

scope

This tutorial attempts to provide an installation guide for OpenCL on the nao v6. First a new kernel is compiled with i915 enabled, which is needed for opencl to work. Second a chroot environment is set up, in which opencl is installed. The third step describes this installation of OpenCL inside the chroot environment and describes a method to verify whether it worked or not.

Cross compile kernel

```
git clone https://github.com/aldebaran/linux-aldebaran.git
cd linux-aldebaran
git checkout sbr/v4.4.86-rt99-baytrail
scp nao@<nao-ip>:/boot/config .config
```

Download a current naoqi ctc-toolchain from aldebaran (2.8.3.54 for example). Extract it to the linux-aldebaran folder and run the relocate_qitoolchain.sh script in the yocto-sdk folder.

Run menuconfig and enable I915 kernel module (set device drivers -> graphics support -> intel 8xx/9xx/G3x/G4x/HDGraphics to mandatory) :

```
make ARCH=x86_64 CROSS_COMPILE=<ORDNER>/ctc-linux64-atom-2.8.3.54/yocto-sdk/sysroots/x86_64-naoqisdk-linux/usr/libexec/i686-sbr-linux/gcc/i686-sbr-linux/5.3.0/ menuconfig
```

Compile the kernel + modules:

```
make ARCH=x86_64 CROSS_COMPILE=<ordner>/ctc-linux64-atom-2.8.3.54/yocto-sdk/sysroots/x86_64-naoqisdk-linux/usr/libexec/i686-sbr-linux/gcc/i686-sbr-linux/5.3.0/ -j24
```

Remount root

```
su # PW: root
mount -o remount,rw /
```

Modules and kernels

scp is only an example for a command, it's only important to copy the files to the corresponding locations.

on the nao

```
mkdir /lib/modules/4.4.86-rt99-aldebaran/kernel/drivers/gpu/drm/i915
mkdir /lib/modules/4.4.86-rt99-aldebaran/kernel/drivers/video
mkdir /lib/modules/4.4.86-rt99-aldebaran/kernel/drivers/video/backlight
mkdir /lib/modules/4.4.86-rt99-aldebaran/kernel/drivers/char/agp
mkdir /lib/modules/4.4.86-rt99-aldebaran/kernel/drivers/acpi
```

on the normal pc

```
scp ./arch/x86_64/boot/bzImage root@<nao-ip>:/boot/bzImagenew
scp ./drivers/gpu/drm/drm_kms_helper.ko root@<nao-ip>:/lib/modules/4.4.86-rt99-aldebaran/kernel/drivers/gpu/drm/
scp ./drivers/gpu/drm/drm.ko root@<nao-ip>:/lib/modules/4.4.86-rt99-aldebaran/kernel/drivers/gpu/drm/
scp ./drivers/gpu/drm/i915/i915.ko root@<nao-ip>:/lib/modules/4.4.86-rt99-aldebaran/kernel/drivers/gpu/drm/i915
scp ./drivers/video/backlight/backlight.ko root@<nao-ip>:/lib/modules/4.4.86-rt99-aldebaran/kernel/drivers/video/backlight
```

```
scp ./drivers/video/backlight/generic_bl.ko root@<nao-ip>:/lib/modules/4.4.86-rt99-
aldebaran/kernel/drivers/video/backlight
scp ./drivers/video/backlight/lcd.ko root@<nao-ip>:/lib/modules/4.4.86-rt99-
aldebaran/kernel/drivers/video/backlight
scp ./drivers/char/agp/intel-gtt.ko root@<nao-ip>:/lib/modules/4.4.86-rt99-
aldebaran/kernel/drivers/char/agp/
scp ./drivers/acpi/video.ko root@<nao-ip>:/lib/modules/4.4.86-rt99-aldebaran/kernel/drivers/acpi/
```

1. Change symlinks in /boot to new kernelimage e.g. (more than one symlink has to be changed)

```
2. ls -l /boot # to show existing symlinks
3. rm /boot/vmlinuz
   ln -s /boot/bzImagenew /boot/vmlinuz
```

4. Add modules link so that the kernel can find its modules.

```
5. cd /lib/modules
   ln -s 4.4.86-rt99-aldebaran 4.4.86-rt99-aldebaran-g085ca88f9bd1
```

6. Rebuild dependencies with depmod

set up chroot

Installation with Schroot

The following is based on [ubuntu forum](#).

```
sudo debootstrap --arch i386 xenial /chroot-xenial32 http://de.archive.ubuntu.com/ubuntu/
replace BENUTZER with your username
```

```
cat >> /etc/schroot/schroot.conf << "EOF"
[xenial32]
description=Ubuntu 16.04 Xenial (32 Bit)
directory=/chroot-xenial32
users=BENUTZER
type=directory
profile=desktop
personality=linux32
preserve-environment=true
EOF
```

copy chroot to nao

Prepare nao for copying files

```
ssh root@192.168.101.114
mount -o remount,rw /
exit
```

