DragonBoard™ 410c based on Qualcomm® Snapdragon™ 410E processor

Software Build and Installation Guide, Linux Android

December 2016
## Revision history

<table>
<thead>
<tr>
<th>Revision</th>
<th>Date</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>J</td>
<td>December 9, 2016</td>
<td>Fix to Section 1.3, Step 3: text of the command updated.</td>
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</tr>
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<td>Updated file &amp; package names.</td>
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<td>Miscellaneous updates.</td>
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<td>April 21, 2015</td>
<td>Initial release.</td>
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1 Introduction

1.1 Purpose

This document describes how to obtain, build, and program software applicable to the Linux Android Software Product “as-is” into a reference platform including:

- Setting up a development environment and installing the software.
- Building the software and flashing it onto the DragonBoard™ 410c platform.
- Please also refer to https://source.android.com/source/initializing.html to find the most recent set up instructions from Google on how to build Android source code on Ubuntu machines.

1.2 Required equipment and software

Table 1-1 Required equipment and software

<table>
<thead>
<tr>
<th>#</th>
<th>Item description</th>
<th>Version</th>
<th>Source/vendor</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ubuntu 12.0.4 LTS Linux distribution for 64-bit architecture</td>
<td>12.0.4 LTS</td>
<td>Ubuntu Community/Canonical, Ltd.</td>
<td>Android build host OS. Note that google may recommend other Ubuntu newer versions as well, please keep upto date per the link <a href="https://source.android.com/source/initializing.html">https://source.android.com/source/initializing.html</a></td>
</tr>
<tr>
<td>2</td>
<td>Windows 7 or Windows XP workstation</td>
<td>Windows 7 or Windows XP</td>
<td>Microsoft</td>
<td>Windows-based programming tools</td>
</tr>
<tr>
<td>3</td>
<td>Java SE JDK for Linux x64</td>
<td>7</td>
<td>Oracle</td>
<td>Building Android</td>
</tr>
<tr>
<td>4</td>
<td>repo</td>
<td>_</td>
<td>Android Open Source Project</td>
<td>Android source management tool</td>
</tr>
</tbody>
</table>

1.3 Install Ubuntu

IMPORTANT! You must be able to log in as root or use sudo to have root permissions during the installation.

1. Create an installation CD and install it onto the computer by following the instructions at http://releases.ubuntu.com/.

2. After installation, perform a software update using one of the following options:
   a. Use the GUI, select System > Administration > Update Manager, OR
   b. Use the shell command line and edit the source config file directly, as follows:
i  sudo vi /etc/apt/sources.list

ii  Edit the file to enable the universe and multiverse sources, and disable the Ubuntu installation CD source.

iii  From the command line, perform the package list update and package upgrades:
    
    sudo apt-get update
    sudo apt-get upgrade

3. Use apt-get to install the additional required packages.

   $ sudo apt-get install git-core gnupg flex bison gperf build-essential
   zip curl zlib1g-dev libncurses5-dev x11proto-core-dev
   libx11-dev lib32ncurses5-dev libgl1-mesa-dev g++-multilib
   mingw32 tofrodos python-markdown libxml2-utils xsltproc

4. IMPORTANT! Make bash the default shell using one of the following options (Android build scripts contain bash shell dependencies that require the system default shell /bin/sh to invoke bash).

   a. Reconfigure the package:
      i  Use the command:
         sudo dpkg-reconfigure dash
      ii  Answer “no” when the options for the above command pop up on your screen.

   b. Manually change the symlink /bin/sh←$B"*←(Bdash to /bin/sh←$B"*←(Bbash
      using the following commands:
      sudo rm /bin/sh
      sudo ln -s /bin/bash /bin/sh

   NOTE: See the Ubuntu Wiki page at https://wiki.ubuntu.com/DashAsBinSh for more information.

1.4 Configure Samba for Windows sharing (optional)

   1. Use the following command to install the Samba server and configuration manager for Windows sharing:
      sudo apt-get install samba system-config-samba

   2. Configure the Samba server using:
      System->Administration->Samba
      preferences->server settings:
      □ vmgroup, security=user authentication
      □ encrypt pw=yes, guest accnt=no guest accnt
      □ add share directory=/, share name=root, description=root directory

1.5 Install JDK

The Sun JDK is no longer in Ubuntu’s main package repository. To download it, add the appropriate repository and indicate to the system about the JDK being used.
sudo add-apt-repository "deb http://archive.canonical.com/ lucid partner"
sudo apt-get update
For latest Android releases you might need to use openjdk7, please install as below:
sudo apt-get install openjdk-7-jdk

1.6 Install repo

The repo tool is a source code configuration management tool used by the Android project. The repo tool is a front end to git written in Python. It uses a manifest file to help download code organized as a set of projects that are stored in different git repositories.

