ENTERPRISE IT

TCO OVER 5 YEARS

DESCRIPTION OF THE ENVIRONMENT UC – CREDIT CARD (CC) TRANSACTION FOR A BANK

Every CC transaction has to be approved by:

- Checking if the CC is valid
- Checking if the POS is valid
- Checking if the money amount is valid or enough (if CC is prepaid)
- Checking if the transaction is suspect
- Checking if the POS type requires a second identification step. If so, perform that step and check complete successfully

At the end of the transaction, issue OK or abort.

- The information about the transaction has to be stored whatever is the exit status.

SIZING

		Workload (TPS)	Core per Server	Max Server Faults	HA Ratio															
		2.000	48	3	100%															
	Typical core Ratio	TPS by Core	# of Cores for workload TPS	HA cores	Prod cores	Dev % of Workload	Dev cores	Test % of Workload	Test cores	PreProd % of Workload	PreProd cores	DR active cores % of Prod+PrePr od	DR cores	DR CBU (spare) cores	Tot # of Active cores	x86 to z Active Core ratio	Tot # of Active cores no DR	x86 to z Core ratio no DR	Tot # of cores	x86 to z Core ratio
x86	10	20	100	100	200	100%	100	100%	100	200%	200	125%	500		1.100	36,7	600	20,0	1.100	22,0
LinuxONE	1	200	10		10	50%	5,0	50%	5,0	100%	10			20	30		30		50	

- The input provided is that the system must handle up to 2000 TPS:
- A x86 core is able to perform 20 TPS.
- A LinuxOne core is 10 times more powerful than a x86 one, so a single core can perform 200 TPS.

TECHNICAL ARCHITECTURE FOR THE TWO CASES

CASE 1 X86 SERVER: RACK SERVER W XEON GOLD 6146 12C 3.20GHZ (4 CHIPS, 48 CORES)

1.100 ACTIVE CORES
26 TOTAL SERVERS

- PRODUCTION: 200 CORES IN 5 SERVERS
- PRE-PRODUCTION: 200 CORES IN 5 SERVERS
- DEVELOPMENT: 100 CORES IN 3 SERVERS
- TEST: 100 CORES IN 3 SERVERS
- DISASTER RECOVERY: 500 CORES IN 10 SERVERS

CASE 2: LINUXONE SERVER

30 ACTIVE CORES
20 CBU (SPARE CORES)
2 SERVERS DISTRIBUTED IN 2 DIFFERENT SITES

- PRODUCTION: 10 CORES
- PRE-PRODUCTION: 10 CORES
- DEVELOPMENT: 5 CORES
- TEST: 5 CORES
- DR CBU: 20 SPARE CORES

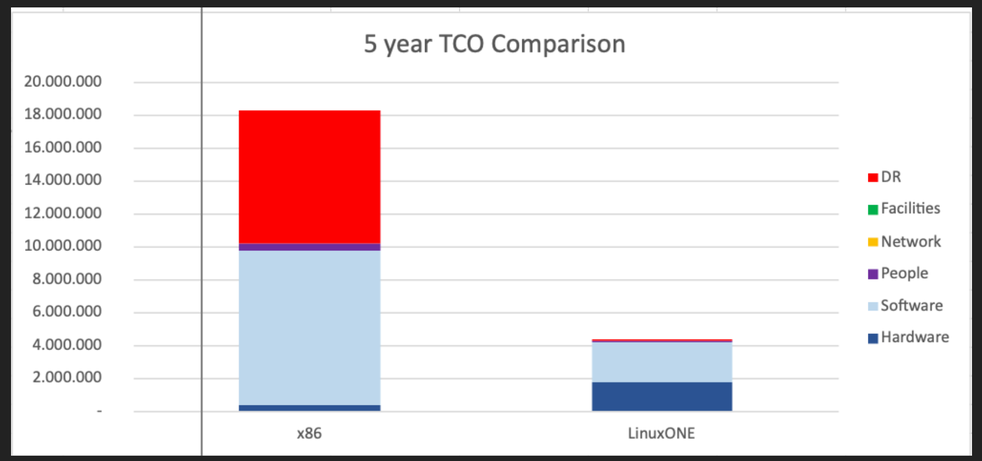
SITE 1: 15 CORES -> 10 CORES PROD, 5 CORES DEV + 10 CBU
SITE 2: 15 CORES -> 10 CORES PRE-PROD, 5 CORES TEST + 10 CBU

