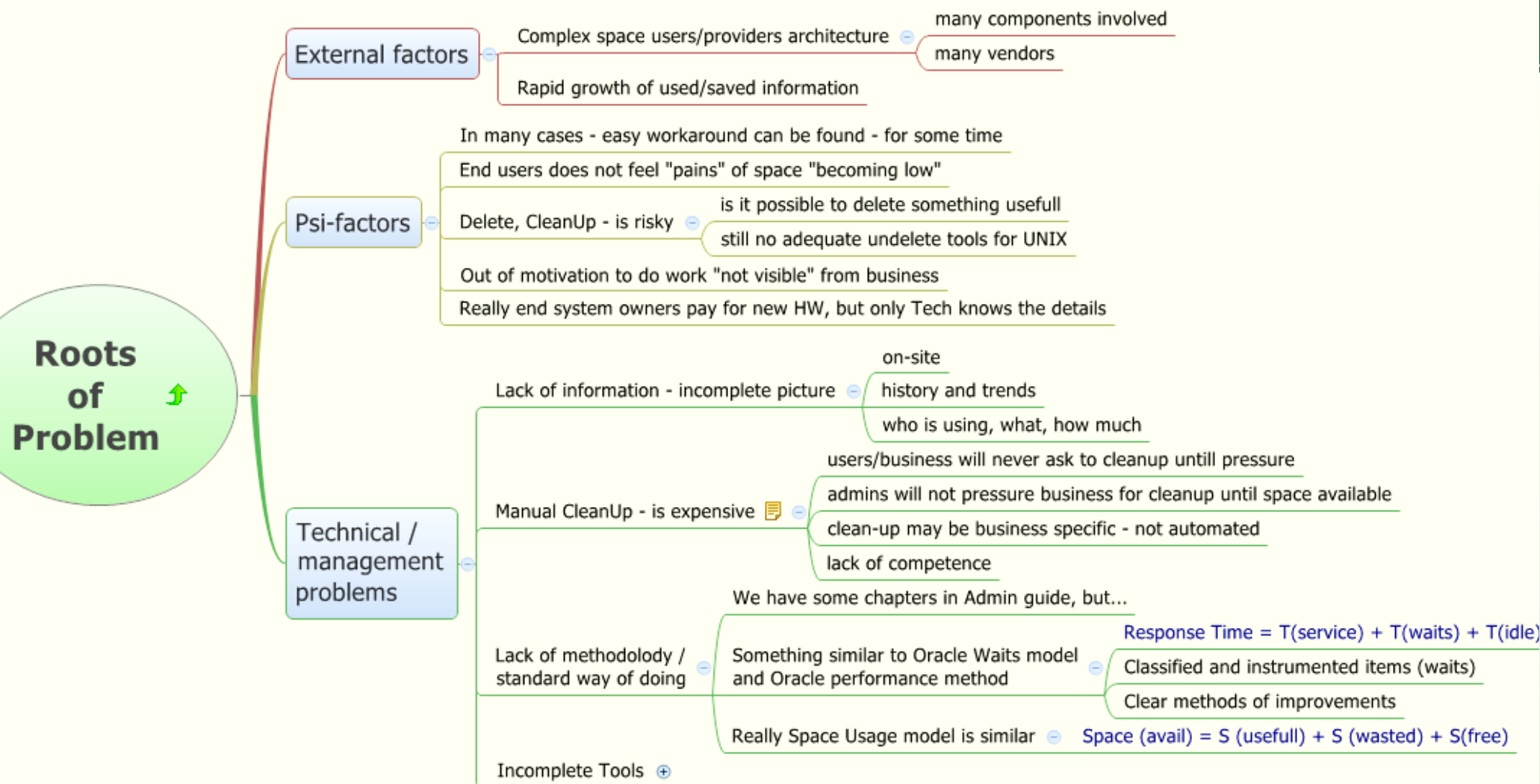
- Minimise Total Cost of Ownership (TCO)
- Minimise DBA and management stress from unexpected events
- To have time for:
  - tea, coffee and sleep well :)
  - Other more interesting issues troubleshooting
  - New solutions development
  - Education, etc...
  - Private life.

## How it should look like (S.M.A.R.T. goals):

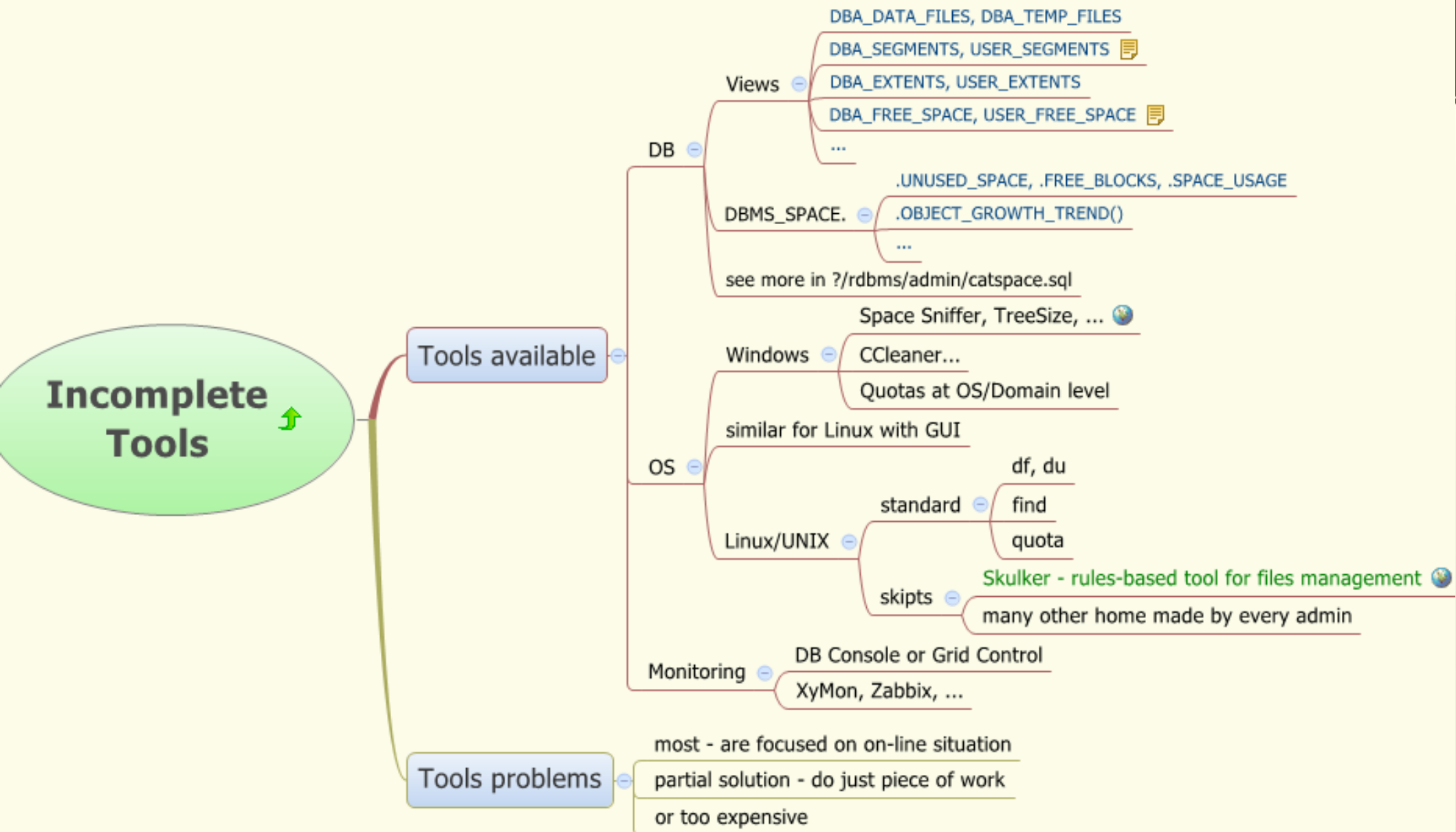
- No unexpected incidents (at least not due lack of space)
- Clear on-site situation picture any time
- Predicted space usage and capacity management based on facts, not just “feelings”
- New hardware ordered in-advance!



