# Описание вычислительного узла

#### Наименование и краткая характеристика CPU (lscpu):

Architecture: x86\_64

CPU op-mode(s): 32-bit, 64-bit

Address sizes: 46 bits physical, 48 bits virtual

Byte Order: Little Endian

CPU(s): 80

On-line CPU(s) list: 0-79

Vendor ID: GenuineIntel

Model name: Intel(R) Xeon(R) Gold 6248 CPU @ 2.50GHz

CPU family: 6

Model: 85

Thread(s) per core: 2

Core(s) per socket: 20

Socket(s): 2

Stepping: 7

CPU max MHz: 3900.0000

CPU min MHz: 1000.0000

BogoMIPS: 5000.00

Flags: fpu vme de pse tsc msr pae mce cx8 apic sep mtrr pge

mca cmov pat pse36 clflush dts acpi mmx fxsr sse sse2

ss ht tm pbe syscall nx pdpe1gb rdtscp lm constant\_t

sc art arch\_perfmon pebs bts rep\_good nopl xtopology

nonstop\_tsc cpuid aperfmperf pni pclmulqdq dtes64 mon

itor ds\_cpl smx est tm2 ssse3 sdbg fma cx16 xtpr pdcm

pcid dca sse4\_1 sse4\_2 x2apic movbe popcnt tsc\_deadl

ine\_timer aes xsave avx f16c rdrand lahf\_lm abm 3dnow

prefetch cpuid\_fault epb cat\_l3 cdp\_l3 invpcid\_single

intel\_ppin ssbd mba ibrs ibpb stibp ibrs\_enhanced fs

gsbase tsc\_adjust bmi1 avx2 smep bmi2 erms invpcid cq

m mpx rdt\_a avx512f avx512dq rdseed adx smap clflusho

pt clwb intel\_pt avx512cd avx512bw avx512vl xsaveopt

xsavec xgetbv1 xsaves cqm\_llc cqm\_occup\_llc cqm\_mbm\_t

otal cqm\_mbm\_local dtherm ida arat pln pts hwp hwp\_ac

t\_window hwp\_pkg\_req pku ospke avx512\_vnni md\_clear f

lush\_l1d arch\_capabilities

Caches (sum of all):

L1d: 1.3 MiB (40 instances)

L1i: 1.3 MiB (40 instances)

L2: 40 MiB (40 instances)

L3: 55 MiB (2 instances)

NUMA:

NUMA node(s): 2

NUMA node0 CPU(s): 0-19,40-59

NUMA node1 CPU(s): 20-39,60-79

Vulnerabilities:

Gather data sampling: Mitigation; Microcode

Itlb multihit: KVM: Mitigation: VMX unsupported

L1tf: Not affected

Mds: Not affected

Meltdown: Not affected

Mmio stale data: Mitigation; Clear CPU buffers; SMT vulnerable

Retbleed: Mitigation; Enhanced IBRS

Spec rstack overflow: Not affected

Spec store bypass: Mitigation; Speculative Store Bypass disabled via prc

tl and seccomp

Spectre v1: Mitigation; usercopy/swapgs barriers and \_\_user point

er sanitization

Spectre v2: Mitigation; Enhanced IBRS, IBPB conditional, RSB fill

ing, PBRSB-eIBRS SW sequence

Srbds: Not affected

Tsx async abort: Mitigation; TSX disabled

#### Наименование сервера (cat /sys/devices/virtual/dmi/id/product\_name):

ProLiant XL270d Gen10

#### Сколько NUMA node, сколько памяти у каждой ноды (numactl --hardware):

available: 2 nodes (0-1)

node 0 cpus: 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59

node 0 size: 385636 MB

node 0 free: 28441 MB

node 1 cpus: 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79

node 1 size: 387008 MB

node 1 free: 138857 MB

node distances:

node 0 1

0: 10 21

1: 21 10

#### Операционная система (cat /etc/os-release):

PRETTY\_NAME="Ubuntu 22.04.3 LTS"

NAME="Ubuntu"

VERSION\_ID="22.04"

VERSION="22.04.3 LTS (Jammy Jellyfish)"

VERSION\_CODENAME=jammy

ID=ubuntu

ID\_LIKE=debian

HOME\_URL="https://www.ubuntu.com/"

SUPPORT\_URL="https://help.ubuntu.com/"

BUG\_REPORT\_URL="https://bugs.launchpad.net/ubuntu/"

PRIVACY\_POLICY\_URL="https://www.ubuntu.com/legal/terms-and-policies/privacy-policy"

UBUNTU\_CODENAME=jammy

# Анализ масштабируемости

#### Таблица для 1,2,4,7,8,16,20,40 потоков (в мс):

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **M = N** | | **Количество потоков** | | | | | | | |
| 1 | | 2 | | 4 | | 7 | |
| T1 | S1 | T2 | S2 | T4 | S4 | T7 | S7 |
| 20 000 (~3 GiB) | | 1924 | 0,985 | 2453 | 2,438 | 512 | 3,996 | 286 | 7,025 |
| 40 000 (~ 12 GiB) | | 7682 | 0,990 | 4031 | 2,042 | 2091 | 3,732 | 1159 | 9,052 |

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **M = N** | | **Количество потоков** | | | | | | | |
| 8 | | 16 | | 20 | | 40 | |
| T8 | S8 | T16 | S16 | T20 | S20 | T40 | S40 |
| 20 000 (~3 GiB) | | 276 | 7,134 | 137 | 14,159 | 114 | 16,500 | 83 | 23,531 |
| 40 000 (~ 12 GiB) | | 1054 | 7,441 | 547 | 14,064 | 452 | 18,108 | 325 | 24,347 |

#### График ускорения в зависимости от кол-ва потоков:

#### Вывод:

При работе на одном потоке, параллельная реализация программы проигрывает последовательной в производительности. Однако, с увеличением числа потоков, производительность параллельная реализация начинает существенно превосходить последовательную, приближаясь к геометрической прогрессии.  
При этом рост коэффициента ускорения не зависит от объёма данных, приблизительно одинаково возрастая для матрицы размером как 20000x20000, так и 40000х40000.