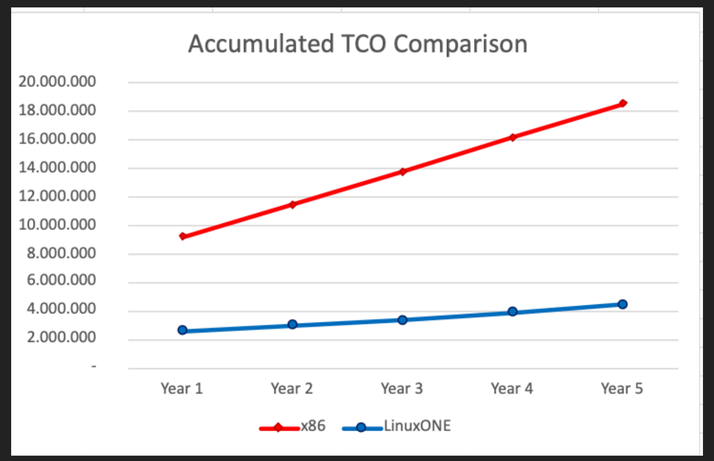
TCO COMPARISON ON 5 YEARS – OUTPUT

Savings with LinuxOne platform
vs x86 equivalent platform = 76%

x86		Environments					
Rack server w Xeon Gold 6146 12C 3.20GHz (4 Chips, 48 Cores)		Prod	Dev	Test	PreProd/QA	DR	Tot by Comp
Components	Hardware	117.600	70.560	70.560	117.600	235.200	611.520
	Software	3.117.400	1.571.700	1.571.700	3.117.400	7.758.900	##########
	People	433.333					433.333
	Network	34.300	20.580	20.580	34.300	68.600	178.360
	Space	13.000	6.760	6.760	11.267	26.000	63.787
	Electricity	26.280	15.768	15.768	26.280	52.560	136.656
	Total by Env	3.741.913	1.685.368	1.685.368	3.306.847	8.141.260	18.560.756

LinuxONE		Environments					
		Prod	Dev	Test	PreProd/QA	DR	Tot by Comp
Components	Hardware	588.000	294.000	294.000	588.000	84.000	1.848.000
	Software	802.200	401.100	401.100	802.200	-	2.406.600
	People			120.000			120.000
	Network	9.147	4.573	4.573	9.147	-	27.440
	Space	24.267	12.133	12.133	24.267	-	72.800
	Electricity	3.458	1.729	1.729	3.458	-	10.374
	Total by Env	1.547.071	713.536	713.536	1.427.071	84.000	4.485.214





X86 TCO ASSUMPTIONS

HARDWARE:
- RACK SERVER W XEON GOLD 6146 12C 3.20GHZ (4 CHIPS, 48 CORES)
- ACQUISITION COST: 24K€ -30% DISCOUNT INCLUDING 3 YEARS SUPPORT
- SUPPORT FOR FOLLOWING YEARS IS 20% OF PURCHASE PRICE

NETWORK:
7000€ PER SERVER -30% DISCOUNT. MAINTENANCE 10% OF PURCHASE PRICE FROM THE SECOND YEAR.

PEOPLE:
ONE FULL TIME EQUIVALENT (FTE) COVERS 30 SERVER. THE AVERAGE YEARLY FULLY LOADED COST IS 100.000€

SPACE:
FULLY LOADED COST OF SQUARE METER IS 2.600€

ELECTRICITY:
FOR AN ENTERPRISE, THE PRICE GOES AROUND 0.10€ PER KWH IN ITALY.