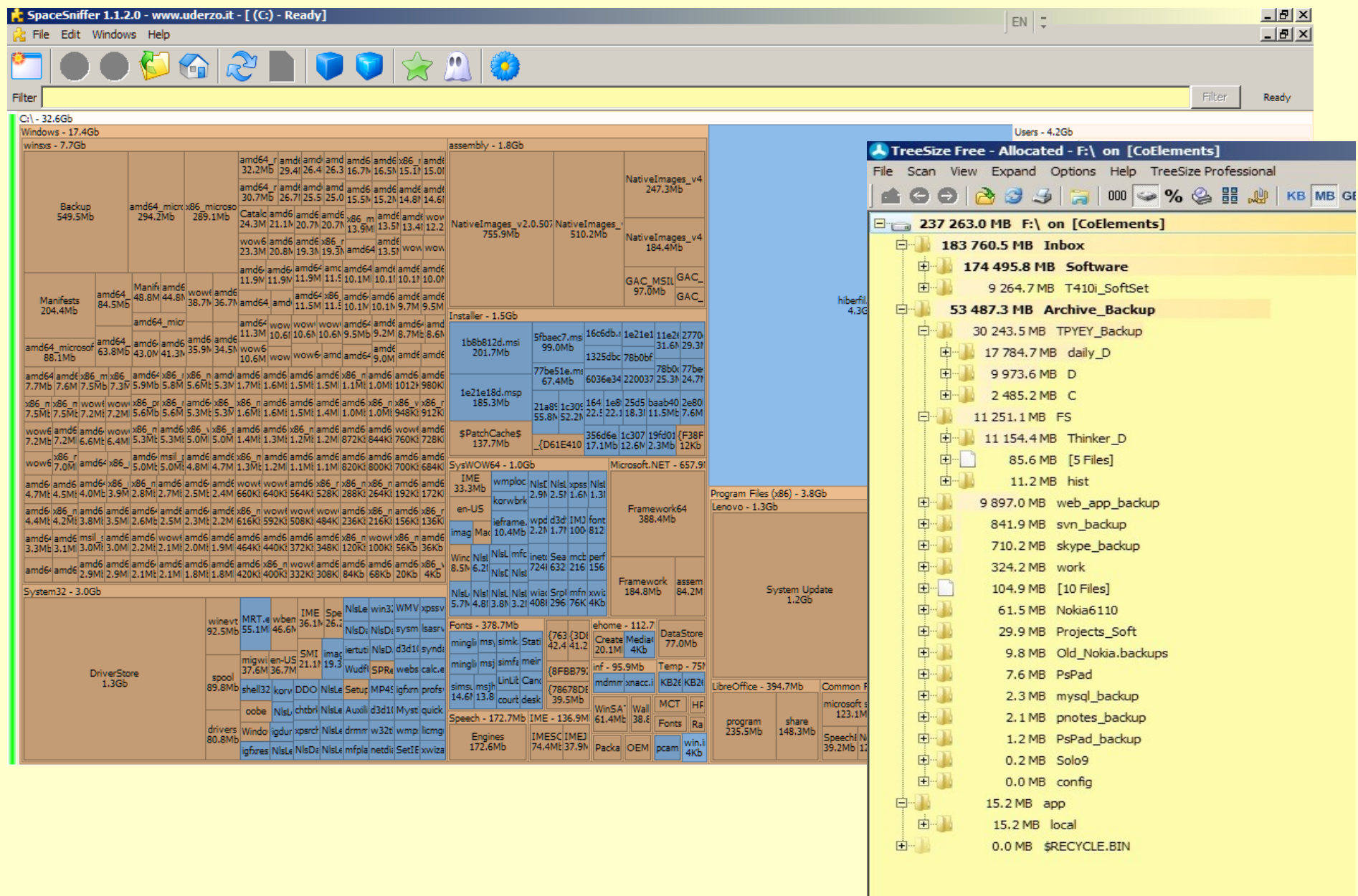
# Preventing factors



# Tools



## Tools



# Tools

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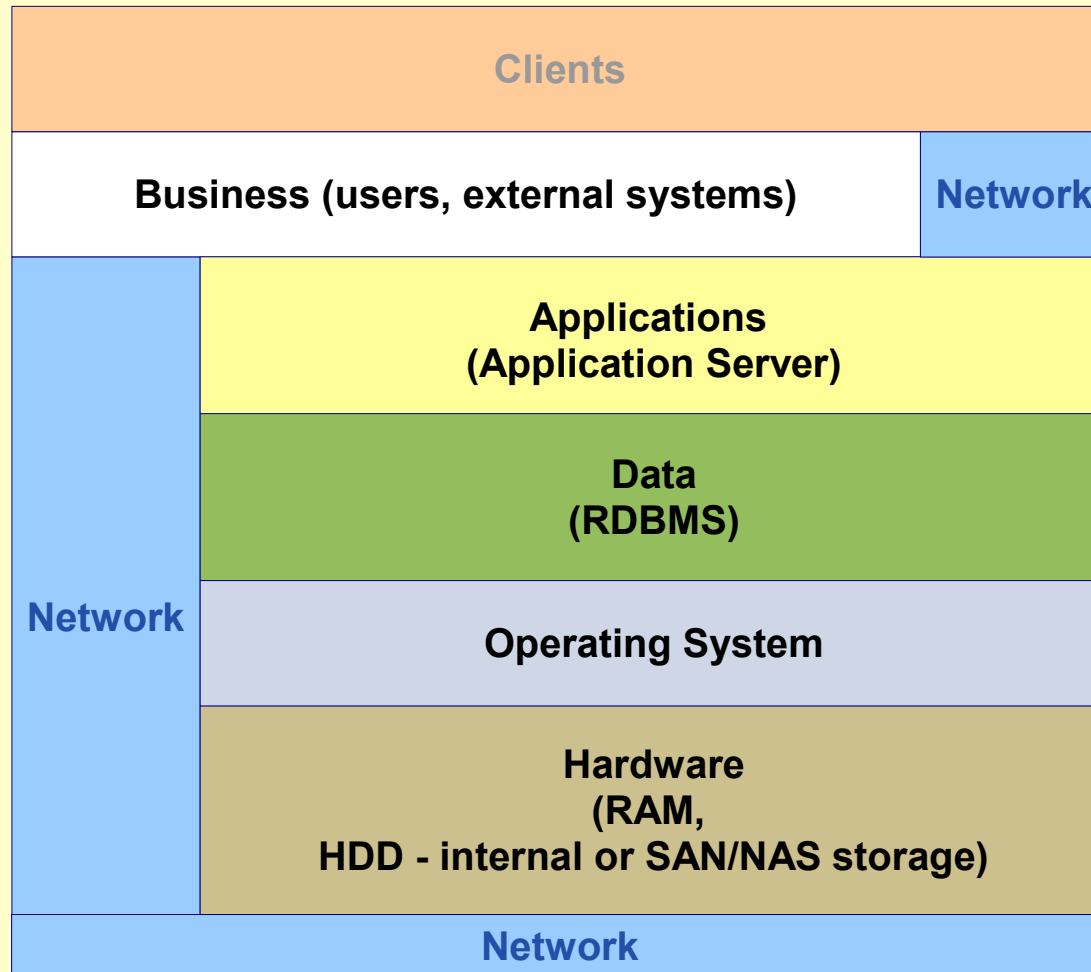
## Part II – SC Concept

# Key principles of Space Control (SC)

- Law of Space Dynamic
  - In isolated System, without external impact (like adding new HW, etc...) - disk space does not appear, and does not disappear – it just distributed between objects.
  - **space provided (Server) = space allocated + free (Client)**
- There is no "silver bullet" - we should understand how it works (how System use space)
- Holistic approach - we should control **ALL** elements of the system
- System approach - all element are related and impact each other
- 1st focus on elements with top usage or/and growth for period
- Do check-outs and implement solutions on regular basis
- Automate what is reasonable

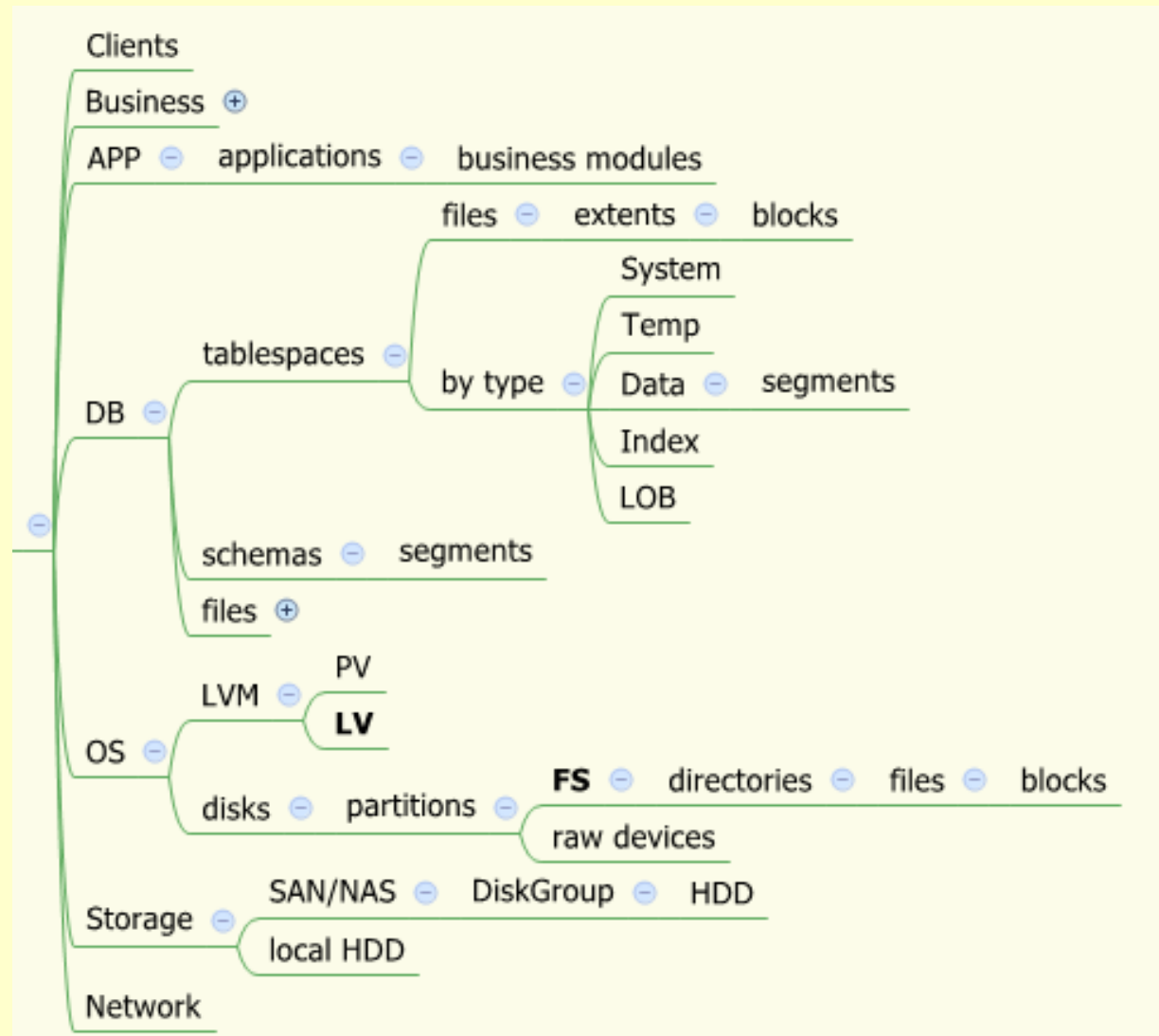
# Space Architecture

- 7 level vertical model



# Space Architecture

- 7 level vertical model



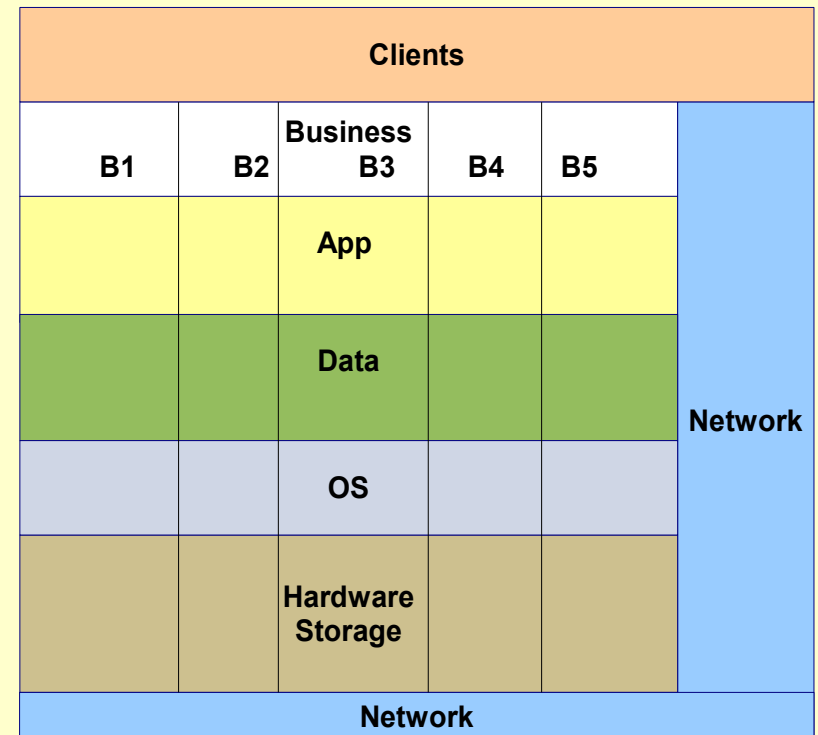


# Space Architecture

- Horizontal model (at each level)
- Understand relationships between levels and modules
- Understand what item groups to be managed
- Why we need so complex model?!