To install repo, do the following:
1. Create a ~/bin directory in your home directory, or, if you have root or sudo access, install for all system users under a common location, such as /usr/local/bin or somewhere under /opt.
2. Download the repo script.
   $ curl https://storage.googleapis.com/git-repo-downloads/repo > ~/bin/repo
3. Set the repo script attributes to executable.
   $ chmod a+x ~/bin/repo
4. Include the installed directory location for repo in your PATH.
   $ export PATH=~/bin:$PATH
5. Run repo --help to verify the installation.
   $ repo --help
   You should see a message similar to the following:
   usage: repo COMMAND [ARGS]
   repo is not yet installed. Use “repo init” to install it here.

The most commonly used repo commands are as follows:
- `init` -> Install repo in the current working directory
- `help` -> Display detailed help on a command

**NOTE:** For access to the full online help, install repo (repo init).

1.7 Acronyms

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>APQ</td>
<td>Application Processor Qualcomm</td>
</tr>
<tr>
<td>APSS</td>
<td>Applications Processor Sub-System</td>
</tr>
<tr>
<td>DC</td>
<td>Direct Current</td>
</tr>
<tr>
<td>FFA</td>
<td>Form Factor Accurate</td>
</tr>
<tr>
<td>FS</td>
<td>File System</td>
</tr>
<tr>
<td>GNU</td>
<td>GNU's Not Unix</td>
</tr>
<tr>
<td>Acronym</td>
<td>Definition</td>
</tr>
<tr>
<td>---------</td>
<td>---------------------------------</td>
</tr>
<tr>
<td>GUI</td>
<td>Graphical User Interface</td>
</tr>
<tr>
<td>HAL</td>
<td>Hardware Abstraction Layer</td>
</tr>
<tr>
<td>HLOS</td>
<td>High Level Operating System</td>
</tr>
<tr>
<td>ID</td>
<td>Identification</td>
</tr>
<tr>
<td>JDK</td>
<td>Java Development Kit</td>
</tr>
<tr>
<td>JVM</td>
<td>Java Virtual Machine</td>
</tr>
<tr>
<td>LED</td>
<td>Light Emitting Diode</td>
</tr>
<tr>
<td>LK</td>
<td>Little Kernel</td>
</tr>
<tr>
<td>MSM</td>
<td>Mobile Station Modem</td>
</tr>
<tr>
<td>OS</td>
<td>Operating System</td>
</tr>
<tr>
<td>PID</td>
<td>Process Identification Number</td>
</tr>
<tr>
<td>SD</td>
<td>Secure Digital</td>
</tr>
<tr>
<td>SDK</td>
<td>Software Developer's Kit</td>
</tr>
<tr>
<td>SE</td>
<td>Standard Edition</td>
</tr>
<tr>
<td>SURF</td>
<td>Subscriber Unit Reference</td>
</tr>
<tr>
<td>USB</td>
<td>Universal Serial Bus</td>
</tr>
<tr>
<td>VID</td>
<td>Vendor Identification Number</td>
</tr>
</tbody>
</table>

### 1.8 Additional information

For additional information, go to [https://www.96boards.org/DragonBoard410c/docs](https://www.96boards.org/DragonBoard410c/docs).
2 Downloading and Building the Software

2.1 Introduction to www.codeaurora.org

Open source HLOS (High Level Operating System) software for Qualcomm® Snapdragon™ chipsets is available on the Linux Foundation hosted site www.codeaurora.org. The abbreviation “HLOS” is used in this document.

Specifically for the Android platform, go to https://www.codeaurora.org/xwiki/bin/QAEP/release, which can be accessed through Wiki Home > Android for MSM™ project > Android releases.

