Measuring Capacity
or
How big is your foot?
Having captured, reduced, and converted the CPU data to produce CPU Utilization charts
Having captured, reduced, and converted the CPU data to produce CPU Utilization charts

Which metric should we use to represent the capacity of a system?
Having captured, reduced, and converted the CPU data to produce CPU Utilization charts.

Which metric should we use to represent the capacity of a system?

- CPU percentage
- Physical CPUs
- MIPS
- MFLOPS
- MHz
- tpmC
- Rperf
- SAPS
Objective

To discuss CPU Capacity and how it applies to Capacity Plans

An example of a new system Capacity Plan
Agenda

Introduction
Capacity Metrics
What to measure
Sizing a new system

Copyright: Pedro Escosteguy Resources Inc.
Introduction

Back in the 60’s computer utilization was measured like this:
Introduction

Back in the 60’s computer utilization was measured like this:

There were lights on the computer console: Green, yellow and red.
Introduction

Back in the 60’s computer utilization was measured like this:

There were lights on the computer console: Green, yellow and red.

And meters to measure the hours that the CPU was busy.
Introduction

Back in the 60’s computer utilization was measured like this:

There were lights on the computer console: Green, yellow and red.

And meters to measure the hours that the CPU was busy.

That was our CPU utilization hours that we paid as part of the rent of the machine.
Introduction

Back in the 60’s computer utilization was measured like this:

There were lights on the computer console: Green, yellow and red.

And meters to measure the hours that the CPU was busy.

That was our CPU utilization hours that we paid as part of the rent of the machine.

So, performance was measured by the frequency of the flashing of the green and yellow lights and the work/capacity by the hours we consumed when the CPU was busy.
In the 70’s, with Amdahl and IBM competing for the market, computer capacity was measured in MIPS.
In the 70’s, with Amdahl and IBM competing for the market, computer capacity was measured in MIPS.

Then in February 1982 Intel releases the 16-bit microprocessor Intel 80286. At the time Intel reports it as a 1 MIPS machine.
In the 70’s, with Amdahl and IBM competing for the market, computer capacity was measured in MIPS.

Then in February 1982 Intel releases the 16-bit microprocessor Intel 80286. At the time Intel reports it as a 1 MIPS machine.

At the same time, IBM (and the computing industry) considered the IBM System/370 model 158-3 as running at 1 MIPS.
In the 70’s, with Amdahl and IBM competing for the market, computer capacity was measured in MIPS.

Then in February 1982 Intel releases the 16-bit microprocessor Intel 80286. At the time Intel reports it as a 1 MIPS machine.

At the same time, IBM (and the computing industry) considered the IBM System/370 model 158-3 as running at 1 MIPS.

Have been working in the field for 10 years I was astonished by Intel’s claims.
In the 70’s, with Amdahl and IBM competing for the market, computer capacity was measured in MIPS.

Then in February 1982 Intel releases the 16-bit microprocessor Intel 80286. At the time Intel reports it as a 1 MIPS machine.

At the same time, IBM (and the computing industry) considered the IBM System/370 model 158-3 as running at 1 MIPS.

Have been working in the field for 10 years I was astonished by Intel’s claims.

That’s when an IBMer came into the office and said: It all depends on the size of the foot.
The world of measurement
The world of measurement

• In the old days, length was measured in feet
The world of measurement

• In the old days, length was measured in feet
• The feet length depended on who’s foot you were considering
The world of measurement

- In the old days, length was measured in feet
- The feet length depended on who’s foot you were considering
- Until the standard meter was created
The world of measurement

• In the old days, length was measured in feet
• The feet length depended on who’s foot you were using
• Until the standard meter was created
• Have you ever gone to Canadian Tire to buy chain?
The world of measurement

How you measure is important.
The world of measurement

How you measure is important.

As an experiment I decided to go hiking
The world of measurement

How you measure is important.

I took my pedometer and GPS
The world of measurement

How you measure is important.

I walked 3 KM in 1 hour and 17 minutes
How you measure is important.

