IBM PRESENTATION TO:

Expert Working Group on gTLD Directory Services

Registration Directory Service (RDS)
Implementation Model Cost Analysis
Full Report, posted 6 June 2014

Prepared for ICANN
By IBM

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20th March 2014
(updated 22 May 2014)

About this document

- This document is a summary version of the deliverable of the RDS Implementation Model Cost Analysis conducted over a 3,5 week period by IBM GTS Consulting on request of ICANN. Compared to the original analysis (v1.1) presented March 20th 2014, this version reflects the absence of zone file retrieval/usage in the FRDS model.

- This document does in no sense constitute an IBM implementation proposal. The material contained in this report and any relates files has been constructed for the sole purpose of and is only to be used and considered as part of a budgetary costing analysis aimed at comparing two RDS implementation models.

- Engagement Objective & Approach
- RDS Requirement
- Solution Outline
- Costing & Conclusions

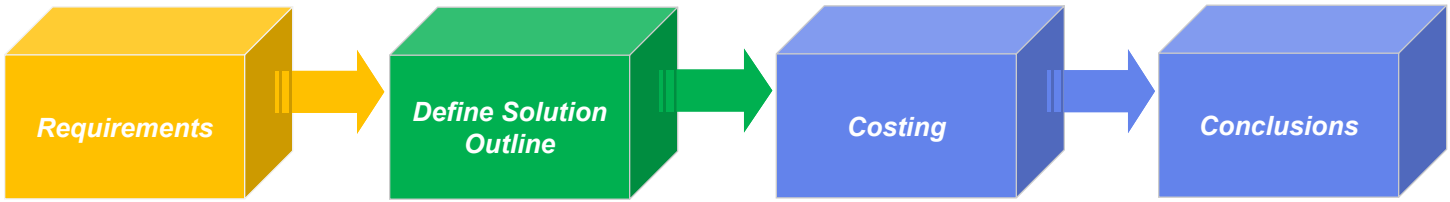
Engagement Objective

- Assist ICANN in the creation of a budgetary cost estimation for two RDS implementation models, being an Synchronized* model and a Federated model.

* For alignment with the EWG's Final Report, this summary refers to the Synchronized RDS (SRDS), the model described in earlier EWG reports as the Aggregated RDS (ARDS).

Engagement Approach

- Step 1: Gather baseline requirements for each of the implementation models from ICANN.
- Step 2: Based on ICANN input, define and agree key volumetric assumptions, derive the expected system workload and define a high level baseline solution outline for each of the two implementation models.
- Step 3: Create cost model and perform a budgetary costing of each of the baseline solution outlines.
- Step 4: Formulate findings

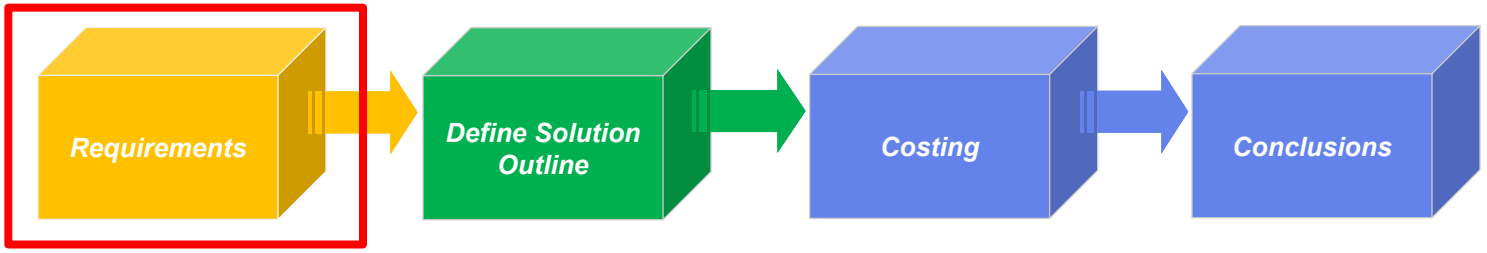


Engagement Starting Points

- Create a budgetary cost estimate for the central "RDS system/provider". Registry Operator side costs are not estimated.
- A Managed Service cost model and estimate is created. That is, assume the setup and ongoing operations of a managed RDS service and estimate the related costs.
- Solution and cost based on IBM service and solution portfolio. Third Party alternatives are not considered; unless no alternative exists in the IBM portfolio.
- For the Infrastructure costs, we will assume an IaaS realization mode and assume the solution can largely be based on the IBM SoftLayer offering.
- No detailed cost variance analysis is performed. Cost estimations are created for the baseline requirement/solution outline, not for variants; no detailed cost driver analysis is performed.

- Engagement Objective & Approach
- **RDS Requirement**
- Solution Outline
- Costing & Conclusions

RDS System Requirements

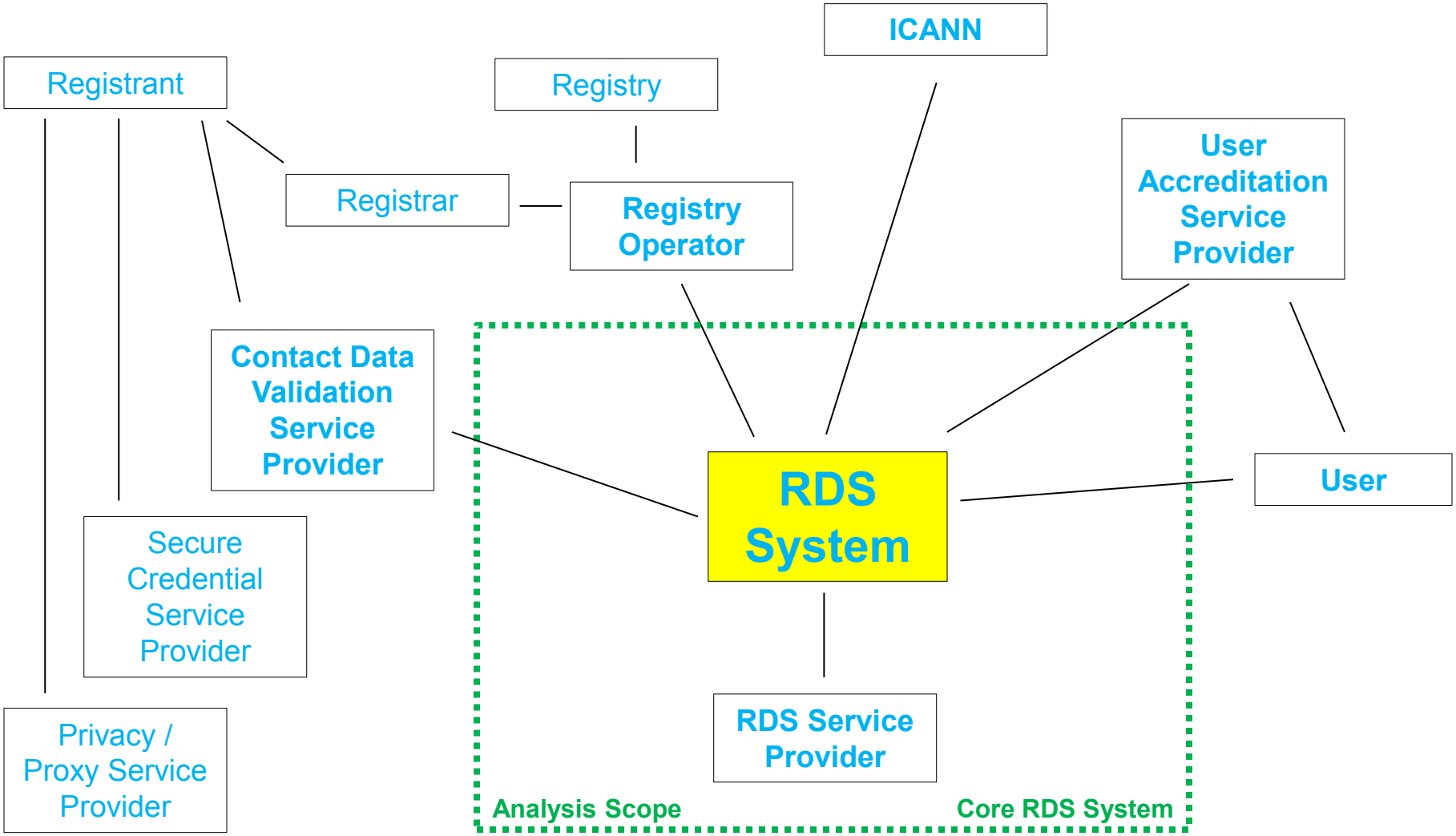


This section contains the RDS System Requirement that has been used in the cost analysis. The purpose of this step was to provide the analysis team a reasonable understanding of the purpose, scope, and usage of the RDS System in order to allow sizing and solution definition for the purpose of the budgetary cost analysis.