Specific for each “cell”:

- Business cycles
- Optimisation methods
- Garbage collection methods
- Peoples making decisions



**Every “dimension” or even “cell” may be managed in specific way  
=> different rules for monitoring and maintenance**

# Space Formula

- Have = Free + Used + Wasted/Missing

Used - for business or anything usefull - can be optimised - in most cases

Free - really can be used - nothing to do with it - in most cases until  $\geq 5\%$

just monitor we have it

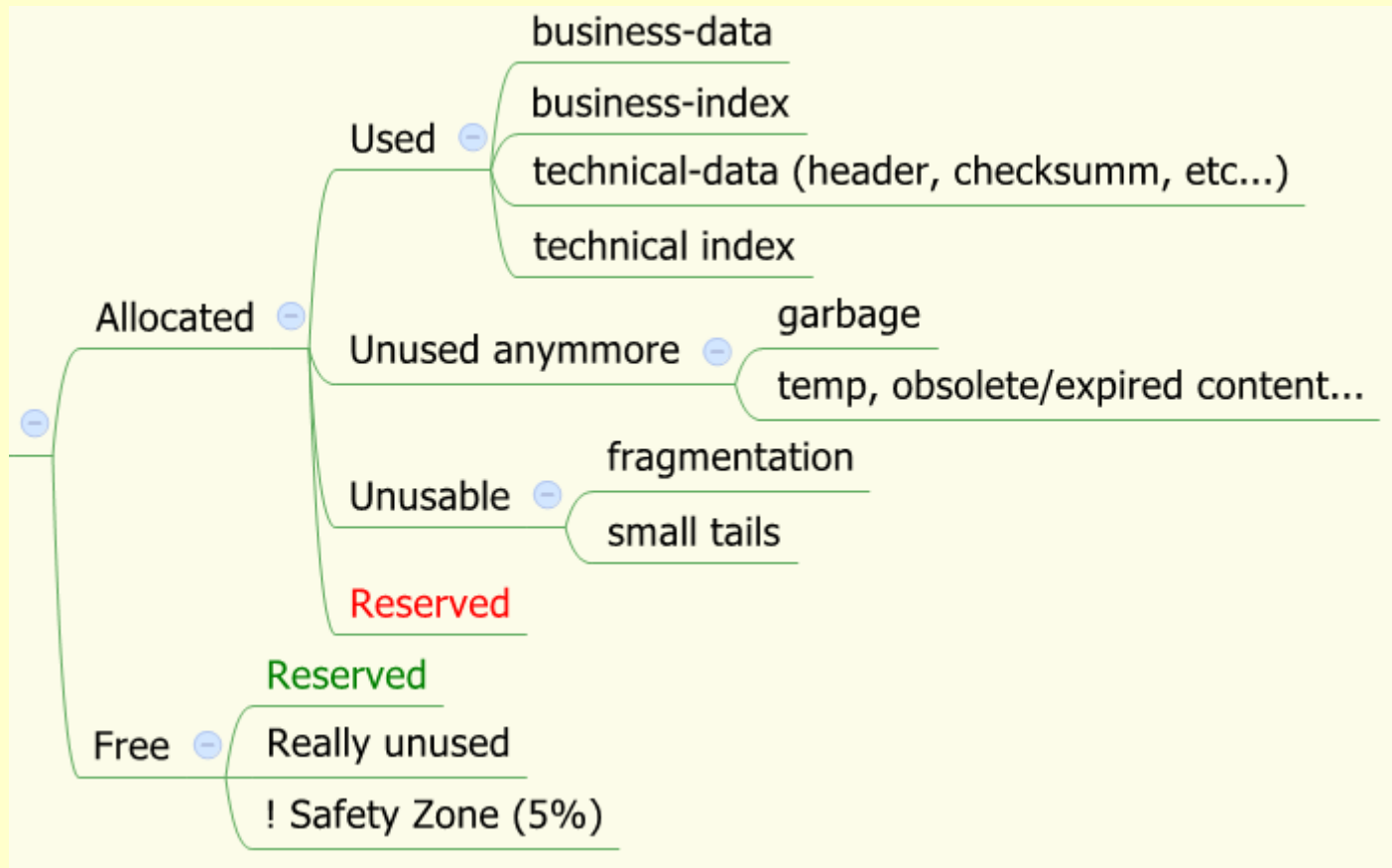
Wasted - anything should not be there

Missing - all other - unclear, unknow - often called "mistic" missing space

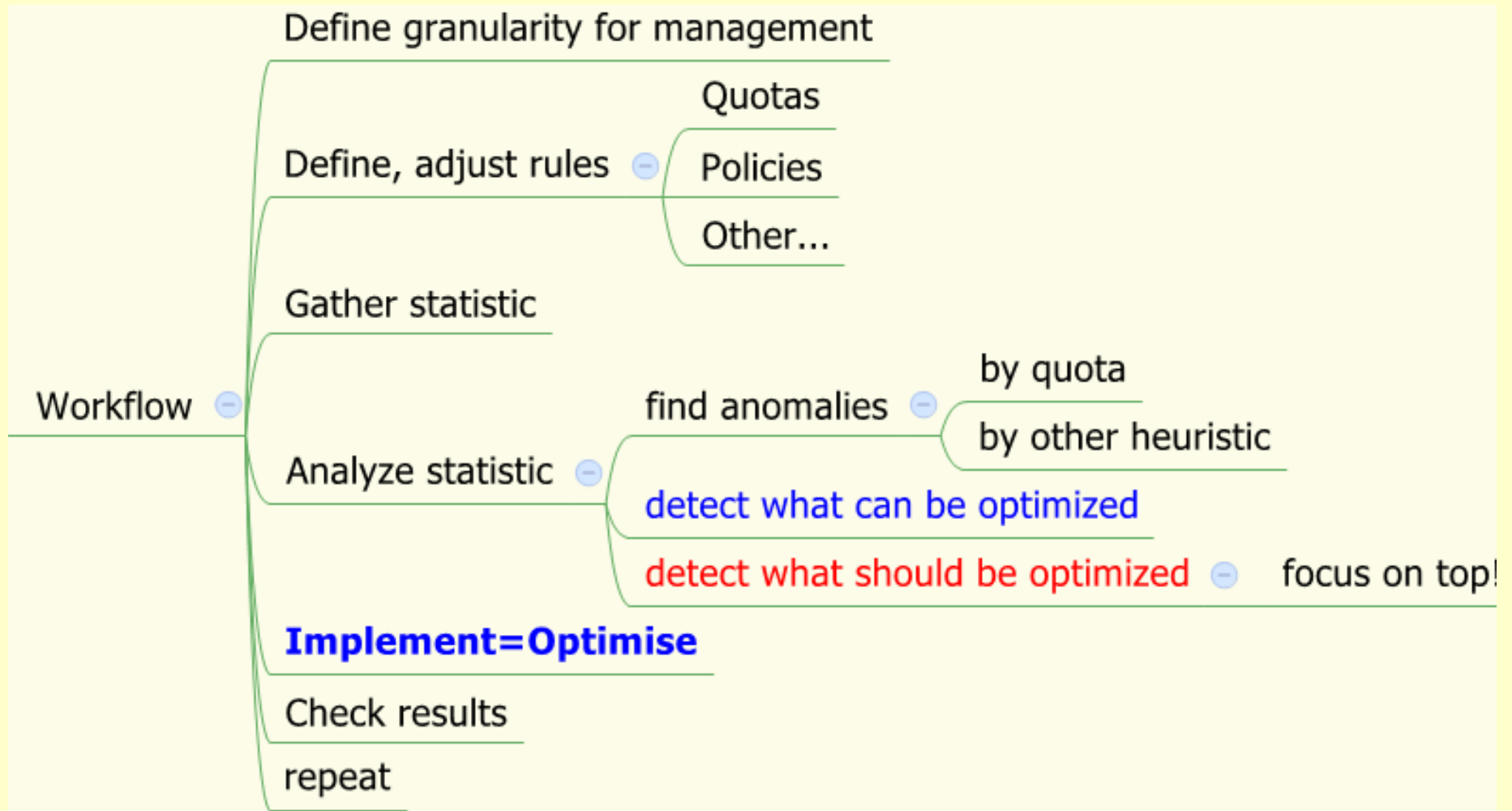
We should draw WHOLE picture!

# Space Formula

- Space Available:

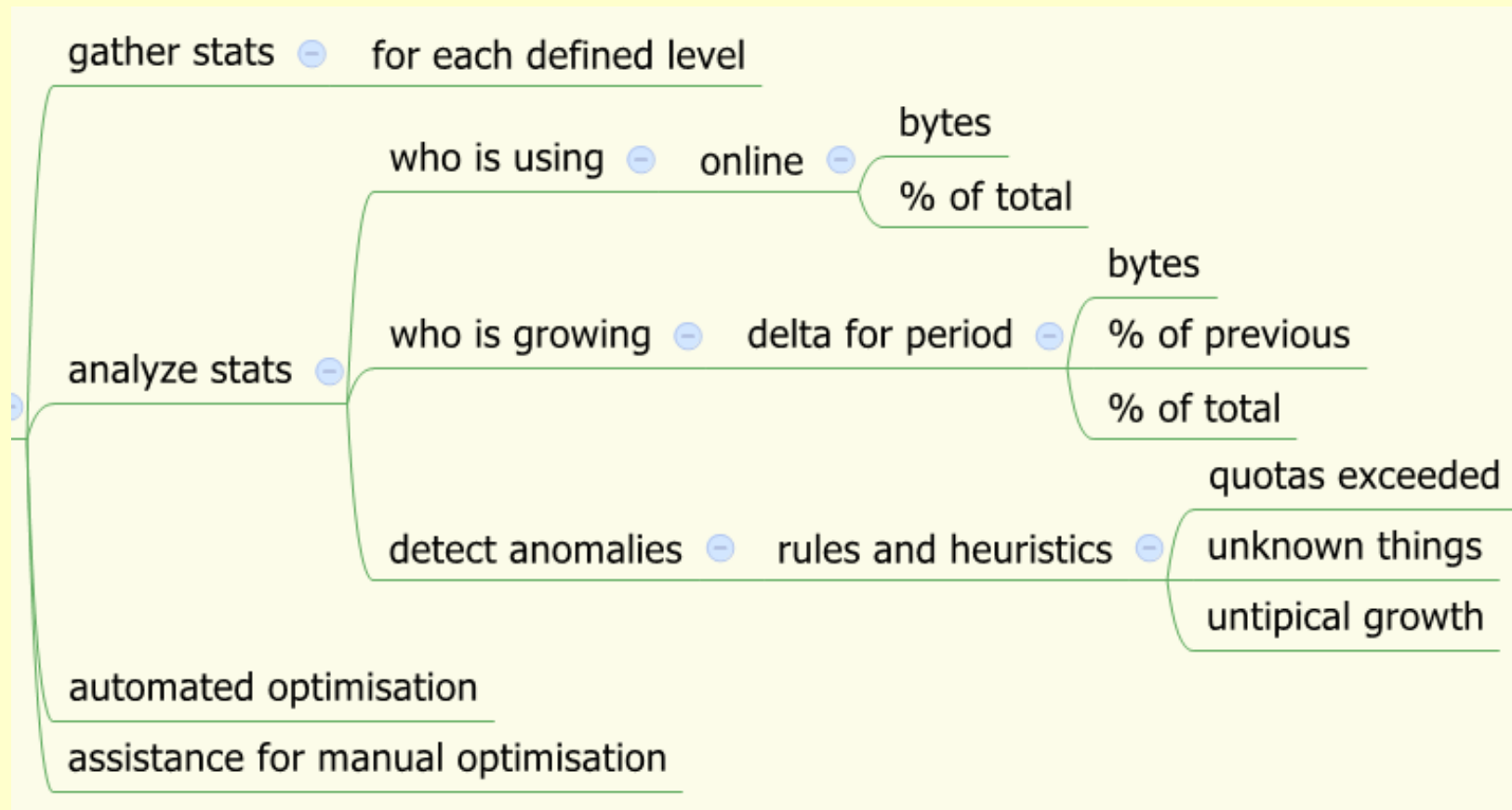


# Action plan



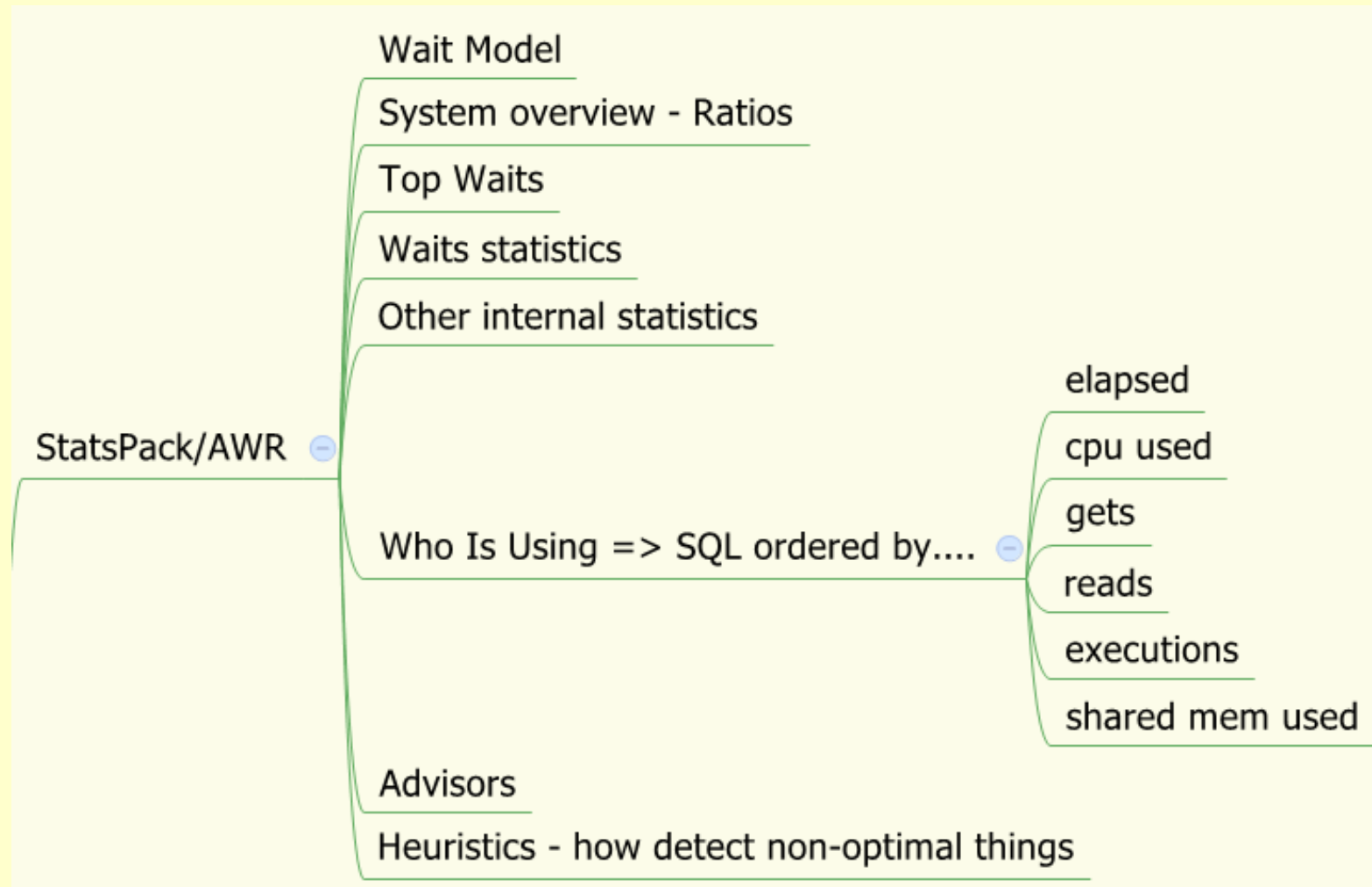
# Tools

- Requirements:



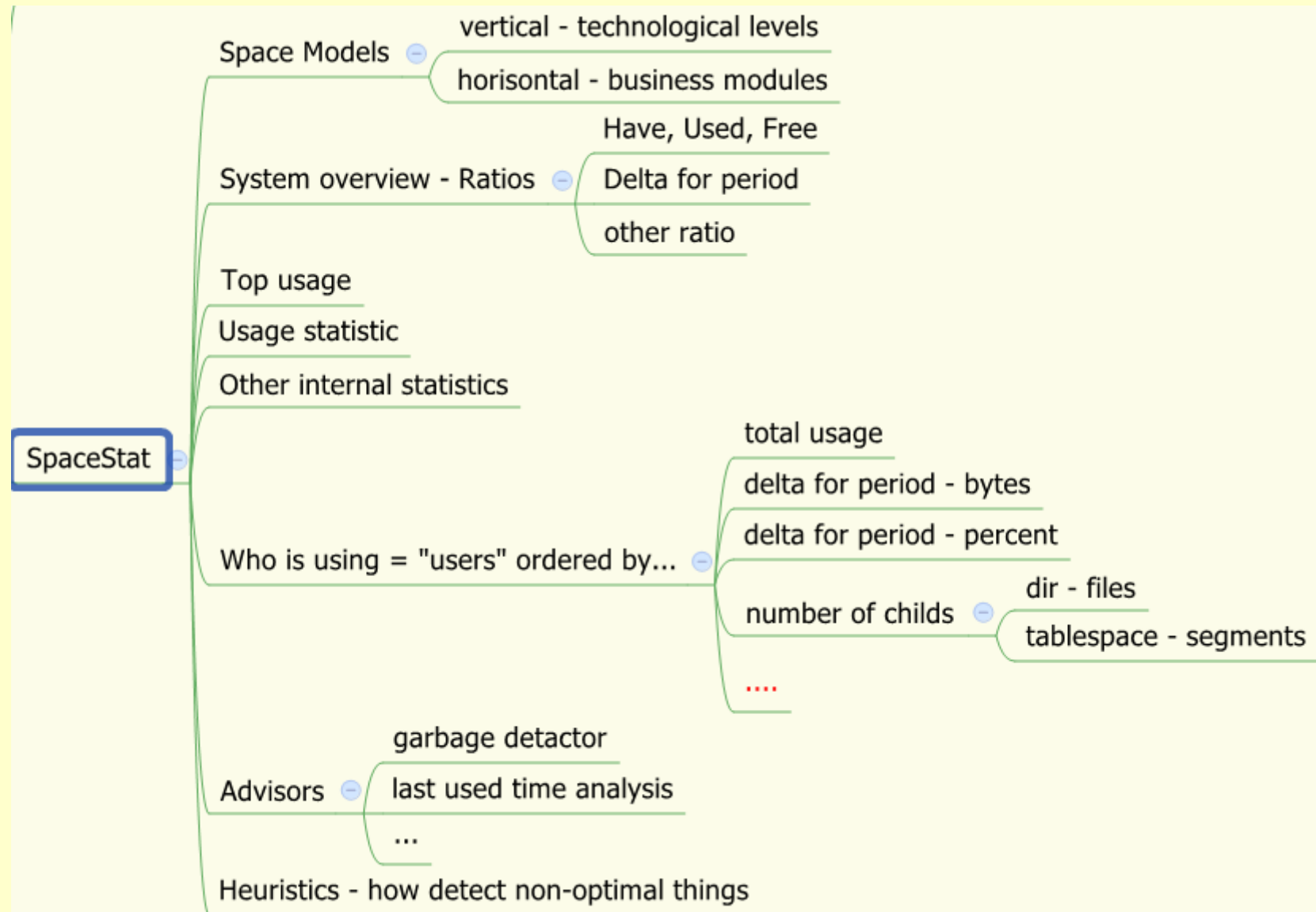
# Tools

- Like what?!



# Tools

- Similar for space:



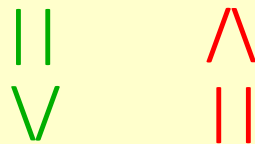
# Tools

- Have You ever heard Oracle has SpaceStat?
- No?!
- And me too! :)
- Because Oracle does not have it!
- But, really nothing prevents us to invent it  
*(see more details about **CoMinder SpaceStat** in part IV)*



# System Life Cycle

Design (Re-Design)