SOFTWARE:
- OS: SUBSCRIPTION 2000€/YEAR – 20% DISCOUNT PER SOCKET.
- VM: LICENSING 5000€/SOCKET - 20% DISCOUNT, MAINTENANCE 20% OF PURCHASE PRICE FROM THE SECOND YEAR.
- APPLICATION SERVER: LICENSING 100€/PVU (PRICE VALUE UNIT) -75% DISCOUNT (70 PVU PER CORE), MAINTENANCE 20% OF PURCHASE PRICE FROM THE SECOND YEAR.
- DB: LICENSING 40.000€ FOR 2 CORES -75% DISCOUNT, MAINTENANCE 20% OF PURCHASE PRICE FROM THE SECOND YEAR.
- DATA REPLICATION TOOLS: SUBSCRIPTION 3000€/YEAR – 75% DISCOUNT PER CORE
- MONITORING TOOLS: LICENSING 5.000€/SERVER AND -40% DISCOUNT, MAINTENANCE 20% OF PURCHASE PRICE FROM THE SECOND YEAR.
- SECURITY TOOLS: LICENSING 5.000€/SERVER WITH -40% DISCOUNT, MAINTENANCE 20% OF PURCHASE PRICE FROM THE SECOND YEAR.

LINUXONE TCO ASSUMPTIONS

HARDWARE:
- 2 LINUXONE SERVERS.
- DEFAULT PRICES:600K ACQUISITION COST WITH 30% DISCOUNT, 6 INCLUDED CORES, EACH CORE COSTS 50K AND A CBU ONE 5K
- MAINTENANCE: 10% OF PURCHASE PRICE FROM THE FOURTH YEAR.

NETWORK:
14000€ PER SERVER -30% DISCOUNT. MAINTENANCE 10% OF PURCHASE PRICE FROM THE SECOND YEAR.

PEOPLE:
ONE FULL TIME EQUIVALENT (FTE) COVERS 10 SERVERS. THE AVERAGE YEARLY FULLY LOADED COST IS 120.000€

SPACE:
FULLY LOADED COST OF SQUARE METER IS 2.800€

ELECTRICITY:
FOR AN ENTERPRISE, THE PRICE GOES AROUND 0.10€ PER KWH.

SOFTWARE:
- OS: SUBSCRIPTION 6000€/YEAR – 20% DISCOUNT PER SOCKET.
- VM: INCLUDED IN THE HARDWARE.
- APPLICATION SERVER: LICENSING 100€/PVU (PRICE VALUE UNIT) -50% DISCOUNT (120 PVU PER CORE), MAINTENANCE 20% OF PURCHASE PRICE FROM THE SECOND YEAR.
- DB: LICENSING 40.000€ PER CORE -50% DISCOUNT, MAINTENANCE 20% OF PURCHASE PRICE FROM THE SECOND YEAR.
- DATA REPLICATION TOOLS: SUBSCRIPTION 3000€/YEAR – 50% DISCOUNT PER CORE
- MONITORING TOOLS: LICENSING 5.000€/SERVER AND -40% DISCOUNT, MAINTENANCE 20% OF PURCHASE PRICE FROM THE SECOND YEAR.
- SECURITY TOOLS: LICENSING 5.000€/SERVER WITH -40% DISCOUNT, MAINTENANCE 20% OF PURCHASE PRICE FROM THE SECOND YEAR.