2.2 Downloading HLOS software

If you want to download Android source code that will work on your Dragonboard 410c, these are the instructions you should use. To download the HLOS software, do the following:

1. First, you need to decide what release you would like to download. If you want to download a board support package, the release should match the board support package. For instance, if you downloaded

   linux_android_board_support_package_vla.br_.1.2.4-01810-8x16.0-2.zip

   then you’ll look for a manifest called LA.BR.1.2.4-01810-8x16.0.xml

This series of letters and numbers is called the APSS (Application processor subsystem software) Build ID.
Downloading and Building the Software

Figure 2-1 Code Aurora Forum releases page

Each Tag/Build ID as shown in Figure 2-2 is identified by a unique build identification code which follows this naming convention:

<PL_Image>-<Version>-<Chipset>

Where:
- PL_Image – LNX.LA.Branch for Linux Android
- Version – Variable number of digits used to represent the build ID version.
- Chipset – 8x16 for MSM8916/APQ8016E

Figure 2-2 Build ID code example

NOTE: This example is for reference only and does not specify the exact Build ID for DragonBoard 410c.

2. The APPS Build ID TAG can be used to find the appropriate open source release manifest XML file from the cross reference table at https://www.codeaurora.org/xwiki/bin/QAEP/release
3. Once you’ve found the manifest file you want, you need to actually run the command to download all the source code. In an empty directory, issue the `repo init` command with the correct branch and manifest as indicated in the branch releases table. Please note that a readymade script and build package has been created on

https://developer.qualcomm.com/hardware/dragonboard-410c/tools

for different Android releases. The script `DB410c_build.sh` inside the `android_board_support_package_vla.br_XXXX.zip` file automatically downloads the right source files and uses a proprietary `tar` file in the same directory for the build. One can directly skip to step 5 for clone and build. Steps 1-4 are for informational purposes only.

```bash
$ repo init -u git://codeaurora.org/platform/manifest.git -b release-[manifest] -repo-url=git://codeaurora.org/tools/repo.git
```

4. Type the `repo sync` command:

```bash
$ repo sync
```

5. Make sure you have at least ~60GB of free space, then download the `android_board_support_package_vla.br_XXXX.zip` file depending on the version you want from https://developer.qualcomm.com/dragonboard-410c/tools and copy to the directory where you want to build Android images. This package has the `DB410c_build.sh`, proprietary `tar` file, readme and a license file.

6. After unzipping, run the command `chmod a+x DB410c_build.sh` and run `bash` shell using the `bash` command at the Linux prompt. Then run the build script as `./DB410c_build.sh` or “sh DB410c_build.sh” in a `bash` shell.

   a. Accept your name and email ID, when prompted, for the clone to begin.

   The script `DB410c_build.sh` clones the code from `www.codeaurora.org`, uses the files in the Linux Android Board Support Package that includes proprietary-XXXX-x.tgz, and applies relevant patches, if needed.

   Where XXXX-x is the “www.codeaurora.org build manifest ID”-“version number”

   b. Source code clone and build takes about an hour or longer depending on the configuration of the Ubuntu machine. You can edit the `DB410c_build.sh` for build command and change make `-j4 BUILD_ID=APQ8016_$ITCVER` to:

   ```bash
   make -j8 BUILD_ID=APQ8016_$ITCVER or make -j16 BUILD_ID=APQ8016_$ITCVER
   ```

   depending on your Ubuntu machine configuration.

   **NOTE:** Sometimes the clone from `www.codeaurora.org` may fail due to network issues; please try again.

### 2.3 Rebuild apps processor Android HLOS

To build the apps processor Android HLOS, do the following:

1. In a `bash` shell, navigate to the Android source tree base directory.

   ```bash
cd $BUILDROOT
   ```

2. Enter the following command to configure the build environment shell settings:

   ```bash
   source build/envsetup.sh
   ```
NOTE: You must use the source command so the environment settings are defined in the current shell.

3. Enter the lunch command to select the build configuration, or enter it with no parameters to see an interactive menu for making selections.
   lunch msm8916_64-userdebug  (for 64-bit kernel space and 64 bit user space)

4. Run make to start the build. To run parallel builds for faster build times on a multicore build machine, run the make command as follows:
   make -j8  → to build everything
   make -j8 aboot  → to build LK bootloader emmc_appsboot.mbn
   make -j8 bootimage  → to build kernel boot.img
   make -j8 clean  → cleans the out directory completely

For user space components standard, running with “mm” and “mm –B” (to rebuild) also works. For more information, see Chapter 4.