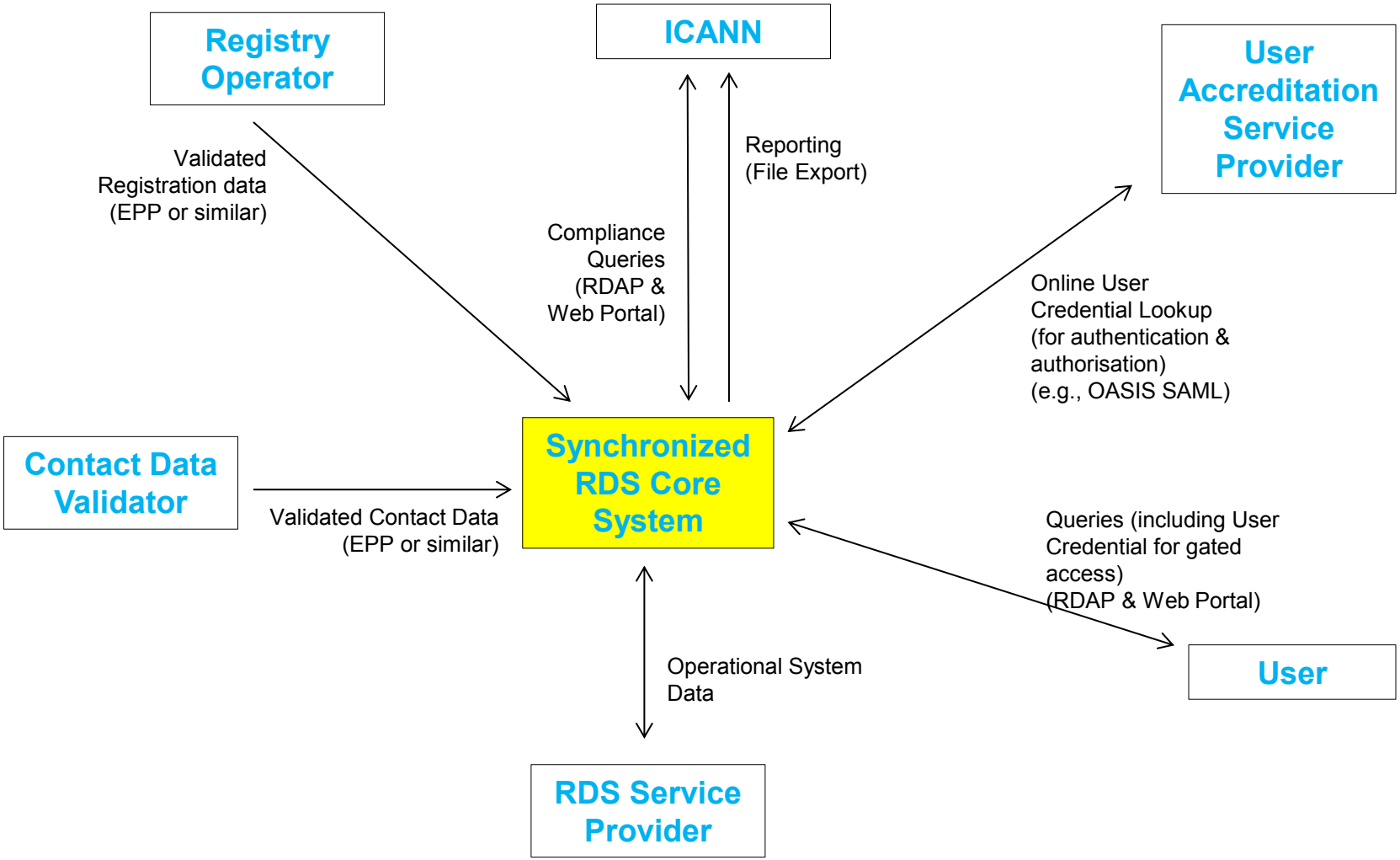
- The following inputs have been used in drafting these requirements:
- https://www.icann.org/en/groups/other/gtld-directory-services/initial-report-24jun13-en.pdf
- https://www.icann.org/en/groups/other/gtld-directory-services/status-update-11nov13-en.pdf
- VOLUMETRIC INPUTS TO RDS IMPLEMENTATION MODEL COST ANALYSIS paper from ICANN, 22 February 2014 , updated 06 March 2014 - Provided by ICANN for use by IBM GTS Consulting Project Team
- EWG-ICANN48-PublicSession-ForIBM.pptx - Provided by ICANN
- Reviews with the ICANN RDS Implementation Model Cost Analysis core team