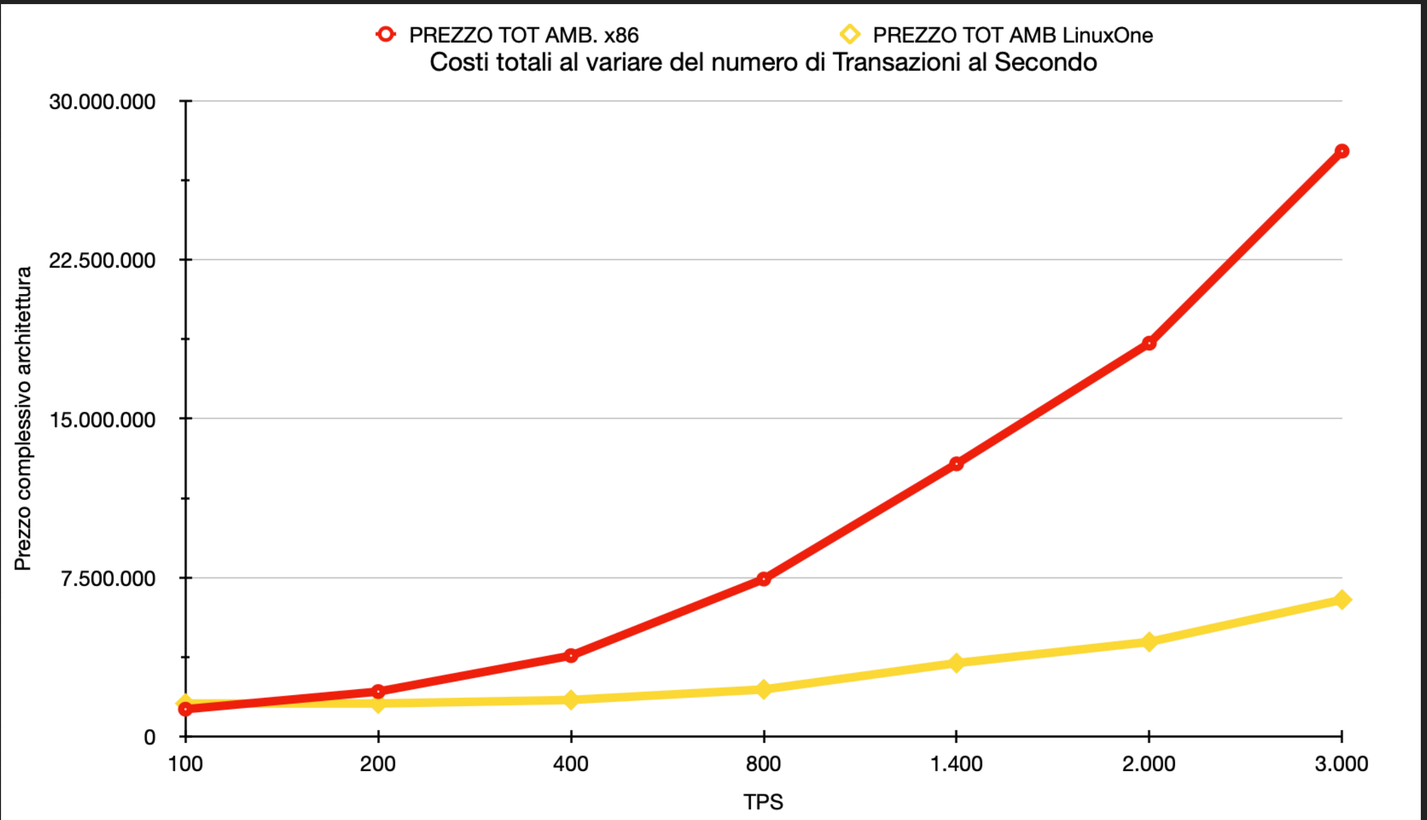
CONCLUDING REMARKS (1)

- All the calculations have been carried out assuming the TPS as the peak of the Transactions Per Second the system must be able to handle. In the first NFR, it is specified that the system works 90% of the time with a load less than twice the average. Considering 2000 TPS as the global peak it will grant the system to be up as much time as possible.
- To ensure a HA at 99.999%, many servers were added in order to handle 3 max server faults. In this way, the HA ratio is 100% as shown in the Excel document (slide 3).
- In order to ensure the system to remain operational even in the event of natural disasters, some measures have been taken: the total number of cores and servers have been designed to ensure the recovery of the entire production and pre-production environment, in addition to 50% of the development and test environments; this for both x86 and LinuxOne architectures.
- For the x86 case, the total 1100 cores calculated by the tool were allocated as specified (slide 4). The 500 Disaster Recovery cores can be used to restore all 200 cores of the production environment, all 200 cores of the pre-production environment (it is critical that these two environments are always equally guaranteed) and the remaining 100 can be used to achieve 50% of the original total development and test environments.
- For the LinuxOne case, the same reasoning has been applied. In this case, however, DR is offered via spare cores, split across two sites. In case one of these two sites should go down, by activating the spare cores in the other one it is possible to restore the whole production and pre-production environment plus half of the development and test environments (as you can deduce from slide 4).
- In the LinuxOne environment, CBUs are more convenient because we are not charged for the licenses of the software that runs on them. For the x86 environment we are charged for the entire number of cores we have, even if they are spare.
- LinuxOne hardware price is always more expensive than x86 one (the TCA on the first year is always higher than x86 one). This is because these servers are designed to grant zero downtime and can handle so much load on the same processor (designed to reach even 98% load), while x86 servers have an average utilization of 30% and an overload could cause periods of downtime. For this reason, on x86 you don't do statistical multiplexing, rather is preferable a single server per load type. With LinuxOne, instead, it would be convenient to think in terms of parallel workload, being able to buy until 190 cores per machine.