Regular maintenance



Support on incidents

## Part III – How IT works

# SC phases

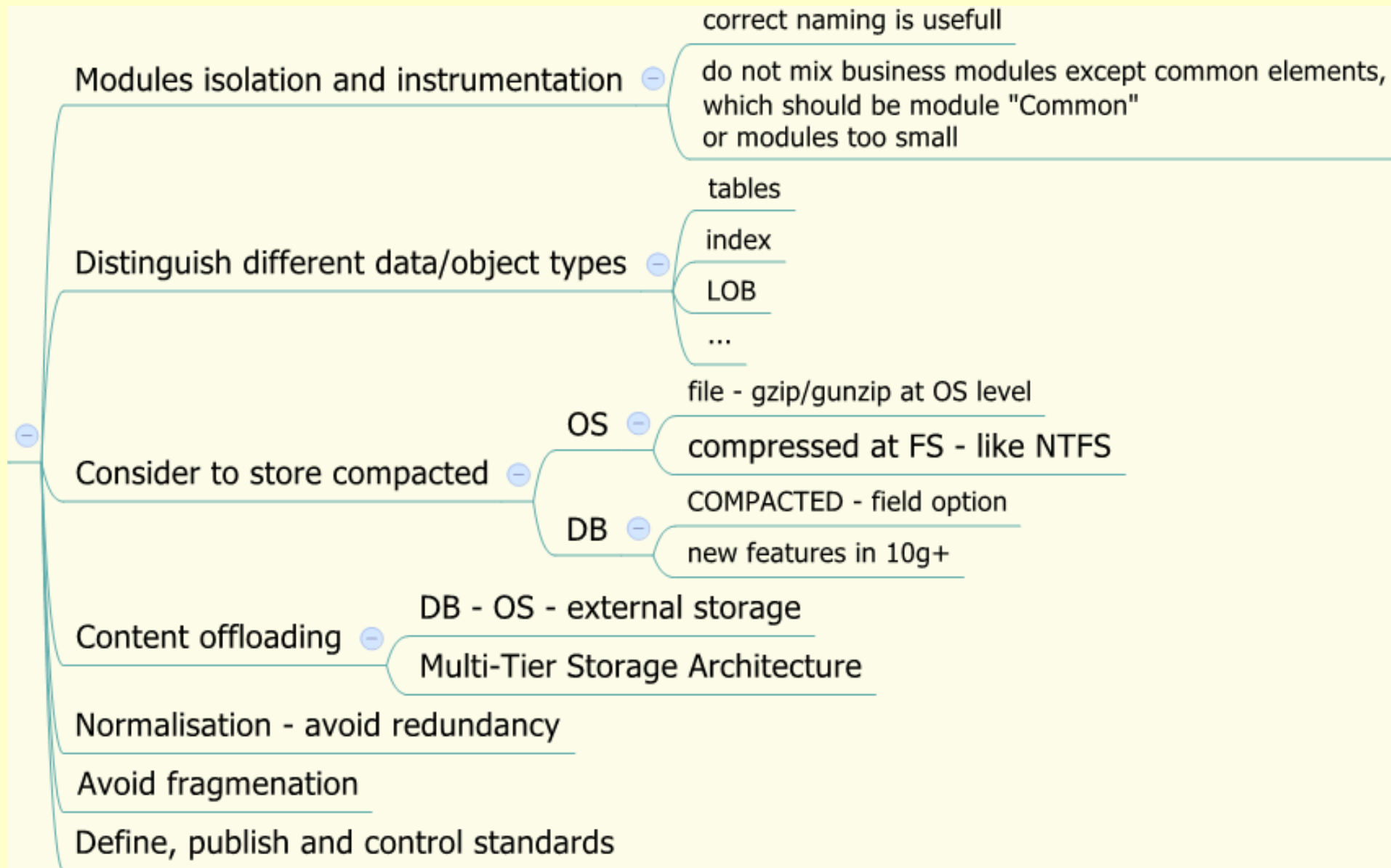
- Space usage by **Design** - space usage efficiency defined during Design
- Testing should consider space usage too
- Production
  - **Pro-Active management** – focus on **Maintenance**
  - **Re-Active management** – focus on **Support**

# Space usage by Design

- Key ideas:
  - ! optimal space usage should be built-in business, applications, db...
  - changes in live system are more expensive then on DEV phase
  - concern about other requirements (performance, security...)
- Capacity Planning:
  - **Analytical** - during design phase or when we decide about Space
    - Extent and Block Space Calculation and Usage in Oracle Databases [ID 10640.1]
    - SAFE method: HOW TO STOP DEFRAGMENTING AND START LIVING (see refs.)
    - SAME method: Stripe And Mirror Everything – implemented in ASM (see refs.)
  - **Statistical** - observe facts after some time of production (re-design or just for future)
    - DBMS\_SPACE – calculate usage and trends
  - Do not forget space required for Backups!
    - Backups size
    - Storage de-duplication/optimisation savings hard to predict

# Space usage by Design

- Techniques:



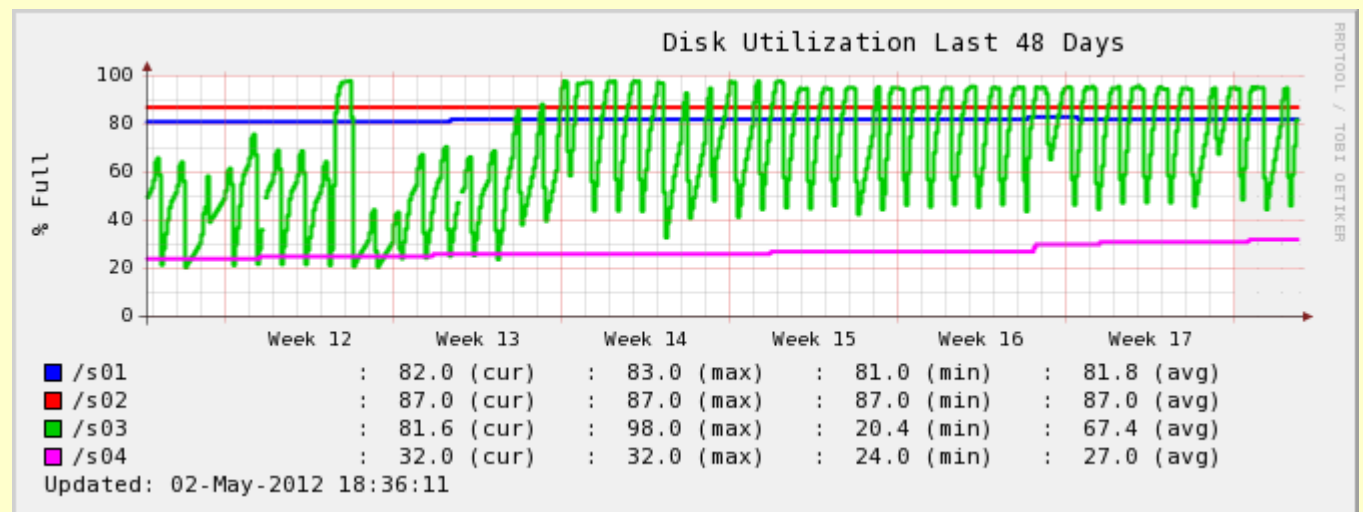
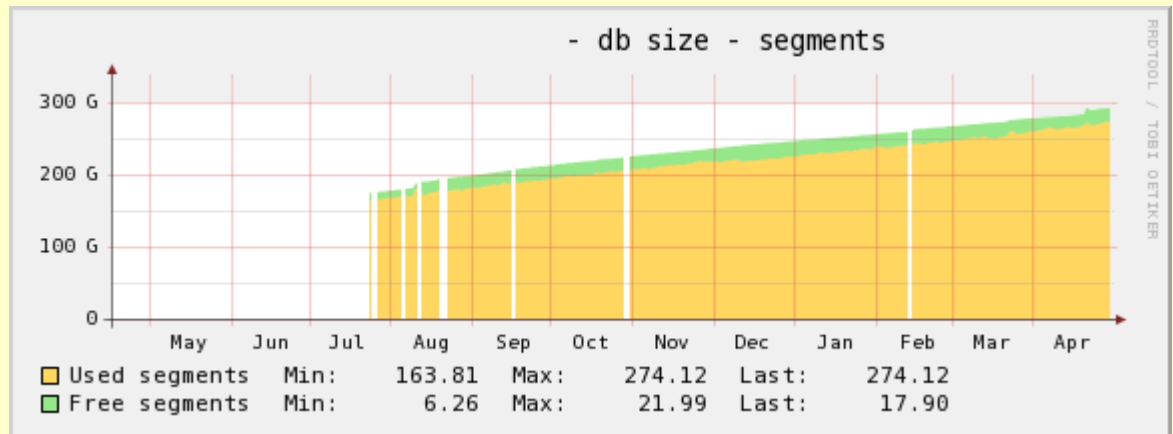
# Pro-Active SC

- Key moments:
  - Capacity Planning – is not only App/DB design phase
  - Track Business changes and plans
    - should be transparent
      - company management and partners
      - for everybody or **at least technical staff**
    - understand how changes/trends impacts space requirements
    - **should be prepared - In Advance**
  - **Focus on regular activities, delta and trends**
  - **Implement regular (automated) maintenance procedures**
  - **Take action BEFORE it is too critical!**
  - For regular problems - re-design can be/should be requested

# Pro-Active SC

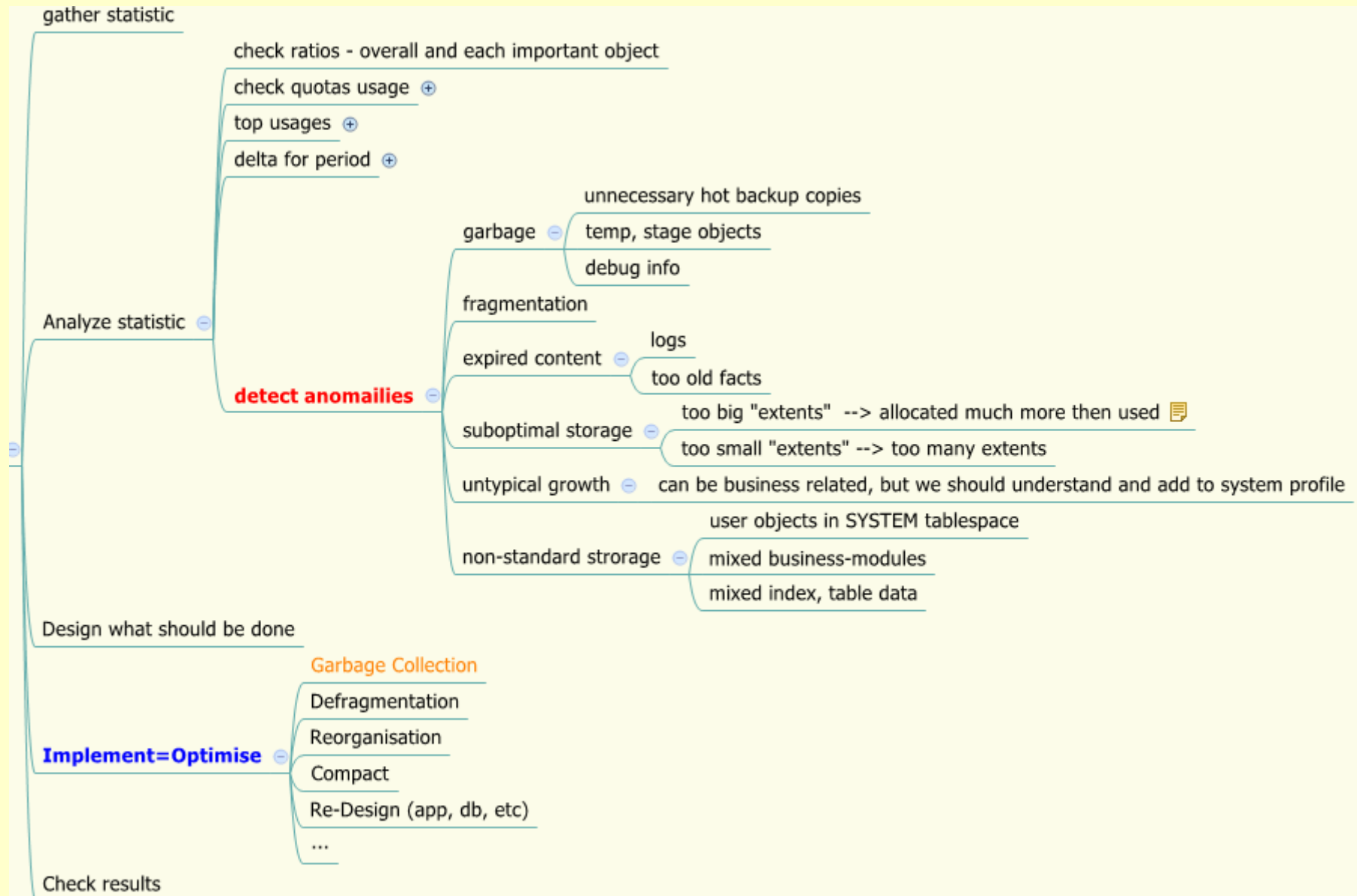
- Tools:

- Statistics collector
- On-line monitoring
- Tools to analyse statistics
  - scripts
  - Statistic data visualisation (graph, pie, ...)
  - Excel, Calc, analytical functions in DB, ...
- Maintenance scripts and tools



# Pro-Active SC - workflow

- Workflow:





# Re-Active SC

- Key moments:
  - Problems happens – be prepared with good scripts & tools!
  - **Focus on - online situation and changes since last observation**
  - **Resolve emergency first**
    - business should work - this is 1st goal
    - find any known way to make it working
    - we can be "detective" a bit later
  - **For frequent problems - we should:**
    - implement automated maintenance procedure
    - or request for re-design

# System Life Cycle

Design (Re-Design)



Regular maintenance



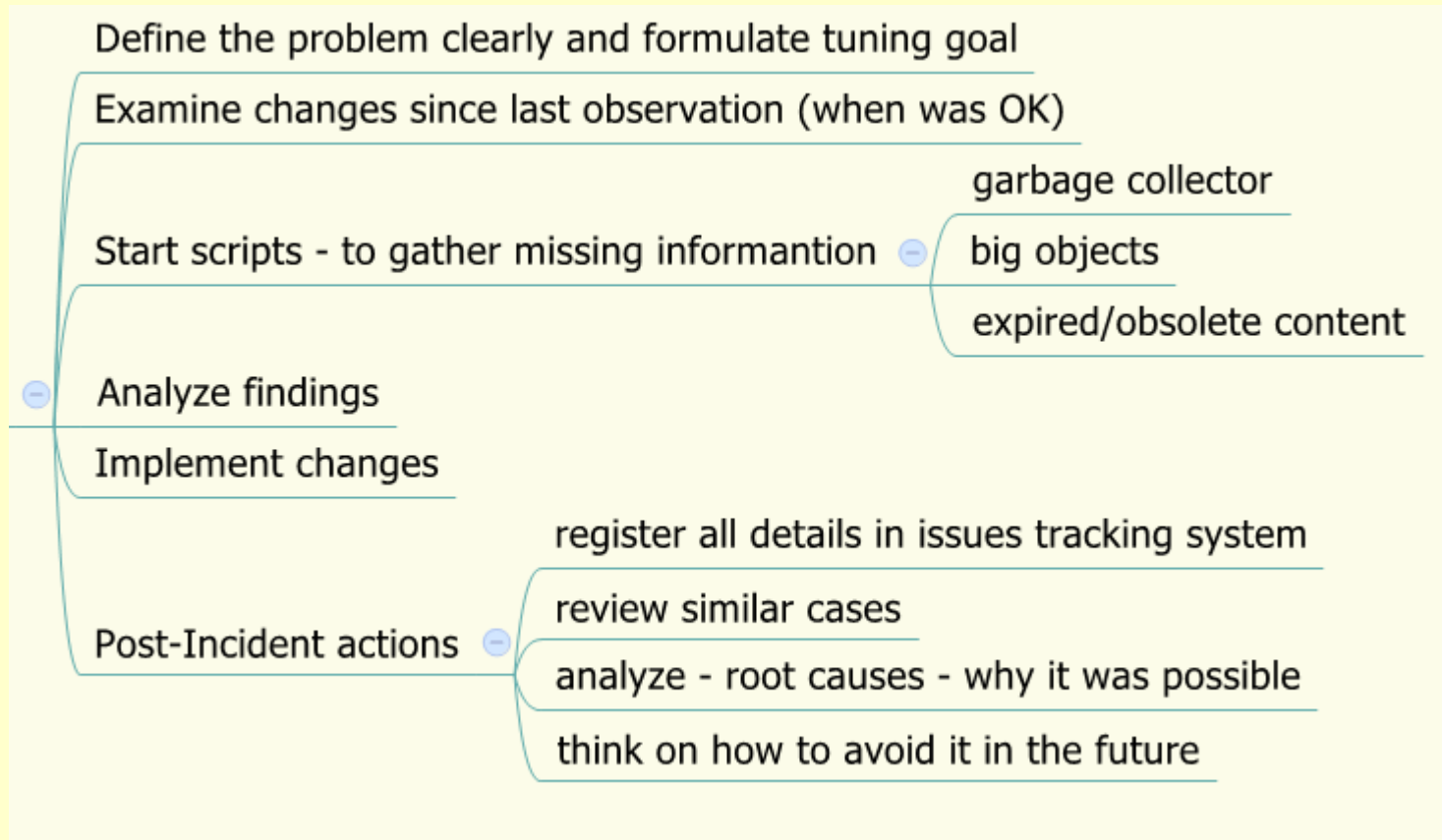
Support on incidents

# Re-Active SC

- Tools:
  - On-line monitoring
  - Statistics
  - “Who is using” tools
    - OS (win): SpaceSniffer, TreeSize
    - OS (Unix/Linux): du + find
    - DB: select ... from dba\_segments
  - Scripts
    - to find top usage by...
    - to find anomalies
    - garbage collectors
    - offload data/files
    - backup and remove, or compress

# Re-Active SC - workflow

- Workflow:



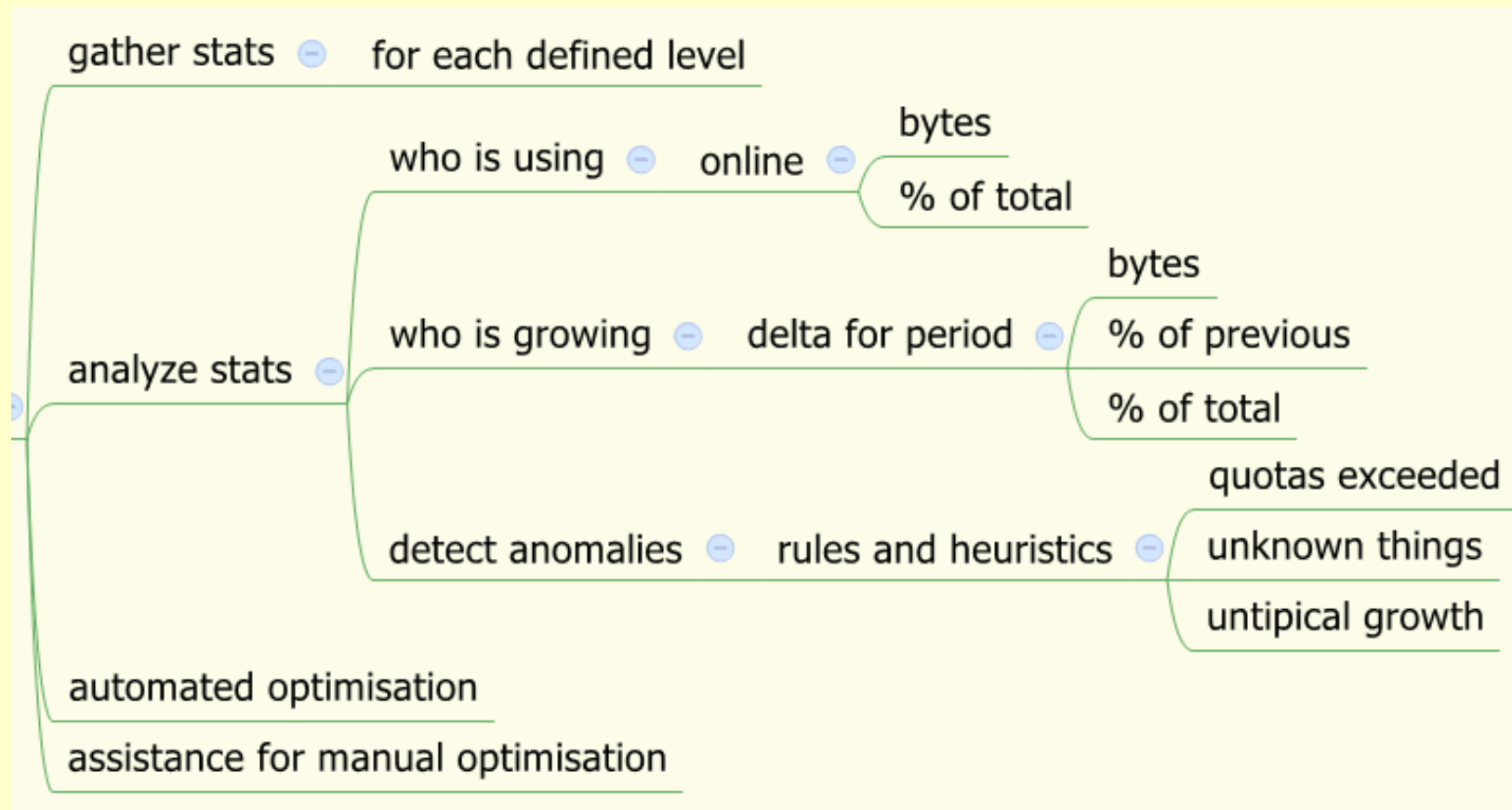
# Part IV

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## Hints, Links and Notes

# Tools

- Requirements:



# Hints

- “Missing” space in Linux:

System 1

```
[root@abc-monika00 ~] df -k
Filesystem            1K-blocks      Used Available Use% Mounted on
/dev/simfs             10485760    2996300    7489460   29% /
none                   287144         4     287140    1% /dev
```

System 2

```
[root@abc-oracle04 ~]$ df -k
Filesystem            1K-blocks      Used Available Use% Mounted on
/dev/mapper/VolGr40LV00 36832848   13158184   21803612   38% /
/dev/sda1              295561     19479     260822    7% /boot
none                   4080932         0     4080932    0% /dev/shm
/dev/mapper/VolGr320-s01 309604352 274390644   19486708   94% /s01
/dev/mapper/VolGr9-s02  10288760   8432824    1333288   87% /s02
/dev/mapper/VolGr30-s03 30930940  13741012   15618704   47% /s03
```

# Hints

- “Missing” space in Linux:

Filesystem	1K-blocks	Used	Available	Use%	Mounted	Missing	Miss %
/dev/simfs	10485760	2995120	7490640	29%	/	0	0.00%
Filesystem	1K-blocks	Used	Available	Use%	Mounted	Missing	Miss %
/dev/mapper/VolGr40-LogVol00	36832848	13158184	21803612	38%	/	1871052	5.08%
/dev/sda1	295561	19479	260822	7%	/boot	15260	5.16%
/dev/mapper/VolGr320-s01	309604352	274390644	19486708	94%	/s01	15727000	5.08%
/dev/mapper/VolGr9-s02	10288760	8432824	1333288	87%	/s02	522648	5.08%
/dev/mapper/VolGr30-s03	30930940	13741012	15618704	47%	/s03	1571224	5.08%

Q: Who is using 5%?