I must be a giant with each step measuring 2 city blocks or 200 meters.
Capacity Metrics

FLOPS and MIPS: Units of measure for the numerical computing performance of a computer
Capacity Metrics

FLOPS and MIPS: Units of measure for the numerical computing performance of a computer

rPerf: A computer benchmark that evaluates the relative OLTP performance of servers based on IBM POWER microprocessors
Capacity Metrics

FLOPS and MIPS: Units of measure for the numerical computing performance of a computer

rPerf: A computer benchmark that evaluates the relative OLTP performance of servers based on IBM POWER microprocessors

tpmC: A "business throughput" benchmark measuring the number of orders processed per minute
Capacity Metrics

FLOPS and MIPS: Units of measure for the numerical computing performance of a computer

rPerf: A computer benchmark that evaluates the relative OLTP performance of servers based on IBM POWER microprocessors

tpmC: A "business throughput" benchmark measuring the number of orders processed per minute

SAPS: An SAP metric used to measure SAP applications capacity
Measuring CPU Capacity (Cont.)

According to wikipedia IPS (or MIPS) can be calculated using the equation in figure 1.

\[
IPS = \text{sockets} \times \frac{\text{cores}}{\text{socket}} \times \text{clock} \times \frac{\text{IPs}}{\text{cycle}}
\]

Copyright: Pedro Escosteguy Resources Inc.
Measuring CPU Capacity (Cont.)

According to wikipedia IPS (or MIPS) can be calculated using the equation in figure 1.

\[
IPS = \text{sockets} \times \frac{\text{cores}}{\text{socket}} \times \text{clock} \times \frac{\text{IPs}}{\text{cycle}}
\]

By this formula the IBM System/370 model 158-3 Capacity was 0.73 MIPS at 8.696 MHz and **0.0839 IPS/cycle**.
Measuring CPU Capacity (Cont.)

According to wikipedia IPS (or MIPS) can be calculated using the equation in figure 1.

\[
\text{IPS} = \text{sockets} \times \frac{\text{cores}}{\text{socket}} \times \text{clock} \times \frac{\text{IPS}}{\text{cycle}}
\]

By this formula the IBM System/370 model 158-3 Capacity was 0.73 MIPS at 8.696 MHz and **0.0839 IPS/cycle**.

By the same formula, with an **IPS/cycle of 0.107** and clock of 12 MHz, the Intel 80286 was a 1.28 MIPS machine.

Copyright: Pedro Escosteguy Resources Inc.
Measuring CPU Capacity (Cont.)

The machine clock is easy to calculate.

\[ \text{IPS} = \text{sockets} \times \frac{\text{cores}}{\text{socket}} \times \text{clock} \times \frac{\text{IPs}}{\text{cycle}} \]
Measuring CPU Capacity (Cont.)

The machine clock is easy to calculate.

\[ IPS = \text{sockets} \times \frac{\text{cores}}{\text{socket}} \times \text{clock} \times \frac{\text{IPs}}{\text{cycle}} \]

How do you get the **IPS/cycle** without a benchmark?
The machine clock is easy to calculate.

\[
\text{IPS} = \text{sockets} \times \frac{\text{cores}}{\text{socket}} \times \text{clock} \times \frac{\text{IPs}}{\text{cycle}}
\]

How do you get the \textit{IPS/cycle} without a benchmark?

Which Instructions to consider?
Measuring CPU Capacity (Cont.)

The machine clock is easy to calculate.

\[ IPS = \text{sockets} \times \left( \frac{\text{cores}}{\text{socket}} \right) \times \text{clock} \times \frac{\text{IPs}}{\text{cycle}} \]

How do you get the \textit{IPS/cycle} without a benchmark?

Which Instructions to consider?

The IBM System/370 had complex instructions that you needed a complex routine in the Intel processor to achieve the same result.
The machine clock is easy to calculate.

\[
\text{IPS} = \text{sockets} \times \frac{\text{cores}}{\text{socket}} \times \text{clock} \times \frac{\text{IPS}}{\text{cycle}}
\]

How do you get the **IPS/cycle** without a benchmark?