ToC

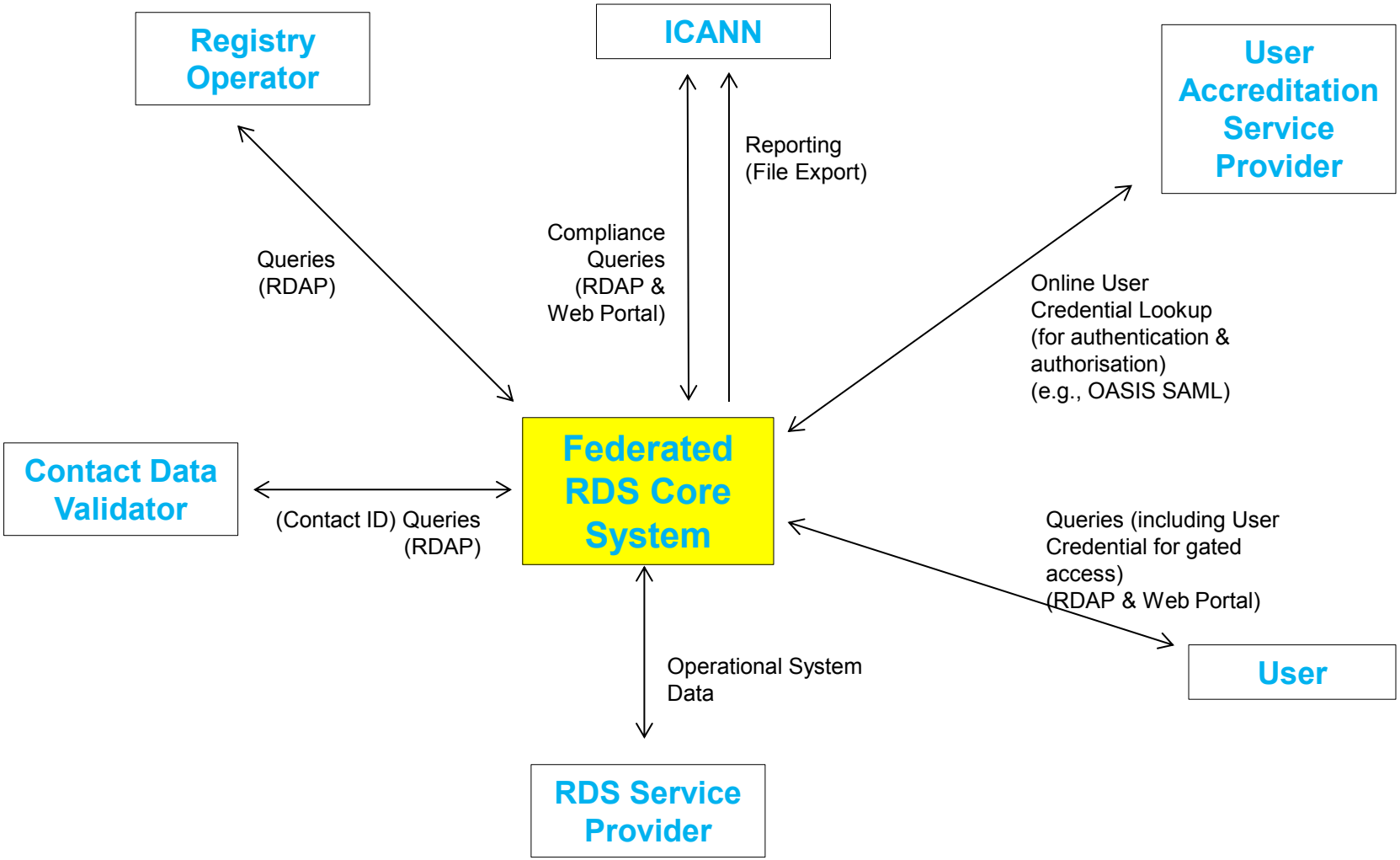
System Context Diagram & Actors



Core RDS System, Main Interfaces and Data Flows Synchronized Model



Core RDS System, Main Interfaces and Data Flows Federated Model



ToC

Main Use Cases
Synchronized Model

- **RDS System receives initial copy of and stores gTLD registration data from Registry Operator (start-up phase)**
- **RDS System receives copy of and stores updated gTLD registration data from Registry Operator (ongoing)**
- **RDS System receives initial copy of and stores Contact Data from Contact Data Validators (start-up phase)**
- **RDS System receives copy of and stores updated Contact Data from Contact Data Validators (ongoing)**
- User accesses RDS and queries RDS System (Anonymous Access case)
- User access RDS, is redirected to User Accreditation Service Provider (UASP), authenticates at UASP, obtains gated access to RDS System, RDS System obtains entitlements from UASP and User performs Query (Gated Access case)
  - Note: Users will logon, a session will be established and during that session the User can perform multiple queries
- RDS System provides Users access to stored data in line with entitlements (Anonymous and Gated Access Case)
- ICANN (or appointed third parties) performs compliance queries (using RDAP or portal)
- ICANN retrieves Statistics Reports
- RDS Operator audits data access by Users → understood as: Data access by users is logged (2 year data retention) and statistics reporting is made available. (analysis and abuse determination is handled by ICANN).
- RDS Operator handles data accuracy complaints → understood as: RDS Operator/System will support investigation of data inconsistencies between RDS System and Registry Operator; i.e. RDS Operator/System does not handle/intervene in problems where data received is identical to data available at Registry Operator but the data is incorrect itself due to a problem introduced at collection (domain name registration) time

Main Use Cases
Federated Model

- User accesses RDS and queries RDS System (Anonymous Access case)
- User access RDS, is redirected to User Accreditation Service Provider (UASP), authenticates at UASP, obtains gated access to RDS System, RDS System obtains entitlements from UASP and User performs Query (Gated Access case)
  - Note: Users will logon, a session will be established and during that session the User can perform multiple queries
- **RDS System federates query to applicable Registry Operators; caches received data; consolidates result if multiple Registries are involved, and provides response to User in line with entitlements**
- **RDS System resolves Contact Data ID with Contact Data Validator (when applicable)**
- ICANN (or appointed third parties) performs compliance queries (using RDAP or portal)
- ICANN retrieves Statistics Reports
- RDS Operator audits data access by Users → understood as: Data access by users is logged (2 year data retention) and statistics reporting is made available. (analysis and abuse determination is handled by ICANN).
- RDS Operator handles data accuracy complaints → understood as: RDS Operator/System will support investigation of data inconsistencies between RDS System and Registry Operator; i.e. RDS Operator/System does not handle/intervene in problems where data received is identical to data available at Registry Operator but the data is incorrect itself due to a problem introduced at collection (domain name registration) time

ToC

Requirements (for purposes of Cost Analysis*)

- Implement support for the Main Use Cases (see previous slides)
- Query Interface methods to be supported for Users and ICANN
  - Web portal
  - Web Service (RDAP)
- RDS Portal to support Multilanguage
- The RDS System Logon procedure should include a captcha mechanism (implemented RDS System side)
- Reporting Module (available to ICANN … providing usage stats)
- Ability for User and ICANN to save query result as xls / csv / pdf
- Two user Access Models to be supported: Public + Gated
  - anonymous access to public data elements with restrictions to deter bulk harvesting of public data access
  - gated access to more sensitive data elements only to be available to requestors who applied for and were issued credentials for RDS query authentication
  - the RDS monitors both public and gated data access to minimize abuse and impose penalties and other remedies for inappropriate use → understood as a requirement for rate limiting by source IP, rate limiting by gated user, and blacklisting (user/IP)
- Authentication for Gated Access is relayed by the RDS System to the User Accreditation Service Provider (UASP). Also access entitlements are received from UASP.
  - If a User is not accredited yet with a UASP when accessing the RDS System the User will be provided a page with some explanation and links to the User Accreditation Service Providers
- Interface with User Accreditation Service Provider: OASIS SAML

** This cost analysis was based on draft EWG recommendations, which may or may not result in RDS implementation. To enable cost analysis, certain assumptions had to be made about system requirements – these are the given "requirements" enumerated here.*

Core Volumetric Assumptions

YEARLY GROWTH RATE	22%	nr of DN records added in a year, assumed to include the growth in the nr of gTLDs					
Nr of DN RECORDS, YEARLY UPDATE RATE	100%	nr of DN records updated in a year					
		start yr1 (2015)	start yr2 (2016)	start yr3 (2017)	start yr4 (2018)	start yr5 (2019)	end yr 5 (2020)
	Nr of gTLDs	2000	3000	4000	5000	6000	7000
	growth rate		50%	33%	25%	20%	17%
	December 2013, ICANN input	start yr1 (2015)	start yr2 (2016)	start yr3 (2017)	start yr4 (2018)	start yr5 (2019)	end yr 5 (2020)
NR OF DOMAIN NAMES	151.196.101	184.459.243	225.040.277	274.549.138	334.949.948	408.638.936	498.539.502
NR OF QUERIES/MONTH	9.031.522.529	11.018.457.485	13.442.518.132	16.399.872.121	20.007.843.988	24.409.569.665	29.779.674.992
AVERAGE NR OF QUERIES/SEC	3.484	4.251	5.186	6.327	7.719	9.417	11.489
NR OF QUERIES/PEAK SEC		42.509	51.862	63.271	77.191	94.173	114.891
AVERAGE NR OF QUERIES/HOUR	12.543.781	15.303.413	18.670.164	22.777.600	27.788.672	33.902.180	41.360.660
NR OF QUERIES IN PEAK HOUR	25.087.563	30.606.826	37.340.328	45.555.200	55.577.344	67.804.360	82.721.319
USER VISITS IN PEAK HOUR	16.892.292	20.608.596	25.142.488	30.673.835	37.422.079	45.654.936	55.699.022
CONCURRENT VISITS IN PEAK HOUR	563.076	686.953	838.083	1.022.461	1.247.403	1.521.831	1.856.634
NEW VISITS IN PEAK SEC		28.623	34.920	42.603	51.975	63.410	77.360

See tab “workload model” in RDS COST MODEL file for additional volumetric assumptions

Additional Assumptions

- For the gated access case, it is assumed that the user has been accredited by the User Accreditation Service Provider (UASP) prior to using the RDS System; i.e. user accreditation at query time is not supported
  - If a User is not accredited yet with a UASP when accessing the RDS System the User will be provided a page with some explanation and links to the User Accreditation Service Providers

- A two DC deployment with an active/active setup. Each DC capable of handling 50% of the peak load.

- A five year costing horizon will be taken (no HW renewal will be considered)

- Data Access Logging
  - No result data will be logged
  - Gated Access: logging of query, user identity, timestamp + success or not / nr of records returned
  - Anonymous Access: same requirement, but not identity data, except for the source IP address

- Wildcard queries are not to be supported (If wildcards were to be supported, the federated model implies that RDAP and Registry Operator support wildcard based queries)

- Federated Model: Registry Operators maintain historical data which can be queried over RDAP

Not Being Considered in the Costing Analysis

- Escrow
- RDS implementation model selection
- Implementation vendor selection & contracting
- Any further specification & development of API extensions (RDAP, EPP, ...). We assume a mature well defined API specification will exists.
- Payment handling; invoicing for data accessed or any other service provided
- Transliteration Requirement (requirement unclear at this stage)

Not in scope of core RDS System/Operator

- Not in scope of RDS System/Operator in the Synchronized Model: RDS System provides Users access to live data retrieved in real time from Registry Operator in line with entitlements

➔ Live querying against the Registry Operator is only provided for in the Federated Model (using the RDS System as proxy)

➔ Note: In case of the SRDS model, the delay at which Registry Operator side updates are pushed to the RDS will determine how current the query results.