A: reserved by ext3 file system

Info: man **tunefs** (or **tune2fs**)

**Hint:** When totally out of space, try reduce percent of disk space reserved by file system :

```
fstune -m pct_reserved
```



# Hints

- OS – Top usage

```
du -xb /u01/ | sort -k 1g
```

```
[root@abc-oracle04 temp]$ du -xb /u01/ | sort -k 1g | more
4096      /u01/app/cominder/work
4096      /u01/app/oracle/admin/ATEST/cdump/core_2148
4096      /u01/app/oracle/admin/ATEST/cdump/core_8818
4096      /u01/app/oracle/admin/ATEST/cdump/core_9815
4096      /u01/app/oracle/admin/PRODDB/cdump
4096      /u01/app/oracle/product/9.2.0.8/assistants/dbca/logs
...
309856116      /u01/app/oracle/product/9.2.0.8/assistants
487250056      /u01/inst.ora/rdbms/9204_64/9208
1982678664     /u01/inst.ora/rdbms/9204_64
2064689619     /u01/inst.ora/rdbms
2187986576     /u01/inst.ora
2299627375     /u01/app/oracle/product/9.2.0.8
3255055872     /u01/oradata/ATEST
3255064064     /u01/oradata
3396730237     /u01/app/oracle/product
3439307656     /u01/app/oracle
3856168124     /u01/app
9299222860     /u01/
```

# Hints

- OS – Who is growing (also right now)

```
du -xb /u01/ | sort -k 2 > before.out
```

... wait some time or do something in FS ...

```
du -xb /u01/ | sort -k 2 > after.out
```

... compare output ...

```
diff before.out after.out | grep '/' | sort -k 3
```

```
< 9245879883    /u01/
> 9292575701    /u01/
< 3820439441    /u01/app
> 3820754656    /u01/app
< 424912        /u01/app/cominder
> 738124        /u01/app/cominder
< 172714        /u01/app/cominder/LOG
> 172948        /u01/app/cominder/LOG
> 317074        /u01/app/cominder/temp
< 4096         /u01/app/cominder/temp
....
< 2170372282    /u01/inst.ora
> 2216752885    /u01/inst.ora
> 20010526      /u01/inst.ora/java.dropme
< 2064689619    /u01/inst.ora/rdbms
> 2091059696    /u01/inst.ora/rdbms
> 26370077      /u01/inst.ora/rdbms/OPatch.dropme
```

# OS garbage collector

- OS garbage collector example:

```
TARGET=${1}
echo " Looking for large archives"
find ${TARGET} -name "*.tar" -size +102400000c -exec ls -l {} \;
find ${TARGET} -name "*.gz" -size +102400000c -exec ls -l {} \;
find ${TARGET} -name "*.Z" -size +102400000c -exec ls -l {} \;

echo " Looking for large logs"
find ${TARGET} -name "*log" -size +102400000c -exec ls -l {} \;

echo " Looking for dumps"
find ${TARGET} -name "*dmp" -exec ls -l {} \;
find ${TARGET} -name "core" -exec ls -l {} \;

echo " Looking for audit and lost traces"
find ${TARGET} -name "*.aud" -mtime +30 -exec ls -l {} \;
find ${TARGET} -name "*.trc" -mtime +30 -exec ls -l {} \;
```

# SpaceStat

- CoMinder SpaceStat:
  - Collection of SQL, Shell scripts
  - Collects DB space info (can be extended to process uploaded OS sizes info)
  - Snapshots like in StatsPack
  - Based on DB views: DBA\_SEGMENTS, DBA\_DATA\_FILES, .....
  - Reports current state and/or changes for period
    - Usage by files, file types
    - Usage by segments
    - Usage by users
    - Other (can easy develop new reports)
  - **Still working on it**
    - Will be available for download 1<sup>st</sup> June, 2012 at <http://www.cominder.eu/>

# SpaceStat

- DB – Summary

SPACESTAT report for

DB_NAME	DBID	CREATED	LOG_MODE
DEMO DB	77043597	13.05.2011 21:32:19	ARCHIVELOG

Hostname: abc-oracle04.abc.com  
Instance: DEMO DB  
Started: 01.02.2012 23:06:00  
Server IP: 10.10.10.10  
OS: x86\_64/Linux 2.4.xx

Begin Snap:94 DEMO DB 01-04-2012 01:01:03  
End Snap:158 DEMO DB 01-05-2012 01:01:03  
Elapsed:30 days

=== Files Size ===

OLD_GB	NEW_GB	DELTA_GB	D_PCT	AVG_DAY_GB
285.08	299.97	14.89	5.22	.496

=== By Files type ===

FILE_TYPE	OLD_GB	NEW_GB	DELTA_GB	D_PCT
DATA_FILE	277.08	291.97	14.89	5.37
TEMP_FILE	8.00	8.00	.00	.00

# SpaceStat

- DB – Summary

```
=== Segments Size ===
      OLD_GB      NEW_GB      DELTA_GB      D_PCT      AVG_DAY_GB
-----
      260.48      273.07      12.59      4.83      .420
=== By Segment type ===
SEGMENT_TYPE      OLD_GB      NEW_GB      DELTA_GB      D_PCT
-----
TABLE              148.80      157.07      8.27      5.56
INDEX              100.57      103.27      2.69      2.68
TYPE2 UNDO         5.27      6.57      1.30     24.69
LOBSEGMENT         5.72      6.05      .32      5.67
CLUSTER            .10      .10      .00      .06
LOBINDEX           .03      .03     -.00     -.23
ROLLBACK           .00      .00      .00      .00
CACHE              .00      .00      .00      .00
TABLE PARTITION    .00      .00      .00      .00
NESTED TABLE      .00      .00      .00      .00
```

# SpaceStat

- DB – Segments changes

=== New SEGMENTS existing in 157 DEMODB 01-05-2012 01:01:01 only (or size=0 in 93 DEMODB 01-04-2012

OWNER	SEGMENT_TYPE	SEGMENT_NAME	TABLESPACE_NAME	NEW_MB
STEN	TABLE	JN_BAAK_DETAILS	JN_TBL	136.00
STEN	INDEX	JN_BAAK_DETAILS_ROW_ID_I	JN_IND	52.00
RSJOBMAN	TABLE	RW_SERVER_QUEUE	TOOLS	26.00
STEN	INDEX	JN_BAAK_DETAILS_IDS_I	JN_IND	24.00
STEN	TABLE	JN_BAAK_FACT_ALL_TM	JN_TBL	22.00

=== Old SEGMENTS exist in 93 DEMODB 01-04-2012 01:01:01 only (or size=0 in 157 DEMODB 01-05-2012

OWNER	SEGMENT_TYPE	SEGMENT_NAME	TABLESPACE_NAME	OLD_MB
STEN	TABLE	TESTFACT_ERROR_2011_07_15	STEN_TBL	183.00
STEN	TABLE	TOGF_TRANS_20100608_BCK	STEN_TBL	41.00
STEN	TABLE	YDELSER_20110831	STEN_TBL	13.00
STEN	TABLE	YDELSER_20110704	STEN_TBL	12.00
STEN	TABLE	TUNDE_31122010_16	STEN_TBL	5.00

===== CHANGED SEGMENTS =====

OWNER	SEGMENT_TYPE	SEGMENT_NAME	TABLESPACE_NAME	OLD_MB	NEW_MB	DELTA_MB
STEN	TABLE	JN_BAAK_GODS	JN_TBL	16633.00	18041.00	1408.00
STEN	TABLE	JN_BAAK_LIN	JN_TBL	12223.00	13567.00	1344.00
STEN	TABLE	JN_BAAK	JN_TBL	12295.00	13570.00	1275.00
STEN	TABLE	DWH_FACT_BAAK_LIN	STEN_AVG_TBL	4169.00	4864.00	695.00
STEN	INDEX	PK_TESTFACT_FLD_IOT	EDIF_BIG_TBL	11136.00	11584.00	448.00
STEN	TABLE	DWH_FACT_BAAK_LIN_BAK	STEN_AVG_TBL	496.00	896.00	400.00
PERFSTAT	TABLE	STATS\$SQLTEXT	PERFSTAT	432.00	819.94	387.94
STEN	INDEX	JN_BAAK_LIN_ROW_ID_I	JN_IND	2240.00	2260.00	20.00

# DB space details

- DB – Top 100 segments

```
select TOT.* from (
select B.OWNER, B.SEGMENT_TYPE, B.SEGMENT_NAME, B.TABLESPACE_NAME,
      B.BYTES/1024/1024 MBYTES, B.BYTES/S.SBYTES*100 PCT
  from DBA_SEGMENTS B,
      (select sum(bytes) SBYTES from DBA_SEGMENTS) S
 order by B.BYTES DESC, B.OWNER, B.SEGMENT_TYPE, B.SEGMENT_NAME
) TOT where rownum<101;
```

OWNER	SEGMENT_TYPE	SEGMENT_NAME	TABLESPACE	MBYTES	PCT
STEN	TABLE	JN_TAAK_GOODS	JN_TBL	17593	6.26
STEN	TABLE	TSS_SEGMENTS	STEN_TBL	14745	5.25
STEN	TABLE	TAAK_LIN	TAAK_BIG_TBL	13351	4.75
STEN	TABLE	JN_TAAK	JN_TBL	13126	4.67
STEN	TABLE	JN_TAAK_LIN	JN_TBL	13119	4.67
STEN	INDEX	PK_EDIFACT_FLD_IOT	EDIF_BIG_TBL	11456	4.08
STEN	TABLE	TAAK_GOODS	TAAK_BIG_TBL	7042	2.51
STEN	TABLE	BOGF_TRANS	BOGF_BIG_TBL	6912	2.46
STEN	TABLE	ADRESSE	ADR_BIG_TBL	5888	2.10
STEN	LOBSEGMENT	SYS_LOB00000027537C00005\$\$	STEN_SML_TBL	4676	1.66



# DB space details

- DB – Top 20 users

```
select TOT.* from (  
select B.OWNER, sum(B.BYTES/1024/1024) MBYTES, sum(B.BYTES)/S.SBYTES*100 PCT  
  from DBA_SEGMENTS B,  
       (select sum(bytes) SBYTES from DBA_SEGMENTS) S  
group by B.OWNER, S.SBYTES  
order by MBYTES DESC  
) TOT where rownum<21;
```

OWNER	MBYTES	PCT
-----	-----	-----
STEN	263224.19	94.11
SYS	6007.65	2.15
PERFSTAT	3569.56	1.28
TAYB	973.19	0.35
ANI	900.94	0.32
CPROTO	727.69	0.26
ABW	707.00	0.25
SYSKNL	524.31	0.19
HKISKO	357.63	0.13
GOTICH	313.19	0.11
ASRNAF	264.19	0.09
CPHNRA	121.25	0.04
SPACESTAT	86.69	0.03
-----	-----	-----