Delete some folders which we will later create on the nao

```
rm -r chrootfolder/dev
rm -r chrootfolder/sys
rm -r chrootfolder/run
```

Copy chroot folder

```
sshfs nao@192.168.101.114:/ /mnt
mkdir /mnt/data/chrt
cp -r chrootfolder /mnt/data/chrt
fusermount -u /mnt
```

Creating Initial Device Nodes

```
mkdir /data/chrt/dev/
mknod -m 600 /data/chrt/dev/console c 5 1
mknod -m 666 /data/chrt/dev/null c 1 3
cp /etc/passwd /data/chrt/etc/passwd
cp /etc/shadow /data/chrt/etc/shadow
cp /etc/group /data/chrt/etc/group
cp /etc/services /data/chrt/etc/services
cp /etc/protocols /data/chrt/etc/protocols
cp /etc/hosts /data/chrt/etc/hosts
```

using chroot

Mounting chroot (if folders are missing create them)

```
export LFS=/data/chrt
mount -v --rbind /dev $LFS/dev
umount -l $LFS/dev/pts
mount -v --bind /tmp $LFS/tmp
mount -v --bind /data/home $LFS/home
mount -v --bind /usr/share/alsa $LFS/usr/share/alsa
mount -vt devpts devpts $LFS/dev/pts -o gid=5,mode=620
mount -vt proc proc $LFS/proc
mount -vt sysfs sysfs $LFS/sys
mount -vt tmpfs tmpfs $LFS/run
```

Entering chroot

```
chroot /data/chrt /bin/bash
```

OpenCL

Instructions for installing [beignet](#), an open source implementation of OpenCL, to NAO v6 robots:

1. Install Packages needed for compilation (universe repository needed). And make sure to keep version uniform (clang/llvm 3.6 or 3.7 or 3.8):

```
sudo apt install cmake pkg-config python ocl-icd-dev libegl1-mesa-dev ocl-icd-ocl-dev
libdrm-dev libxfixes-dev libxext-dev llvm-3.8-dev clang-3.8 libclang-3.8-dev libtinfo-dev
libedit-dev zlib1g-dev ocl-icd-dev ocl-icd-libopencl1 ocl-icd-ocl-dev
```

2. [Download Beignet 1.3.2 src](#) and unpack
3. Inside Beignet-X.X.X-Source folder execute

4. mkdir build
5. cd build

```
cmake .. -DLLVM_INSTALL_DIR=/usr/lib/llvm-3.8/bin/ -DCMAKE_SKIP_RPATH=TRUE -
DGEN_PCI_ID=0x0f31 -DENABLE_OPENCL_20=0 -DCMAKE_BUILD_TYPE="Release"
```

6. make

7. Then do `sudo make install`

Test it with:

[HelloWorld.cpp](#) [HelloWorld.cl](#)