Sometimes for certain changes which may not take effect in kernel, it may be useful to manually remove kernel obj files:
   lunch msm8916_64-userdebug
   rm -rf out/target/product/msm8916_64/obj/KERNEL_OBJ/
   rm out/target/product/msm8916_64/boot.img
   make -j8 bootimage

Output is generated in $BUILDROOT/out/target/product/msm8916/. The list of files is as follows:
- emmc_appsboot.mbn
- boot.img
- cache.img
- userdata.img
- system.img
- persist.img
- recovery.img
3 Configuring Android adb, fastboot, and Flashing Images to Target Device

3.1 Install Android adb, fastboot, and USB driver for Windows

DragonBoard 410c supports requires the following USB device support:

- Android USB Driver (android_winusb.inf)
- Android adb Interface
- Android Boot Loader Interface (fastboot)

1. Before installing the drivers, edit the `qcmdm.inf` and `qcser.inf` files to make sure that they contain support for the DragonBoard 410c VID/PID (Qualcomm SURF/FFA) with appropriate entries in each section, as indicated in Step 4.

2. Go to http://developer.android.com/sdk/win-usb.html, and follow the instructions to install the SDK and USB driver.

3. Right-click My Computer, and select Properties > Advanced > Environment Variables, and set the path to include the directory `c:\android-sdk-windows\tools`.

4. The Android USB driver for adb and fastboot needs to add the DragonBoard 410c VID/PID, which supports the connection to the DragonBoard 410c. Edit this file to add the DragonBoard 410c VID/PID lines to each section: `android-sdk-windows\usb_driver\android_winusb.inf`.

```
android_winusb.inf

[Google.NTx86]
;Qualcomm SURF/FFA
%SingleAdbInterface% = USB_Install, USB\VID_05C6&PID_9025
%CompositeAdbInterface% = USB_Install, USB\VID_05C6&PID_9025&MI_01
%SingleBootLoaderInterface% = USB_Install, USB\VID_18D1&PID_D00D

[Google.NTamd64]
;Qualcomm SURF/FFA
%SingleAdbInterface% = USB_Install, USB\VID_05C6&PID_9025
%CompositeAdbInterface% = USB_Install, USB\VID_05C6&PID_9025&MI_01
%SingleBootLoaderInterface% = USB_Install, USB\VID_18D1&PID_D00D
```

In addition, make sure that there are matching entries under the [Strings] section.
5. The adb client (adb.exe) supports a built-in list of recognized USB VID/PID devices. To add another device to the list of recognized devices, which is not included in the built-in support list, create this directory if it does not exist: %USERPROFILE%\android.

6. Navigate to the %USERPROFILE%\android directory.

7. In the directory %USERPROFILE%\android, create or edit the file adb_usb.ini. If the file exists, it contains a DO NOT EDIT message. Disregard this message and edit the file anyway. Add a line to the end of the file containing 0x05C6.

   **NOTE:** Do not run android update adb or it resets the contents of this file and overwrites the line just added.

After editing, the adb_usb.ini file must look like the following:

```plaintext
# ANDROID 3RD PARTY USB VENDOR ID LIST
—
# DO NOT EDIT.
# USE 'android update adb' TO GENERATE.
# 1 USB VENDOR ID PER LINE.
0x05C6
```

### 3.2 Configure adb and fastboot in Linux

1. To configure adb, modify the USB driver by navigating to the following directory:
   ```
cd /etc/udev/rules.d/
   ```
2. Enter the command:
   ```
sudo vi 50-android.rules
   ```

   The result must be similar to the following output:
   ```
   #Sooner low-level bootloader
   SUBSYSTEM=="usb", SYSFS{idVendor}=="18d1", SYSFS{idProduct}=="d00d",
   MODE="0664", GROUP="plugdev"

   # adb composite interface device 9025
   SUBSYSTEM=="usb", SYSFS{idVendor}=="05C6", SYSFS{idProduct}=="9025",
   MODE="0664", GROUP="plugdev"
   ```
3. After editing the file, to see the list of target devices connected to the Linux box, type:
   ```
   lsusb
   ```
4. After a build is complete, the adb and fastboot executables for Linux are located in the android\out\host\linux-x86\bin directory in the Android software release. If the android\out\host\linux-x86\bin directory is not in the executable search path, use the following steps to add it from $BUILDROOT (build directory).
   a. Type the command:
      ```
      source build/envsetup.sh
      ```
b. Type the command:

   lunch msm8916_64-userdebug

**NOTE:** To run adb or fastboot, sudo or root access on the Linux machine may be required. This is a useful link for Linux and MAC OS to setup adb and fastboot (note that device ID “9025” is needed in 50-android.rules or 51-android.rules): [https://code.google.com/p/adb-fastboot-install/](https://code.google.com/p/adb-fastboot-install/)

### 3.3 Program Android images using fastboot

1. Hold down the VOL- key, connect the DC supply to the DragonBoard 410c, and press the power ON button. Plug the USB cable into the target. This will bring the device into fastboot mode.