- Manage licensing arrangements to access data

➔ This is a User Accreditation Service Provider Use Case

- User (Requestor of data contained in RDS System) obtains Access Credentials

➔ This is a User Accreditation Service Provider Use Case, understood as User registers with Accreditation Service Provider

- Registrants can opt into making any gated Registrant-supplied data public, except as noted due to high risk.

➔ This is handled via/by the registrar. No direct RDS System/Operator involvement (Although the resulting registration data will be copied into the RDS System as part of the data that is receive from the Registry Operator.)

- Contact Management and Validation Process / Contact ID management: Adopting a Contact ID management and validation system aims to create a more accurate RDS

➔ Contact Data Validation is a separate system/process/provider supporting the domain name registration, and not a core RDS System component. However, the RDS System will interface with the Contact Data Validation Service Provider

- Privacy and Proxy Provider services

➔ These are not core RDS System Use Cases, but services that play at domain name registration time

- Secured Protected Credentials services

➔ These are not core RDS System Use Cases, but services that play at domain name registration time

- Engagement Objective & Approach
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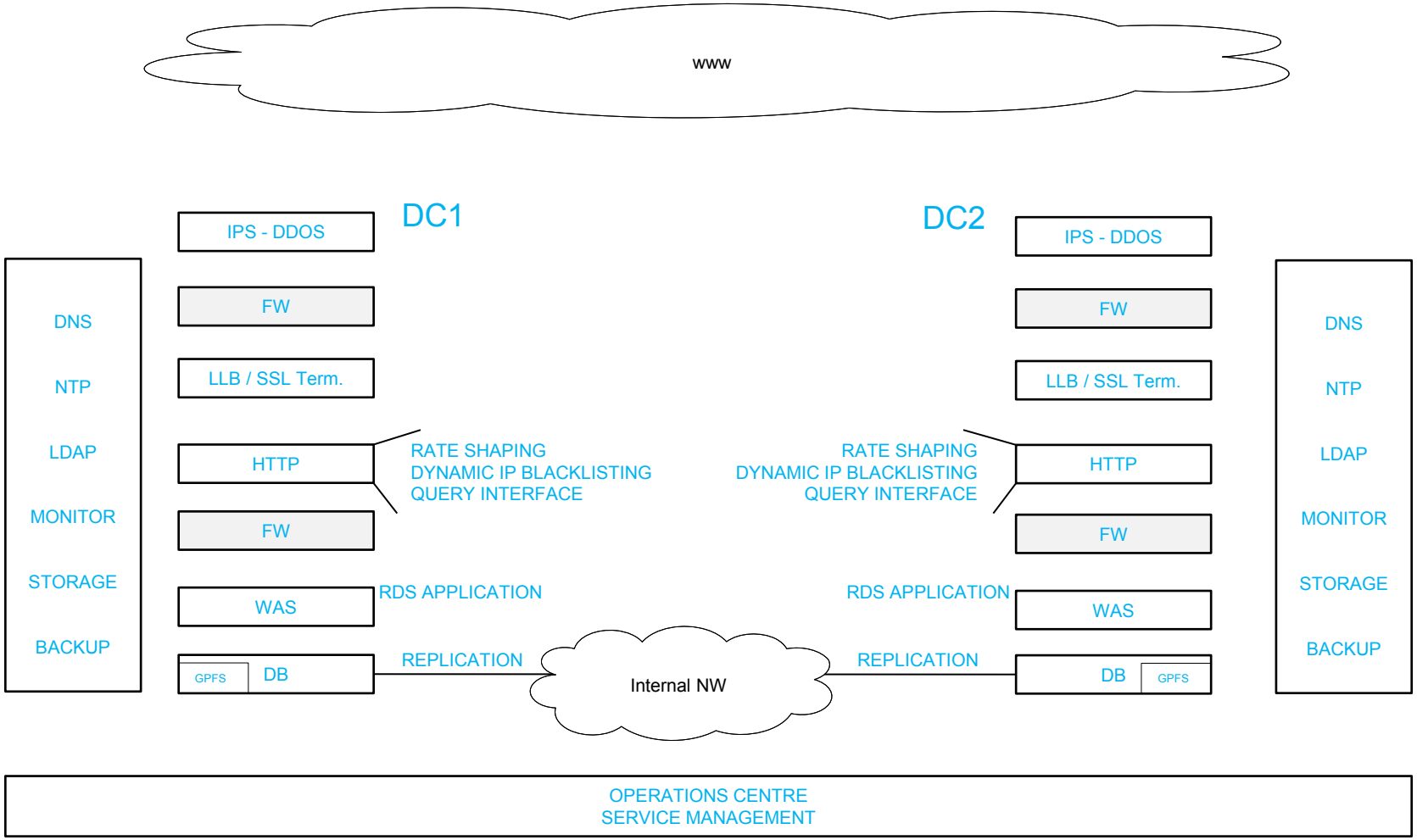
- **Solution Outline**
- Costing & Conclusions

The Component Model (Functional) defines the key functions required to implement the RDS System



The SRDS Workload has been derived from the volumetric assumptions and use case model

	OUTGOING MONTHLY VOLUME				
	yr 1	yr 2	yr 3	yr 4	yr 5
TOTAL (Kb)	11.382.588.640.545	13.886.752.558.745	16.941.832.538.949	20.669.030.114.797	25.216.211.157.333
TOTAL (Mb)	11.115.809.219	13.561.281.796	16.544.758.339	20.184.599.721	24.625.206.208
TOTAL (Gb)	10.855.28				24.048.053
TOTAL (Tb)	10.6				23.484
TOTAL (TB)	1.3				2.936

	INCOMING VOLUME IN PEAK SEC				
	end yr1	end yr2	end yr3	end yr4	end yr5
TOTAL (Kb/sec)	167.059	203.811	248.648	303.349	370.085
			243	296	361
			0,2	0,3	0,4

	OUTGOING VOLUME IN PEAK SEC				
	end yr1	end yr2	end yr3	end yr4	end yr5
TOTAL (Kb/sec)	43.915.253	53.576.588	65.363.416	79.743.346	97.286.861
TOTAL (Mb/sec)	42.886	52.321	63.831	77.874	95.007
TOTAL (Gb/sec)	41,9	51,1	62,3	76,0	92,8

Workload Model

	DB TRANSACTIONS IN PEAK SEC				
	yr1	yr2	yr3	yr4	yr5
TOTAL	57.852	70.580	86.107	105.051	128.162
INSERT	5.472	6.676	8.145	9.936	12.122
SELECT	52.380	63.904	77.963	95.114	116.040

LOGGING DB SIZE				
TB	TB	TB	TB	TB
end yr1	end yr2	end yr3	end yr4	end yr5
77	171	209	255	310

DOMAIN NAME/CONTACT DATA RECORD DB SIZE				
TB	TB	TB	TB	TB
end yr1	end yr2	end yr3	end yr4	end yr5
2,8	3,4	4,1	5,0	6,1

CONCURRENT INCOMING CONNECTIONS				
end yr1	end yr2	end yr3	end yr4	end yr5
838.399	1.022.882	1.247.929	1.522.462	1.857.370

NEW INCOMING CONNECTIONS IN PEAK SEC				
end yr1	end yr2	end yr3	end yr4	end yr5
34.920	42.603	51.975	63.410	77.360

The FRDS Workload has been derived from the volumetric assumptions and use case model