Which Instructions to consider?

The IBM System/370 had complex instructions that you needed a complex routine in the Intel processor to achieve the same result.

That is when the size of the foot matters.
What to measure
Measuring CPU Utilization

However, no matter what you do, at the end, you measure Total CPU consumption by measuring CPU utilization percentage, right?

Copyright: Pedro Escosteguy Resources Inc.
Measuring CPU Utilization (cont.)

WRONG!

You measure Total CPU consumption by measuring CPU utilization time.

Then you convert it to the metric you want.
Measuring CPU Utilization (cont.)

But what is all this talk about sockets, cores and CPU?
But what is all this talk about sockets, cores and CPU?

What is the CPU we need to measure?
Measuring CPU Utilization (cont.)

But what is all this talk about sockets, cores and CPU?

What is the CPU we need to measure?

Do we measure CPU, Cores, Sockets?
In the beginning there was a PC with only one CPU.
Measuring CPU Utilization (cont.)

In the beginning there was a PC with only one CPU.

In this case:

1 socket 1 chip 1 core 1 CPU
Measuring CPU Utilization (cont.)

In the beginning there was a PC with only one CPU.

In this case:

1 socket 1 chip 1 core 1 CPU

For the non-initiated:

socket = chip = CPU

Copyright: Pedro Escosteguy Resources Inc.
Measuring CPU Utilization (cont.)

Due to technology limitations (the current limit being around 6 GHz before the die starts to leak), and further miniaturization techniques, manufacturers start to split the die (chip) creating cores.
Due to technology limitations (the current limit being around 6 GHz before the die starts to leak), and further miniaturization techniques, manufacturers start to split the die (chip) creating cores:

1 socket = 1 chip = 2 cores = 2 CPUs
Measuring CPU Utilization (cont.)

Due to technology limitations (the current limit being around 6 GHz before the die starts to leak), and further miniaturization techniques, manufacturers start to split the die (chip) creating cores:

1 socket = 1 chip = 2 cores = 2 CPUs

1 socket = 1 chip = 4 cores = 4 CPUs
Measuring CPU Utilization (cont.)

But why is that so important?
But why is that so important?

The bigger the boat the bigger the mast, until it becomes so unstable you add more masts.
But why is that so important?
Because when you add capacity you may do it by replacing with faster CPUs or adding more CPUs.
But why is that so important?

Because when you add capacity you may do it by replacing with faster CPUs or adding more CPUs.

It does not matter if they are in the same core or chip. That will be a technology enhancement that will make it faster and smaller.
The information made available through this site is intended for IT personnel familiar with the key indicators used to measure a computing system's capacity and performance, such as:

- CPU
- Memory utilization
- I/O Activity
- Paging
- Run Queue
- Storage
- "Appliance" metrics
- Response time, etc.

Statistics from these indicator categories and others are collected and presented on this site in tabular or chart format. We encourage you to explore the site! We are available to provide assistance regarding any questions and/or interpretation of the information presented here. We can be reached HERE.
The Capacity Plan

Measure the CPU Utilization
Convert to the capacity metric of choice
Apply growth rate and seasonality
Produce chart
Present to management

Copyright: Pedro Escosteguy Resources Inc.
Sizing a new system

Copyright: Pedro Escosteguy Resources Inc.
TPC Benchmark™ C (TPC-C) is an OLTP workload. It is a mixture of read-only and update intensive transactions that simulate the activities found in complex OLTP application environments.

The performance metric reported by TPC-C is a "business throughput" measuring the number of orders processed per minute. Multiple transactions are used to simulate the business activity of processing an order, and each transaction is subject to a response time constraint.
The extent to which a customer can achieve the results reported by a vendor is highly dependent on how closely TPC-C approximates the customer application.