2. Depending on your build environment, choose one of the following options
   a. From the Windows command shell, run:
      
      fastboot devices
   b. From Linux:
      
      i. Navigate to the following directory:
      
      `cd <$BUILDROOT>/device/out/host/linux-x86/bin`
      
      ii. Run: `sudo fastboot devices`

      The list of registered devices is displayed.

3. Once the device is detected, flash the binaries to the target. Run the following commands to flash all the android apps images:

   fastboot flash aboot <path to emmc_appsboot.mbn>
   fastboot flash boot <path to boot.img>
   fastboot flash system <path to system.img>
   fastboot flash userdata <path to userdata.img>
   fastboot flash persist <path to persist.img>
   fastboot flash recovery <path to recovery.img>

4. Reboot the board. During power up you should see USER LED #4 glowing green, indicating bootup sign of life.

**NOTE:** When re-flashing Android Images, the initial boot will take up to 3 minutes as Android initializes user space databases and files. This boot time will reduce to less than a minute on subsequent boots.
4 More on adb Usage and Android Build

4.1 Install applications on Android target using adb

1. Plug the USB cable into the target.
2. Navigate to the following directory:
   \( \text{cd} \ <\text{root}>/\text{LINUX/device/out/host/linux-x86/bin} \)
3. Enter the command below to register a device:
   \( \text{sudo} \ \text{adb} \ \text{devices} \)
4. Push the files as follows:
   \( \text{adb} \ \text{push} \ \text{AppName.apk} \ /\text{system/app/} \)
   or
   \( \text{adb} \ \text{install} \ \text{AppName.apk} \)

NOTE: In general, the syntax is: \( \text{adb} \ \text{push} \ <\text{file_name}> \ <\text{location_on_the_target}> \)

4.2 Android device tree structure

The Android device tree structure, for example, the \(<\text{Android device tree root}>\), is laid out as follows:

- build/ – Build environment setup and makefiles
- bionic/ – Android C library
- dalvik/ – Android JVM
- kernel/ – Linux kernel framework/
  – Android platform layer (system libraries and Java components)
- system/ – Android system (utilities and libraries, fastboot, logcat, liblog)
- external/ – Non-Android-specific Open Source projects required for Android
- prebuilt/ – Precompiled binaries for building Android, e.g., cross-compilers
- packages/ – Standard Android Java applications and components
- development/ – Android reference applications and tools for developers
- hardware/ – HAL (audio, sensors) and Qualcomm specific hardware wrappers
- vendor/qcom/ – Qualcomm target definitions, e.g., msm8916
- vendor/qcom-proprietary/ – Qualcomm-proprietary components
- out/ – Built files created by user
- out/host/ – Host executables created by the Android build
4.3 Android source tree structure

The Android source tree structure is laid out as follows:

/ – Root directory (ramdisk.img, read-only)
   - init.rc – Initialization configuration files (device config, service startups) init.qcom.rc
   - dev/ – Device nodes
   - proc/ – Process information
   - sys/ – System/kernel configuration
   - sbin/ – System startup binaries (adb daemon; read-only)
   - system/ – From system.img (read-write) – bin/ – Android system binaries
     - lib/ – Android system libraries
     - xbin/ – Nonessential binaries
     - framework/ – Android framework components (Java)
     - app/ – Android applications (Java)
     - etc/ – Android configuration files
   - sdcard/ – Mount point for SD card
   - data/ – From userdata.img (read-write)
     - app/ – User installed Android applications
     - tombstones/ – Android crash logs

4.4 Build the Linux kernel manually

1. Set up the Android build environment. From source root directory type the below commands:
   source build/envsetup.sh
   lunch msm8916_64-userdebug

2. make -j8 bootimage
NOTE: In theory, it is possible to use \texttt{--jn} as long as \textit{n} is smaller than the number of processors in the server where the build is being created.