	OUTGOING MONTHLY VOLUME				
	yr 1	yr 2	yr 3	yr 4	yr 5
TOTAL (Kb)	11.945.796.396.553	14.777.679.275.581	18.277.415.303.987	22.601.796.736.152	27.944.280.325.955
TOTAL (Mb)	11.665.816.794	14.431.327.418	17.849.038.383	22.072.067.125	27.289.336.256
TOTAL (Gb)	11.392.399	14.093.093	17.430.702	21.554.753	26.649.742
TOTAL (Tb)	11.125				
TOTAL (TB)	1.391				

	INCOMING VOLUME IN PEAK SEC				
	end yr1	end yr2	end yr3	end yr4	end yr5
TOTAL (Kb/sec)	20.950.341	25.598.731	31.278.416	38.218.184	46.697.575
TOTAL (Mb/sec)	20.459	24.999	30.545	37.322	45.603
TOTAL (Gb/sec)	20,0	24,4	29,8	36,4	44,5

	OUTGOING VOLUME IN PEAK SEC				
	end yr1	end yr2			
TOTAL (Kb/sec)	47.008.027	58.136.088	71.		
TOTAL (Mb/sec)	45.906	56.774	70.201	86.788	107.275
TOTAL (Gb/sec)	44,8	55,4	68,6	84,8	104,8

Workload Model

	DB TRANSACTIONS IN PEAK SEC				
	yr1	yr2	yr3	yr4	yr5
TOTAL	57.761	70.468	85.971	104.885	127.960
INSERT	5.381	6.565	8.009	9.771	11.920
SELECT	52.380	63.904	77.963	95.114	116.040

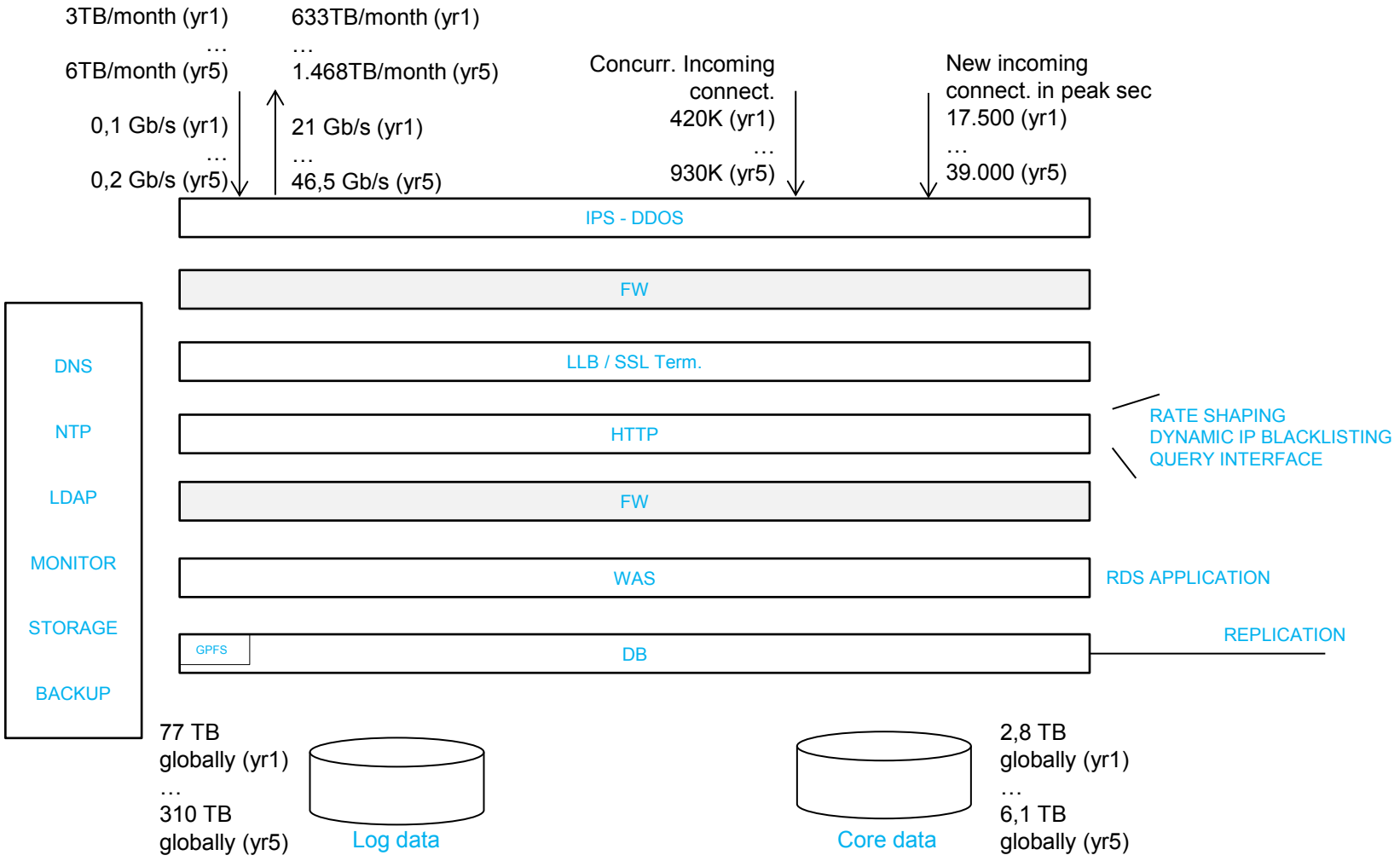
LOGGING DB SIZE				
TB	TB	TB	TB	TB
end yr1	end yr2	end yr3	end yr4	end yr5
77	171	209	255	310

META DATA (zone files)				
GB	GB	GB	GB	GB
end yr1	end yr2	end yr3	end yr4	end yr5
106	129	158	193	235

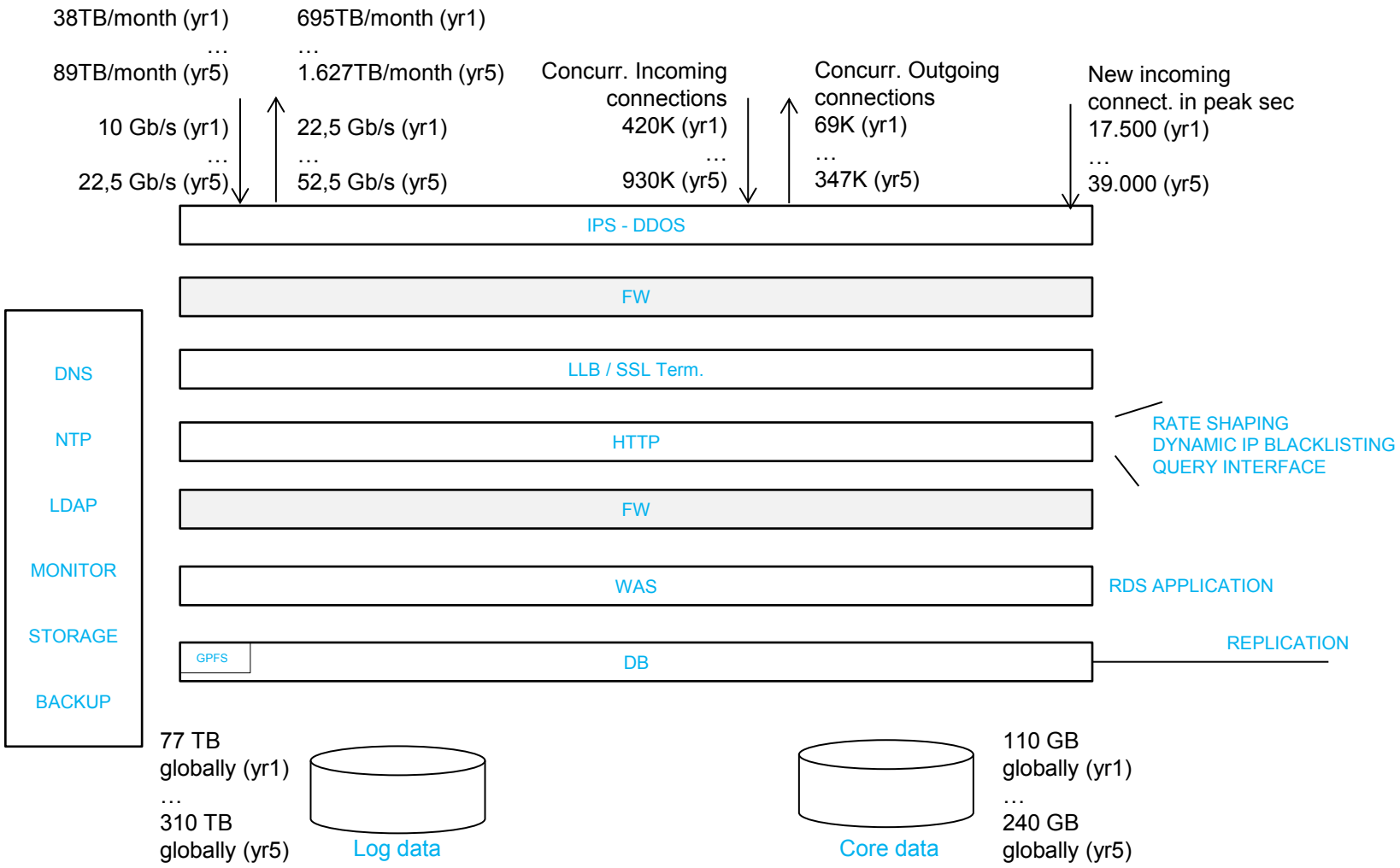
CONCURRENT INCOMING CONNECTIONS				
end yr1	end yr2	end yr3	end yr4	end yr5
838.084	1.022.462	1.247.404	1.521.832	1.856.635