CONCLUDING REMARKS (2)

- Software is definitely one of the most expensive aspects in a TCO. You have to manage the whole software stack and the price of some components can reach considerable amounts. In my case, I tried to search for real data regarding the Database (found incomplete information about Microsoft SQL Server and Oracle Database for the commercial ones and MySQL, SQLite, PostgreSQL, MariaDB and MongoDB for the open source ones), Java Application Servers (found informations about WebSphere, WebLogic and RedHat's JBoss) and Data Replication Tools, but only found incomplete and not exhaustive information, which would have lead me to use partially real data with additional considerations that could have altered the truthfulness of the final output.
- The software price for the production and pre-production environments is the highest, comparing it to the other ones.
- I tested the tool with various rack servers, including those I specified in the Excel, with various TPS as workload. What can be seen is that in each case the software has a very high cost for the x86 environment. This is because in the latter environment there are many more cores to manage (and therefore servers) and licensing takes these quantities as the unit of measure on which to calculate costs. For the LinuxOne environment, instead, the prices for single units are higher and with less discount, but I have to worry about paying less equipment (for example VMs are included).
- DR is another of the most expensive aspects of the x86 architecture, because I pay very dearly for the software that sits on my additional servers, making it the most expensive field among the various environments. For LinuxOne, on the other hand, it is one of the cheapest fields, as I don't have to pay for the software that runs on the various spare cores (CBUs).
- The remaining fields such as the price of FTEs, network, space, and electricity impact the final cost, but not as much as the aforementioned fields. Obviously, the final cost is higher in the x86 environment because you have to pay each field for the DR environment as well, furthermore the number of servers to manage is far greater than in the LinuxOne environment, requiring more human labor, more network resources, and more electricity.

CONCLUDING REMARKS (3)



L'architettura usata per x86 comprende un server rack con Xeon Gold 6146 12C 3.20 GHz (4 Chips, 48 Cores). L'architettura LinuxOne è quella predefinita. I prezzi variano in base al solo numero di transazioni al secondo ed ai server aggiuntivi per garantire l'HA a 5 nove, per ogni modifica non si sono mai toccati i campi Hardware, Software e così via per entrambi gli ambienti.

AS YOU CAN SEE, THE X86 ENVIRONMENT IS NOT VERY ADVANTAGEOUS EVEN IN CASE OF FEW TPS TO MANAGE. SOFTWARE AND DR COSTS IMPACT THE FINAL FIGURE SO MUCH THAT THE LINUXONE ENVIRONMENT IS PREFERRED EVEN FOR SMALL WORKLOADS, FOR EXAMPLE LARGER THAN 150.

THE GROWTH OF THE X86 PRICE AS THE NUMBER OF TPSS INCREASES IS ALMOST EXPONENTIAL, WHILE THE GROWTH OF THE LINUXONE ENVIRONMENT REMAINS VERY LOW.

IT MUST BE ADDED THAT PRICES ARE ALSO AFFECTED BY THE FACT THAT WE ARE CONSIDERING ENTIRELY NEW STRUCTURES, WHICH MAY NOT CORRESPOND TO THE REALITY IN WHICH COMPANIES MAY ALREADY HAVE TECHNICAL ARCHITECTURE.