3. To start with a clean tree, use the following commands:
   a. To remove object files:
      \texttt{make --j8 clean}
      you can also use the below command to delete the kernel object files and run the build command again:
      \texttt{rm -rf out/target/product/msm8916_64/obj/KERNEL_OBJ/}

4.5 Build the Android components manually

1. Set up the Android build environment (envsetup.sh/lunch).
2. Change to the main Android directory.
3. Build with the \texttt{make} command:
   \texttt{make --j4}
4. To build individual components, choose one of the following options:
   a. To run \texttt{make} from the top of the tree, use the command:
      \texttt{m <component name>\# Example: m libril-qc-1}
   b. To build all of the modules in the current directory, change to the component directory and use the command:
      \texttt{mm}
5. To delete individual component object files, choose one of the following options:
   a. To delete a particular module, use the command:
      \texttt{m clean--<module name>}
   b. To delete a module within a given path, use the commands:
      \texttt{rm -rf out/target/product/*/obj/STATIC_LIBRARIES/<module name>_intermediates}
      \texttt{rm -rf out/target/product/*/obj/SHARED_LIBRARIES/<module name>_intermediates}
      \texttt{rm -rf out/target/product/*/obj/EXECUTABLES/<module name>_intermediates}

4.6 Other useful Android build commands

Other important Android build commands are as follows:

- \textbf{printconfig} – Prints the current configuration as set by the choosecombo commands.
- \textbf{m} – Runs \texttt{make} from the top of the tree. This command is useful because the user can run \texttt{make} from within subdirectories.
  If you have the TOP environment variable set, the commands use that.
If you do not have the TOP variable set, the commands look up the tree from the current directory, trying to find the top of the tree.

- **mm** – Builds all of the modules in the current directory.
- **mmm** – Builds all of the modules in the supplied directories.

- **croot** – cd to the top of the tree.
- **sgrep** – grep for the regex you provide in all .c, .cpp, .h, .java, and .xml files below the current directory.

- **clean**-$(LOCAL_MODULE) and **clean**-$(LOCAL_PACKAGE_NAME). Let you selectively clean one target.

For example, if you type **make clean-libutils**, it deletes libutils.so and all of the intermediate files. If you type **make clean-Home**, it cleans just the Home application.

- **make clean** – Cleanly deletes of all of the output and intermediate files for this configuration. This is the same as ```rm -rf out/<configuration>/```.

Android makefiles (Android.mk) are similar to regular GNU makefiles; some differences are:

- Predefined **variables** to assign for source files, include paths, compiler flags, library includes, etc.
- Predefined **action** for compiling executables, shared libraries, static libraries, Android packages, using precompiled binaries, etc.

For example:

- **Variables**
  - LOCAL_SRC_FILES – List of all source files to include
  - LOCAL_MODULE – Module name (used for “m”)
  - LOCAL_CFLAGS – C compiler flags override
  - LOCAL_SHARED_LIBRARIES – Shared libraries to include

- **Action**
  - include $(CLEAR_VARS) – Clears LOCAL* variables for the following sections:
    - include $(BUILD_EXECUTABLE)
    - include $(BUILD_SHARED_LIBRARIES)
    - include $(BUILD_STATIC_LIBRARIES)

**NOTE:** Paths in Android.mk are always relative to the Android device tree root directory.

To add a new module to the Android source tree, perform the following steps:

1. Create a directory to contain the new module source files and Android.mk file.
2. In the Android.mk file, define the LOCAL_MODULE variable with the name of the new module name to be generated from your Android.mk.

**NOTE:** For Applications modules, use LOCAL_PACKAGE_NAME instead.
The local path in your new module is LOCAL_PATH. This is the directory your Android.mk file is in. You can set it by inserting the following as the first line in your Android.mk file:

```
LOCAL_PATH := $(call my-dir).
```

### LOCAL_SRC_FILES

The build system looks at LOCAL_SRC_FILES to find out which source files to compile, .cpp, .c, .y, .l, and/or .java. For .lex and .yacc files, the intermediate .h and .c/.cpp files are generated automatically. If the files are in a subdirectory of the one containing the Android.mk file, you must prefix the files with the directory name:

```
LOCAL_SRC_FILES := 
    file1.cpp 
    dir/file2.cpp
```

The new module can be configured with the following:

- **LOCAL_STATIC_LIBRARIES** – These are the static libraries that you want to include in your module.
  ```
  LOCAL_STATIC_LIBRARIES := 
      libutils 
      libtinyxml
  ```

- **LOCAL_MODULE_PATH** – Instructs the build system to put the module somewhere other than what is normal for its type. If you override this path, make sure that you also set LOCAL_UNSTRIPPED_PATH if it is an executable or a shared library so the unstripped binary also has somewhere to go; otherwise, an error occurs.
  ```
  LOCAL_MODULE_PATH := 
      /path/to/module
  ```
EXHIBIT 1

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