NEW INCOMING CONNECTIONS IN PEAK SEC				
end yr1	end yr2	end yr3	end yr4	end yr5
34.920	42.603	51.975	63.410	77.360

SRDS
Key Workload per DC



FRDS
Key Workload per DC



Solution Model Highlights

IBM SoftLayer IAAS for the majority of the hardware components, using the IBM SoftLayer dedicated bare metal system option for the compute layer.

Where no matching standard IBM SoftLayer component was identified, a dedicated solution component was added. This was done for: FW/IPS (Firewall / Intrusion Protection System) and LLB (Local Load Balancing)

IBM Websphere Application Server for the applications server layer.

IBM DB2 PureScale for the database layer.

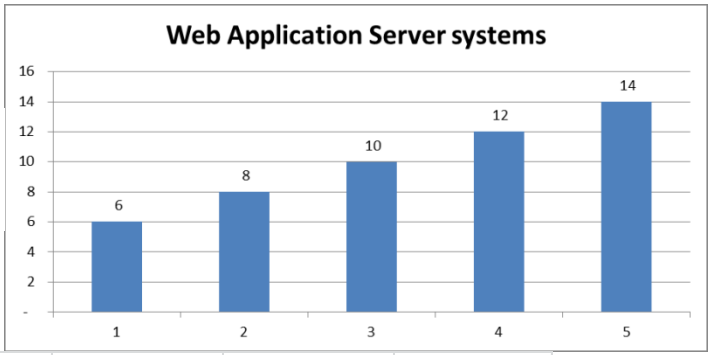
Two Datacenter setup; active-active, each capable of handling 50% of peak load. No clustering for High Availability within a DC.

PLATFORM SOLUTION OUTLINE SRDS	
Functional Component	**Operational Component / notes**
Inter DC Loadbalancing/Routing	DNS on SL Fortigate Device
DDOS	Generic service of SL.
Intra DC Loadbalancing & SSL termination	SL is monitoring the servers F5 Viprion
Web Server	IBM HTTP Server on SL Bare Metal Server with Linux
Web Application Server	IBM WebSphere Application Server on SL Bare Metal Server with Linux
WAS Admin node	IBM WebSphere Application Server on SL Bare Metal Server with Linux
DB Caching System	IBM DB2 PureScale caching node on SL Bare Metal Server with Linux
DB Member System	IBM DB2 PureScale processing node on SL Bare Metal Server with Linux
Storage Server	Softlayer Storage Server (Quantastor)
Systems Monitoring	Nagios on SL Bare Metal Server with Linux
DNS	SL DNS service
NTP	SL NTP service
LDAP	Tivoli Directory Server on SL Bare Metal Server with Linux
syslog/sw repositry	SL Bare Metal Server with Linux
Backup Server	TSM server in third SL DC
Backup Storage Server	Softlayer Storage Server (Quantastor)
DB2 backup client system	DB2 member server
NW Zoning / FW / IPS	Juniper SRX
Internet Connectivity	SL Public NW
DC NW	SL Private NW & Management NW
Inter DC NW	SL Private NW

For each functional component, a physical building block was defined and sized to handle the previously defined workload, for both implementation models

PLATFORM SOLUTION OUTLINE SRDS	
Functional Component	**Operational Component / notes**
Inter DC Loadbalancing/Routing	DNS on SL Fortigate Device
Intra DC Loadbalancing & SSL termination	F5 Viprion
Web Application Server	IBM WebSphere Application Server on SL Bare Metal Server with Linux

Solution Model



Nr of queries to support in peak hour

start yr1	end yr1	end yr2	end yr3	end yr4	end yr5	
20.608.596	25.142.488	30.673.835	37.422.079	45.654.936	55.699.022	
6	6	8	10	12	14	systems needed

WAS sizing

30	nr of queries in peak hour (million) for baseline configuration	
ARDS:	7	systems needed (source = techline) for 30 M queries in peak hour
4,3	million queries supported by 1 system	

System Model

global (ie 2 DCs)			
yr	Web Application Server systems	Deployment Mngrs	HTTP servers
1	6	2	6
2	8	2	8
3	10	2	10
4	12	2	12
5	14	2	14

Finally, the labor required to implement and run the RDS System has been estimated, again for both implementation models

SETUP PHASE

APPLICATION DEVELOPMENT & TESTING

APPLICATION MAINTENANCE

INFRASTRUCTURE SETUP COSTS

ARCHITECTURE & DESIGN (2 DCs)

PROVISION, INSTALL & CONFIGURE (2 DCs)

INFRASTRUCTURE TEST

E2E SYSTEM TESTING

PERFORMANCE TESTING

SECURITY (ETHICAL HACK) TESTING

TRANSITION TO BAU

(BAU = Business As Usual)

Transition Manager (receiving BAU organisation)

System Boarding

Train BAU Team

SD (Service Desk) Setup

PROJECT MANAGEMENT

RUN PHASE

Key assumption: Service Desk not accessible directly by end-users.

RUN PHASE

SD

INFRASTRUCTURE L2/L3

APPLICATION L2/L3

RECURRING INFRASTRUCTURE CHECKS

PERFORMANCE & CAPACITY MNGT

DR TEST

SERVICE GOVERNANCE

PE (Project Executive)

SDM (Service Delivery Manager)

Project Office

Architect

- Engagement Objective & Approach
- RDS Requirement
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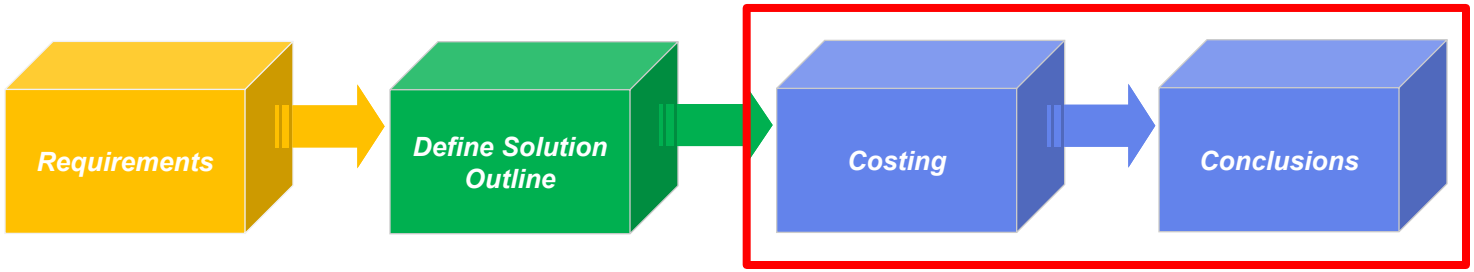
Costing and Conclusions



This section describes the Costing and presents the Conclusions

The costing does in no sense constitute an IBM implementation proposal. The costing has been created for the sole purpose of and is only to be used and considered as part of a budgetary costing analysis aimed at comparing two RDS implementation models.