Compile with either

```
g++ HelloWorld.cpp -o helloworld -l OpenCL
```

or

```
clang++ test.cpp -march=atom --target=i386-pc-linux-gnu -l OpenCL
```

Run

the output should look like

```
0 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 60 63 66 69 72 75 78 81 84 87 90 93 96 99
102 105 108 111 114 117 120 123 126 129 132 135 138 141 144 147 150 153 156 159 162 165 168 171
174 177 180 183 186 189 192 195 198 201 204 207 210 213 216 219 222 225 228 231 234 237 240 243
246 249 252 255 258 261 264 267 270 273 276 279 282 285 288 291 294 297 300 303 306 309 312 315
318 321 324 327 330 333 336 339 342 345 348 351 354 357 360 363 366 369 372 375 378 381 384 387
390 393 396 399 402 405 408 411 414 417 420 423 426 429 432 435 438 441 444 447 450 453 456 459
462 465 468 471 474 477 480 483 486 489 492 495 498 501 504 507 510 513 516 519 522 525 528 531
534 537 540 543 546 549 552 555 558 561 564 567 570 573 576 579 582 585 588 591 594 597 600 603
606 609 612 615 618 621 624 627 630 633 636 639 642 645 648 651 654 657 660 663 666 669 672 675
678 681 684 687 690 693 696 699 702 705 708 711 714 717 720 723 726 729 732 735 738 741 744 747
750 753 756 759 762 765 768 771 774 777 780 783 786 789 792 795 798 801 804 807 810 813 816 819
822 825 828 831 834 837 840 843 846 849 852 855 858 861 864 867 870 873 876 879 882 885 888 891
894 897 900 903 906 909 912 915 918 921 924 927 930 933 936 939 942 945 948 951 954 957 960 963
966 969 972 975 978 981 984 987 990 993 996 999 1002 1005 1008 1011 1014 1017 1020 1023 1026 1029
1032 1035 1038 1041 1044 1047 1050 1053 1056 1059 1062 1065 1068 1071 1074 1077 1080 1083 1086
1089 1092 1095 1098 1101 1104 1107 1110 1113 1116 1119 1122 1125 1128 1131 1134 1137 1140 1143
1146 1149 1152 1155 1158 1161 1164 1167 1170 1173 1176 1179 1182 1185 1188 1191 1194 1197 1200
1203 1206 1209 1212 1215 1218 1221 1224 1227 1230 1233 1236 1239 1242 1245 1248 1251 1254 1257
1260 1263 1266 1269 1272 1275 1278 1281 1284 1287 1290 1293 1296 1299 1302 1305 1308 1311 1314
1317 1320 1323 1326 1329 1332 1335 1338 1341 1344 1347 1350 1353 1356 1359 1362 1365 1368 1371
1374 1377 1380 1383 1386 1389 1392 1395 1398 1401 1404 1407 1410 1413 1416 1419 1422 1425 1428
1431 1434 1437 1440 1443 1446 1449 1452 1455 1458 1461 1464 1467 1470 1473 1476 1479 1482 1485
1488 1491 1494 1497 1500 1503 1506 1509 1512 1515 1518 1521 1524 1527 1530 1533 1536 1539 1542
1545 1548 1551 1554 1557 1560 1563 1566 1569 1572 1575 1578 1581 1584 1587 1590 1593 1596 1599
1602 1605 1608 1611 1614 1617 1620 1623 1626 1629 1632 1635 1638 1641 1644 1647 1650 1653 1656
1659 1662 1665 1668 1671 1674 1677 1680 1683 1686 1689 1692 1695 1698 1701 1704 1707 1710 1713
1716 1719 1722 1725 1728 1731 1734 1737 1740 1743 1746 1749 1752 1755 1758 1761 1764 1767 1770
1773 1776 1779 1782 1785 1788 1791 1794 1797 1800 1803 1806 1809 1812 1815 1818 1821 1824 1827
1830 1833 1836 1839 1842 1845 1848 1851 1854 1857 1860 1863 1866 1869 1872 1875 1878 1881 1884
1887 1890 1893 1896 1899 1902 1905 1908 1911 1914 1917 1920 1923 1926 1929 1932 1935 1938 1941
1944 1947 1950 1953 1956 1959 1962 1965 1968 1971 1974 1977 1980 1983 1986 1989 1992 1995 1998
2001 2004 2007 2010 2013 2016 2019 2022 2025 2028 2031 2034 2037 2040 2043 2046 2049 2052 2055
2058 2061 2064 2067 2070 2073 2076 2079 2082 2085 2088 2091 2094 2097 2100 2103 2106 2109 2112
2115 2118 2121 2124 2127 2130 2133 2136 2139 2142 2145 2148 2151 2154 2157 2160 2163 2166 2169
2172 2175 2178 2181 2184 2187 2190 2193 2196 2199 2202 2205 2208 2211 2214 2217 2220 2223 2226
2229 2232 2235 2238 2241 2244 2247 2250 2253 2256 2259 2262 2265 2268 2271 2274 2277 2280 2283
2286 2289 2292 2295 2298 2301 2304 2307 2310 2313 2316 2319 2322 2325 2328 2331 2334 2337 2340
2343 2346 2349 2352 2355 2358 2361 2364 2367 2370 2373 2376 2379 2382 2385 2388 2391 2394 2397
2400 2403 2406 2409 2412 2415 2418 2421 2424 2427 2430 2433 2436 2439 2442 2445 2448 2451 2454
2457 2460 2463 2466 2469 2472 2475 2478 2481 2484 2487 2490 2493 2496 2499 2502 2505 2508 2511
2514 2517 2520 2523 2526 2529 2532 2535 2538 2541 2544 2547 2550 2553 2556 2559 2562 2565 2568
2571 2574 2577 2580 2583 2586 2589 2592 2595 2598 2601 2604 2607 2610 2613 2616 2619 2622 2625
2628 2631 2634 2637 2640 2643 2646 2649 2652 2655 2658 2661 2664 2667 2670 2673 2676 2679 2682
2685 2688 2691 2694 2697 2700 2703 2706 2709 2712 2715 2718 2721 2724 2727 2730 2733 2736 2739
2742 2745 2748 2751 2754 2757 2760 2763 2766 2769 2772 2775 2778 2781 2784 2787 2790 2793 2796
2799 2802 2805 2808 2811 2814 2817 2820 2823 2826 2829 2832 2835 2838 2841 2844 2847 2850 2853
2856 2859 2862 2865 2868 2871 2874 2877 2880 2883 2886 2889 2892 2895 2898 2901 2904 2907 2910
```

```
2913 2916 2919 2922 2925 2928 2931 2934 2937 2940 2943 2946 2949 2952 2955 2958 2961 2964 2967
2970 2973 2976 2979 2982 2985 2988 2991 2994 2997
Executed program succesfully.
```

troubleshooting

package clang3.8 not found

change /etc/apt/sources.list to "deb <http://de.archive.ubuntu.com/ubuntu> xenial main universe
[dpkg error](#)