# DB space details

- DB – Tablespace info

TABLESPACE_NAME	FALLOCATED	USED_SIZE	FREE_SIZE	RESERVED	MAXTBS	MAXRESFILE	MAXSEG
BAAK_BIG_IND	12800.00	12741.375	58.625	3642.625	16384.000	1920.938	64.000
BAAK_BIG_TBL	31744.00	31685.000	59.000	1083.000	32768.000	399.938	64.000
TAYB_IND	128.00	44.375	83.625	467.625	512.000	467.625	1.000
TAYB_TBL	928.00	926.250	1.750	7265.750	8192.000	7265.750	8.000
DWH_AVG_IND	1345.00	1145.000	200.000	7048.000	8193.000	7048.000	4.000
DWH_BIG_TBL	5889.00	5761.000	128.000	2432.000	8193.000	2432.000	128.000
DWH_SML_IND	257.00	33.625	223.375	8159.375	8193.000	8159.375	.125
DWH_SML_TBL	97.00	50.500	46.500	8142.500	8193.000	8142.500	.125
KNL_AVG_IND	64.00	33.063	30.938	2014.938	2048.000	2014.938	1.000
KNL_AVG_TBL	128.00	120.125	7.875	1927.875	2048.000	1927.875	8.000
KNL_SML_IND	112.00	104.125	7.875	1943.875	2048.000	1943.875	1.000
KNL_SML_TBL	272.00	267.250	4.750	1780.750	2048.000	1780.750	8.000
PERFSTAT	5120.00	3569.625	1550.375	1550.375	5120.000	1550.375	8.000
SPACESTAT	97.00	86.750	10.250	1961.250	2048.000	1961.250	1.000
SYSTEM	810.00	801.625	8.375	1247.375	2049.000	1247.375	8.000
TOOLS	37.50	36.188	1.313	32731.797	32767.984	32731.797	1.000
UNDOTBS1	10240.00	5471.250	4768.750	4768.750	10240.000	4770.750	8.000
USERS	217.00	213.250	3.750	7978.750	8192.000	7978.750	1.000
USER_DAT	7424.00	5106.563	2317.438	3085.438	8192.000	3085.625	8.000
USER_DATA	48.00	.188	47.813	1023.813	1024.000	1023.813	.063
XDB	48.00	44.750	3.250	2003.250	2048.000	2003.250	.063

FALLOCATED – sum of tablespace files size

USED – by segments = FALLOCATED – FREE\_SIZE

MAXTBS – sum(maxbytes) for tablespace files

RESERVED = MAXTBS – USED = logically available while files reach it's max.size

MAXRESFILE – max (MAXBYTES of file minus used space in that file) – **1 extent should reside within 1 file!**

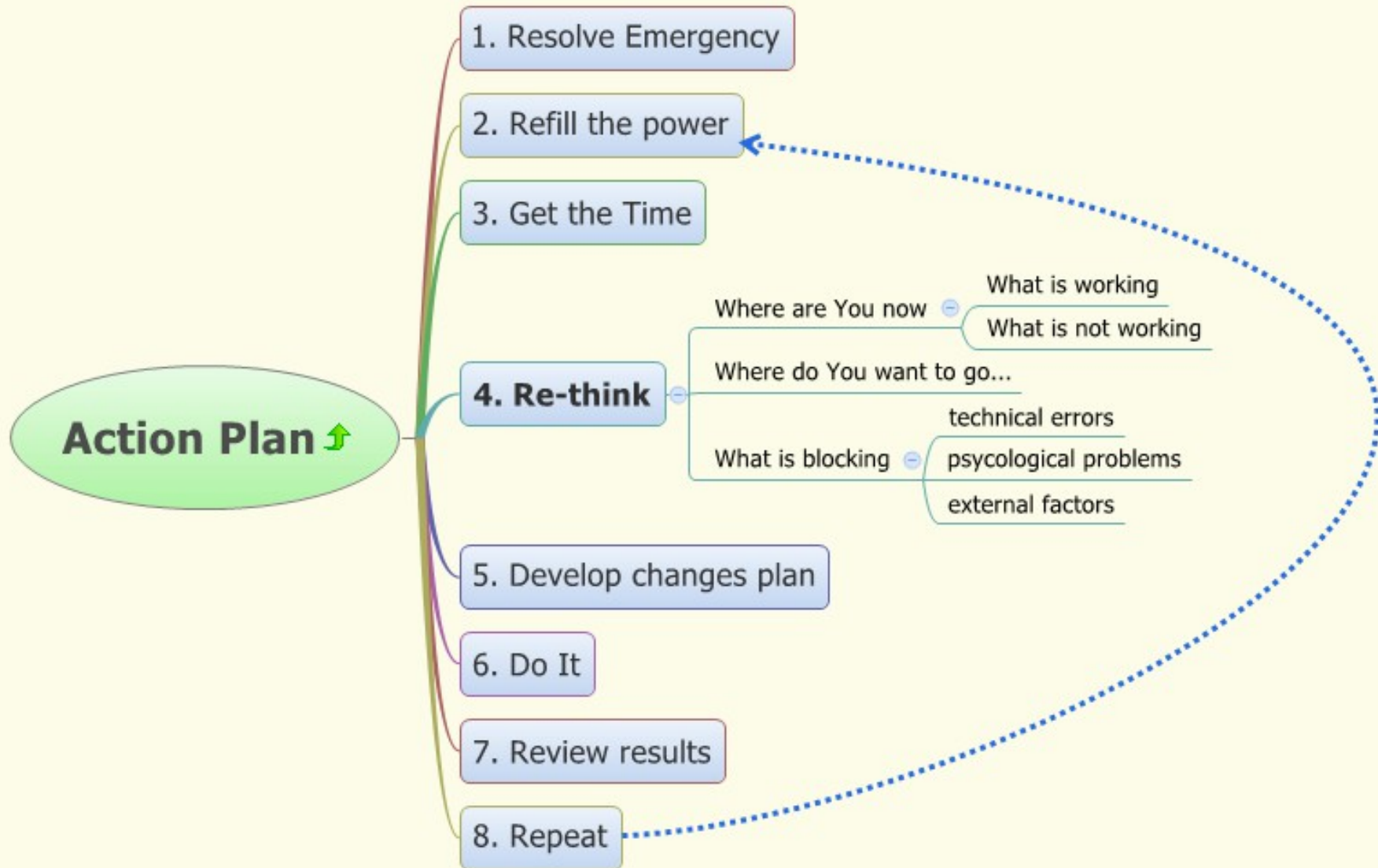
MAXSEG – biggest segment extent in tablespace, next new extent will be at least that size!

# DB garbage collector

- DB garbage collector example:

```
set lines 300
set pages 1000
-- candidates for removal:
select OWNER, SEGMENT_NAME, SEGMENT_TYPE, BYTES/1024/1024 MB
from dba_segments
where owner not in ('SYS','SYSTEM','PERFSTAT','WMSYS','OUTL')
and (segment_name like '%BCK%'
     or segment_name like '%BACKUP%'
     or segment_name like '%BACUP%'
     or segment_name like '%BAK%'
     or segment_name like '%TMP%'
     or segment_name like '%TEMP%'
     or segment_name like '%COPY%'
     or segment_name like '%200%'
     or segment_name like '%2010%'
     or segment_name like '%2011%'
     )
order by OWNER, SEGMENT_TYPE, SEGMENT_NAME;
```

# Live is possible!



# Links

- [?/rdbms/admin/catspace.sql](#)
- Extent and Block Space Calculation and Usage in Oracle Databases [[Note ID 10640.1](#)]
- Index Rebuild, the Need vs the Implications [[Note ID 989093.1](#)]
- SAFE method: HOW TO STOP DEFRAGMENTING AND START LIVING
  - Attachment to Note ID 10640.1
  - <http://www.indiana.edu/~dbateam/Documents/fragment.pdf>
- SAME method: Stripe And Mirror Everything –  
[http://docs.oracle.com/cd/B28359\\_01/server.111/b32024/vldb\\_storage.htm#BABHJEED](http://docs.oracle.com/cd/B28359_01/server.111/b32024/vldb_storage.htm#BABHJEED)
- 26 Disk Space Management of UNIX System Administration Handbook  
<http://www.admin.com/samples/DiskSpace.pdf>
- AVOIDING A DATABASE REORGANIZATION - Understanding, detecting, and eliminating harmful database fragmentation by Craig A. Shallahamer <http://www.allenhayden.com/cgi/getdoc.pl?file=reorg.pdf>
- All About Oracle Database Fragmentation by Craig A. Shallahamer  
[http://resources.orapub.com/product\\_p/dbfrag.htm](http://resources.orapub.com/product_p/dbfrag.htm)

# Links

- Filesystem Hierarchy Standard  
<http://www.pathname.com/fhs/pub/fhs-2.3.html>
- DBMS\_SPACE specification  
[http://docs.oracle.com/cd/B19306\\_01/appdev.102/b14258/d\\_space.htm#i1002179](http://docs.oracle.com/cd/B19306_01/appdev.102/b14258/d_space.htm#i1002179)
- FORECASTING DATABASE DISK SPACE REQUIREMENTS:A POOR MAN'S APPROACH by Edward L. Trettel  
<http://regions.cmg.org/regions/mspcmg/Presentations/Presentation03.doc>
- Strategies for Solving the Datacenter Space, Power, and Cooling Crunch: Sun Server and Storage Optimization Techniques  
<http://www.oracle.com/us/products/servers-storage/servers/sparc-enterprise/sun-datacenter-space-power-wp-075961.pdf>
- System Administration Toolkit: Monitoring disk space and usage  
<http://www.ibm.com/developerworks/aix/library/au-satdiskmon.html>
- CentOS: Chapter 7. Implementing Disk Quotas  
[http://www.centos.org/docs/5/html/Deployment\\_Guide-en-US/ch-disk-quotas.html](http://www.centos.org/docs/5/html/Deployment_Guide-en-US/ch-disk-quotas.html)
- Chapter 15. Optimizing Disk Space at "UNIX Power Tools"  
[http://docstore.mik.ua/oreilly/unix3/upt/ch15\\_01.htm](http://docstore.mik.ua/oreilly/unix3/upt/ch15_01.htm)
- Forty Ways To Free Up Disk Space - <http://technet.microsoft.com/en-us/library/cc750370.aspx>

# Links

## Software Projects:

- Skulker2 - <http://www.linuxha.net/skulker2/>
- Xymon Monitoring - <http://xymon.com/>
- Cacti - <http://www.cacti.net/>
- CCleaner - <http://www.piriform.com/CCLEANER>
- TreeSize - <http://www.jam-software.com/freeware/>
- SpaceSniffer - [http://www.uderzo.it/main\\_products/space\\_sniffer/](http://www.uderzo.it/main_products/space_sniffer/)
- SpaceStat - <http://www.cominder.eu/>

Q + A





3rd OUG Harmony Conference  
30.-31. May 2012  
Aulanko, Hämeenlinna Finland

Thanks for attention!

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