TPC Benchmark™ C - Standard Specification, Revision 5.11  www.tpc.org
New System Capacity Plan

Using transaction volume

1. Measure/estimate the transaction per month
New System Capacity Plan

Using transaction volume

1. Measure/estimate the transaction per month
2. Convert it to transaction per day
New System Capacity Plan

Using transaction volume

1. Measure/estimate the transaction per month
2. Convert it to transaction per day
3. How many hours on the day
New System Capacity Plan

Using transaction volume

1. Measure/estimate the transaction per month
2. Convert it to transaction per day
3. How many hours on the day
4. How many transactions per minute
New System Capacity Plan

Using transaction volume

1. Measure/estimate the transaction per month
2. Convert it to transaction per day
3. How many hours on the day
4. How many transactions per minute
5. Complexity of the transaction
New System Capacity Plan

Using transaction volume

1. Measure/estimate the transaction per month
2. Convert it to transaction per day
3. How many hours on the day
4. How many transactions per minute
5. **Complexity of the transaction**
6. **Calculate capacity in tpmC**
New System Capacity Plan

Monthly Records Processed (Forecast)

Copyright: Pedro Escosteguy Resources Inc.
New System Capacity Plan

5 Year Capacity Plan

Forecast TRX/day

Capacity tpmC

Copyright: Pedro Escosteguy Resources Inc.
New System Capacity Plan

Using concurrent users and complexity of user workload
New System Capacity Plan

Using concurrent users and complexity of user workload

60 seconds to the minute
New System Capacity Plan

Using concurrent users and complexity of user workload

60  seconds to the minute
30  seconds think time = 60 / 30 = 2 tpm
New System Capacity Plan

Using concurrent users and complexity of user workload

60 seconds to the minute
30 seconds think time = $60 / 30 = 2$ tpm

50 complexity level = $2 \times 50 = 100$ tpmC
New System Capacity Plan

Using concurrent users and complexity of user workload

60  seconds to the minute
30  seconds think time = 60 / 30 = 2 tpm
50  complexity level = 2 * 50 = 100 tpmC
1.5 peak to average ratio = 100 * 1.5 = 150 tpmC
New System Capacity Plan

Using concurrent users and complexity of user workload

60 seconds to the minute
30 seconds think time = 60 / 30 = 2 tpm

50 complexity level = 2 * 50 = 100 tpmC

1.5 peak to average ratio = 100 * 1.5 = 150 tpmC

0.75 capture ratio (system overhead) = 150 / 0.75 = 200 tpmC
New System Capacity Plan

Using concurrent users and complexity of user workload

60  seconds to the minute
30  seconds think time = 60 / 30 = 2 tpm

50 complexity level = 2 * 50 = 100 tpmC
1.5 peak to average ratio = 100 * 1.5 = 150 tpmC
0.75 capture ratio (system overhead) = 150 / 0.75 =
200 tpmC
0.50 utilization limit = 200 / 0.5 = 400 tpmC
New System Capacity Plan

Using concurrent users and complexity of user workload

60 seconds to the minute
30 seconds think time = 60 / 30 = 2 tpm

50 complexity level = 2 * 50 = 100 tpmC

1.5 peak to average ratio = 100 * 1.5 = 150 tpmC

0.75 capture ratio (system overhead) = 150 / 0.75 = 200 tpmC

0.50 utilization limit = 200 / 0.5 = 400 tpmC

70 concurrent users (40 light users, 5 heavy users * 2, 1 batch process * 20) = 400 * 70 = 2800 tpmC
New System Capacity Plan

5 Year Capacity Plan

Forecast tpmC

Capacity tpmC

2,800 tpmC

3,100 tpmC

3,400 tpmC

3,800 tpmC

4,100 tpmC

Copyright: Pedro Escosteguy Resources Inc.
Remember that:

After all, computer capacity is like buying beans, you don’t count each one of them as you would with potatoes.

You work with orders of magnitude: pounds of beans, 100’s of MIPS, or 1,000’s of tmpC).
Measuring Capacity
or
How big is your foot?

THANKS

CMG CANADA OCTOBER 2017