Cost Model Principles / Notes

No inflation, no year on year optimization, no setup cost activation, no depreciation of infrastructure acquisition costs (i.e. when dedicated non IAAS components have been included)

All costs allocated to year they are incurred

All amounts excluding taxes

Costs included for production service; other environments not included

All infrastructure costs are “street price” rates, i.e. prudent discount levels are assumed

SW cost is included against market prices

Labor is costed at an average rate of 600 euro/day

Conservative/prudent estimations were used when estimating the required system dimension

No data compression is assumed in the DB layer

Conclusions

With the assumptions used the Core RDS system is slightly less expensive in the Federated RDS (FRDS) model than the Synchronized RDS (SRDS) model.

At the same time, the FRDS model is highly sensitive to variations in the reverse query load. With a higher amount of reverse queries, the FRDS model becomes substantially more expensive: With a 3% reverse query load instead of a 1% reverse query load, the cost of the FRDS model is estimated to increase close to 35%. This is a factor of uncertainty and risk in the FRDS model. The SRDS model is believed to be less sensitive to the amount of reverse queries.

The FDRS model is expected to require higher application operations, support, maintenance and test effort as more interactions with Registry Operators are expected.

In addition, the FRDS model has more impact on the Registry Operators.

€	0,0183	average cost/domain/year

ICANN IBM

SRDS Budgetary Cost Estimate

cost per domain name	yr1	yr2	yr3	yr4	yr5
	€ 0,041	€ 0,023	€ 0,017	€ 0,020	€ 0,019

COST MODEL SRDS								totals	SHARE IN TOTAL	
								€ 31.944.025	100%	
RUN COSTS		yr1	yr2	yr3	yr4	yr5	yr1-yr5	€ 30.340.106	95%	
INFRASTRUCTURE COSTS	PUBLIC NW	€ 653.409	€ 807.972	€ 1.056.373	€ 1.339.237	€ 1.708.121	€ 5.565.112	€ 11.864.229	37%	17%
	DC NW, GLB, LLB, IPS/DDOS	€ 594.920	€ 145.914	€ 278.966	€ 311.589	€ 211.160	€ 1.542.549			5%
	HTTP SERVERS	€ 23.400	€ 31.200	€ 39.000	€ 46.800	€ 54.600	€ 195.000			1%
	WAS SERVERS	€ 44.314	€ 57.343	€ 70.371	€ 83.400	€ 96.429	€ 351.857			1%
	DB SERVERS	€ 169.337	€ 214.577	€ 254.006	€ 338.674	€ 423.343	€ 1.399.937			4%
	STORAGE	€ 191.606	€ 329.469	€ 398.400	€ 467.331	€ 605.194	€ 1.992.000			6%
	BACKUP	€ 97.046	€ 131.511	€ 131.511	€ 165.977	€ 200.443	€ 726.489			2%
	GENERIC SYSTEMS	€ 18.257	€ 18.257	€ 18.257	€ 18.257	€ 18.257	€ 91.286			0%
SW LICENCE &	DB	€ 2.916.864	€ 1.944.576	€ 729.216	€ 2.187.648	€ 2.430.720	€ 10.209.024	€ 11.984.687	38%	32%
	WAS	€ 489.000	€ 254.280	€ 285.576	€ 316.872	€ 348.168	€ 1.693.896			5%
	BACKUP	€ 45.426	€ 9.085	€ 9.085	€ 9.085	€ 9.085	€ 81.767			0%
OPERATIONS AND MANAGEMENT COSTS	INFRA OPERATIONS & MAINTENANCE	€ 504.000	€ 619.500	€ 703.500	€ 819.000	€ 934.500	€ 3.580.500	€ 6.491.190	20%	11%
	APPLICATION OPERATIONS	€ 131.250	€ 131.250	€ 131.250	€ 131.250	€ 131.250	€ 656.250			2%
	APPLICATION MAINTENANCE	€ 87.120	€ 58.080	€ 58.080	€ 58.080	€ 58.080	€ 319.440			1%
	SERVICE GOVERNANCE	€ 315.000	€ 315.000	€ 315.000	€ 315.000	€ 315.000	€ 1.575.000			5%
	SERVICE DESK	€ 72.000	€ 72.000	€ 72.000	€ 72.000	€ 72.000	€ 360.000			1%
SETUP COSTS								€ 1.603.919	5%	
INFRASTRUCTURE SETUP COSTS	ARCHITECTURE & DESIGN	€ 71.700	€ -	€ -	€ -	€ -	€ 71.700	€ 392.138	1%	0%
	PROVISION & CONFIGURE	€ 110.550	€ 35.550	€ 43.500	€ 51.150	€ 52.350	€ 293.100			1%
	INFRASTRUCTURE TESTING	€ 27.338	€ -	€ -	€ -	€ -	€ 27.338			0%
APPLICATION SETUP COSTS	ANALYSIS, DESIGN, CODE, UNIT TEST	€ 348.480	€ -	€ -	€ -	€ -	€ 348.480	€ 348.480	1%	1%
TESTING	INTEGRATION TESTING & DEPLOYMENT	€ 232.320	€ -	€ -	€ -	€ -	€ 232.320	€ 489.393	2%	1%
	E2E SYSTEM TESTING	€ 53.073	€ -	€ -	€ -	€ -	€ 53.073			0%
	PERFORMANCE	€ 54.000	€ -	€ -	€ -	€ -	€ 54.000			0%
	SECURITY (ETHICAL HACK)	€ 30.000	€ 30.000	€ 30.000	€ 30.000	€ 30.000	€ 150.000			0%
TRANSITION TO BAU	TRANSITION TO BAU	€ 75.600	€ 6.600	€ 4.800	€ 6.600	€ 6.600	€ 100.200	€ 142.200	0%	0%
	SERVICE DESK SETUP	€ 42.000	€ -	€ -	€ -	€ -	€ 42.000			0%
PROJECT	PROJECT MANAGEMENT	€ 169.827	€ 19.535	€ 13.932	€ 14.202	€ 14.213	€ 231.708	€ 231.708	1%	1%
TOTAL/YR		€ 7.567.837	€ 5.231.699	€ 4.642.824	€ 6.782.153	€ 7.719.513				
OVERALL TOTAL (over 5 years)		**€ 31.944.025**								

€	0,0173	average cost/domain/year

FRDS Budgetary Cost Estimate

cost per domain name				
yr1	yr2	yr3	yr4	yr5
€ 0,041	€ 0,018	€ 0,017	€ 0,021	€ 0,017

COST MODEL FRDS								totals	SHARE IN TOTAL	
								€ 30.207.476	100,0%	
RUN COSTS		yr1	yr2	yr3	yr4	yr5	yr1-yr5	€ 28.435.251	**94,1%**	
INFRASTRUCTURE COSTS	PUBLIC NW	€ 171.761	€ 324.645	€ 475.497	€ 604.721	€ 876.788	€ 2.453.412	€ 9.204.712	**30,5%**	8,1%
	DC NW, GLB, LLB, IPS/DDOS	€ 594.920	€ 278.966	€ 178.537	€ 311.589	€ 344.211	€ 1.708.223			5,7%
	HTTP SERVERS	€ 85.800	€ 101.400	€ 124.800	€ 156.000	€ 187.200	€ 655.200			2,2%
	WAS SERVERS	€ 148.543	€ 174.600	€ 213.686	€ 265.800	€ 317.914	€ 1.120.543			3,7%
	DB SERVERS	€ 124.097	€ 124.097	€ 84.669	€ 169.337	€ 169.337	€ 671.537			2,2%
	STORAGE	€ 176.383	€ 314.246	€ 383.177	€ 452.109	€ 589.971	€ 1.915.886			6,3%
	BACKUP	€ 62.580	€ 97.046	€ 131.511	€ 131.511	€ 165.977	€ 588.626			1,9%
	GENERIC SYSTEMS	€ 18.257	€ 18.257	€ 18.257	€ 18.257	€ 18.257	€ 91.286			0,3%
SW LICENCE & MAINTENANCE COSTS	DB	€ 1.458.432	€ 243.072	€ 243.072	€ 1.701.504	€ 486.144	€ 4.132.224	€ 9.882.479	**32,7%**	13,7%
	WAS	€ 1.740.840	€ 661.128	€ 880.200	€ 1.130.568	€ 1.255.752	€ 5.668.488			18,8%
	BACKUP	€ 45.426	€ 9.085	€ 9.085	€ 9.085	€ 9.085	€ 81.767			0,3%
OPERATIONS AND MANAGEMENT COSTS	INFRA OPERATIONS & MAINTENANCE	€ 819.000	€ 966.000	€ 1.123.500	€ 1.354.500	€ 1.596.000	€ 5.859.000	€ 9.348.060	**30,9%**	19,4%
	APPLICATION OPERATIONS	€ 262.500	€ 131.250	€ 131.250	€ 131.250	€ 131.250	€ 787.500			2,6%
	APPLICATION MAINTENANCE	€ 104.544	€ 75.504	€ 75.504	€ 75.504	€ 75.504	€ 406.560			1,3%
	SERVICE GOVERNANCE	€ 315.000	€ 315.000	€ 315.000	€ 315.000	€ 315.000	€ 1.575.000			5,2%
	SERVICE DESK	€ 144.000	€ 144.000	€ 144.000	€ 144.000	€ 144.000	€ 720.000			2,4%
SETUP COSTS								€ 1.772.225	**5,9%**	
INFRASTRUCTURE SETUP COSTS	ARCHITECTURE & DESIGN	€ 71.700	€ -	€ -	€ -	€ -	€ 71.700	€ 453.405	**1,5%**	0,2%
	PROVISION & CONFIGURE	€ 144.000	€ 40.350	€ 41.250	€ 59.400	€ 64.350	€ 349.350			1,2%
	INFRASTRUCTURE TESTING	€ 32.355	€ -	€ -	€ -	€ -	€ 32.355			0,1%
APPLICATION SETUP COSTS	ANALYSIS, DESIGN, CODE, UNIT TEST	€ 348.480	€ -	€ -	€ -	€ -	€ 348.480	€ 348.480	**1,2%**	1,2%
TESTING	INTEGRATION TESTING & DEPLOYMENT	€ 232.320	€ -	€ -	€ -	€ -	€ 232.320	€ 527.663	**1,7%**	0,8%
	E2E SYSTEM TESTING	€ 73.343	€ -	€ -	€ -	€ -	€ 73.343			0,2%
	PERFORMANCE	€ 72.000	€ -	€ -	€ -	€ -	€ 72.000			0,2%
	SECURITY (ETHICAL HACK)	€ 30.000	€ 30.000	€ 30.000	€ 30.000	€ 30.000	€ 150.000			0,5%
TRANSITION TO BAU	TRANSITION TO BAU	€ 93.000	€ 9.000	€ 9.000	€ 13.200	€ 13.800	€ 138.000	€ 180.000	**0,6%**	0,5%
	SERVICE DESK SETUP	€ 42.000	€ -	€ -	€ -	€ -	€ 42.000			0,1%
MANAGEMENT	PROJECT MANAGEMENT	€ 186.561	€ 23.228	€ 17.176	€ 17.806	€ 17.906	€ 262.677	€ 262.677	**0,9%**	0,9%
TOTAL/YR		€ 7.597.843	€ 4.080.874	€ 4.629.171	€ 7.091.140	€ 6.808.447				
OVERALL TOTAL (over 5 years)		**€ 30.207.476**								

FRDS – SRDS Budgetary Cost Estimate Differences

COST MODEL FRDS		SHARE IN TOTAL		DIFFERENCE WITH SRDS	
		100,0%		-5,4%	
RUN COSTS		94,1%		-6,3%	
INFRASTRUCTURE COSTS	PUBLIC NW	30,5%	8,1%	-22,4%	-55,9%
	DC NW, GLB, LLB, IPS/DDOS		5,7%		10,7%
	HTTP SERVERS		2,2%		236,0%
	WAS SERVERS		3,7%		218,5%
	DB SERVERS		2,2%		-52,0%
	STORAGE		6,3%		-3,8%
	BACKUP		1,9%		-19,0%
	GENERIC SYSTEMS		0,3%		0,0%
SW LICENCE & MAINTENANCE COSTS	DB	32,7%	13,7%	-17,5%	-59,5%
	WAS		18,8%		234,6%
	BACKUP		0,3%		0,0%
OPERATIONS AND MANAGEMENT COSTS	INFRA OPERATIONS & MAINTENANCE	30,9%	19,4%	44,0%	63,6%
	APPLICATION OPERATIONS		2,6%		20,0%
	APPLICATION MAINTENANCE		1,3%		27,3%
	SERVICE GOVERNANCE		5,2%		0,0%
	SERVICE DESK		2,4%		100,0%

The Public NW cost is lower in the FRDS case due to the IBM SoftLayer NW charging model: incoming traffic is free; per server 20 TB/month outgoing traffic is free, i.e. you get a total free outgoing volume of #servers x 20 TB per month. As the number of servers increases in the FRDS model, the total amount of free TB outgoing NW volume/month increases.

The FDRS model implies a higher NW throughput requirement. Impact on Firewall and Intrusion Prevention Component.

The FRDS model implies a higher computing power requirement in the web and web application server layer.

The FRDS model implies less storage and backup storage capacity as less data is stored centrally.

The DB compute requirement is estimated to be higher in the SRDS model.

Due to a higher amount of systems to interface with in an on-line manner when handling queries, the FRDS model is estimated to involve a higher application operations, support & maintenance release testing workload

FRDS – SRDS Budgetary Cost Estimate Differences

COST MODEL FRDS		SHARE IN TOTAL		DIFFERENCE WITH SRDS	
SETUP COSTS		**5,9%**		10,5%	
INFRASTRUCTURE SETUP COSTS	ARCHITECTURE & DESIGN	**1,5%**	0,2%	15,6%	0,0%
	PROVISION & CONFIGURE		1,2%		19,2%
	INFRASTRUCTURE TESTING		0,1%		18,4%
APPLICATION SETUP COSTS	ANALYSIS, DESIGN, CODE, UNIT TEST	**1,2%**	1,2%	0,0%	0,0%
TESTING	INTEGRATION TESTING & DEPLOYMENT	**1,7%**	0,8%	7,8%	0,0%
	E2E SYSTEM TESTING		0,2%		38,2%
	PERFORMANCE		0,2%		33,3%
	SECURITY (ETHICAL HACK)		0,5%		0,0%
TRANSITION TO BAU	TRANSITION TO BAU	**0,6%**	0,5%	26,6%	37,7%
	SERVICE DESK SETUP		0,1%		0,0%
MANAGEMENT	PROJECT MANAGEMENT	**0,9%**	0,9%	13,4%	13,4%

The FRDS model implies a higher computing power requirement (more systems required to handle the envisaged load) in the web and web application server layer.

Due to a higher amount of systems to interface with in an on-line manner when handling queries, the FRDS model is estimated to involve more testing effort

Observations

The FRDS model is highly sensitive to the number of assumed reverse lookups. The presented model is assuming that 1% of user queries are reverse lookups.

While no detailed sensitivity analysis has been performed, an increase with a factor 3 (to 3%) in the number of reverse lookups is expected to lead to a considerable higher requirement in web application and http resources (about a factor 2.5), and the global FRDS cost is expected to increase with about 35% in this case. With 5% reverse lookups the global FRDS cost is expected to increase with about 85% .

The IBM SoftLayer public network charging model provides for 20TB per month free outgoing network traffic per acquired SoftLayer system. Inbound traffic is free. As the FRDS model requires a considerable higher amount of systems, the public network element is substantially less important in the FRDS case compared to the SRDS case in this model.

Impact on Registry Operators
Registry System Modules to be developed/adapted; and to be operated and supported

- Both models (Synchronized + Federated)
  - Module to get data from Contact Data Service Provider for own use (Registries will need to validate their own Registrant's data)
- Synchronized
  - Use EPP to send Domain information to RDS
  - Queuing mechanism for EPP transmission of updated domains
- Federated
  - Extended RDAP for reverse queries
  - Extended RDAP for historical queries
  - SLA on answers to queries
  - SLA on number of simultaneous RDAP queries (proportional to the number of domain names)