Why OpenEmbedded proved a good foundation for MontaVista

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Moving away from RPM!

- **Shortly after is 10th birthday, MontaVista unleashed MVL6: a complete revamp!**

- **MVL6 is built around the Integration Platform: a new tooling built above OE's build tool: BitBake**

- **So why did we kill RPM and moved over to BitBake?**
- **Why not just package OE and provide support?**

OpenEmbedded / BitBake

- Framework to create Linux distributions for embedded devices.
- Created by Chris Larson, Michael Lauer, and Holger Schurig
- Initially for OpenZaurus with contributions quickly received contributions from projects like Familiar Linux and OpenSIMpad eventually resulting into a common code base.
- Primarily, the project maintains and develops a collection of BitBake recipes, similar to Gentoo's ebuilds.
- OE based distributions cherry-pick the recipes they want/need.

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- First driver: no one fits all
- Rules out binary distribution model
- Source-based distribution probably the solution

- MontaVista is an Open Source company
- So let's not reinvent the wheel

- OE selected after review of build systems:
  - RPM, SB2, BuildRoot, LTIB, PTXDist...

- Great foundation but still did not meet of all our requirements – let's later discuss why...

Some concepts first

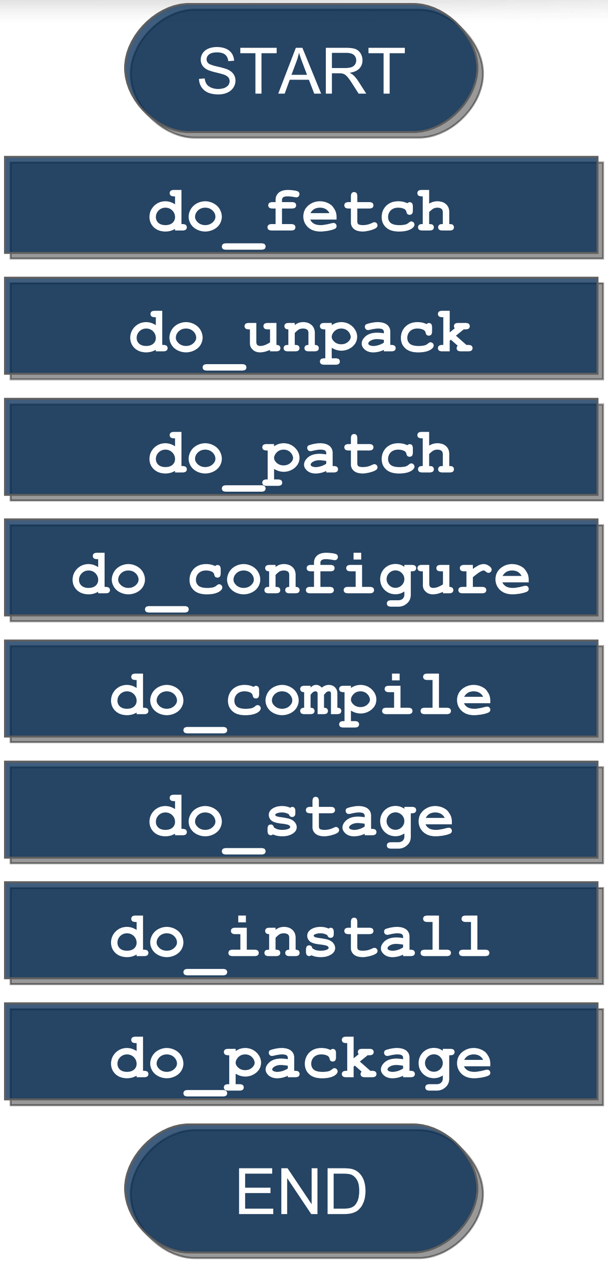
Recipes, Tasks, & Images

- **Recipe**
  - Details where & how to download package sources + patches
  - How to patch
  - How to configure & build
  - How to install files & what to do with the results
  - One recipe may build many packages
    - (glibc, glibc-dev, glibc-i18n-pt_BR, etc, etc, etc)

- **Task**
  - Usually lists several (meta-)packages
  - E.g.`Task-boot.bb` contains: *kernel, base-files, base-passwd, busybox, modutils-initscripts, netbase, update-alternatives*

- **Image**
  - Lists several tasks and (meta-)packages

The Basics of a Recipe



START

do_fetch

do_unpack

do_patch

do_configure

do_compile

do_stage

do_install

do_package

END

A recipe is a file containing:

- **Non-executable metadata:**
  - DESCRIPTION
  - LICENSE
  - DEPENDS
  - RDEPENDS
  - Which files to package into which sub-packages
- **Executable tasks the build system knows how to execute**
  - Can inherit custom definitions from base classes
  - Can override any definition

Example recipe (sqlite3, modified) - 1

```
DESCRIPTION = "An Embeddable SQL Database Engine"
SECTION = "libs"
PRIORITY = "optional"
DEPENDS = "readline ncurses"
LICENSE = "PD"
```

```
SRC_URI = "http://www.sqlite.org/sqlite-${PV}.tar.gz \
     file://libtool.patch;patch=1"

S = "${WORKDIR}/sqlite-${PV}"
```

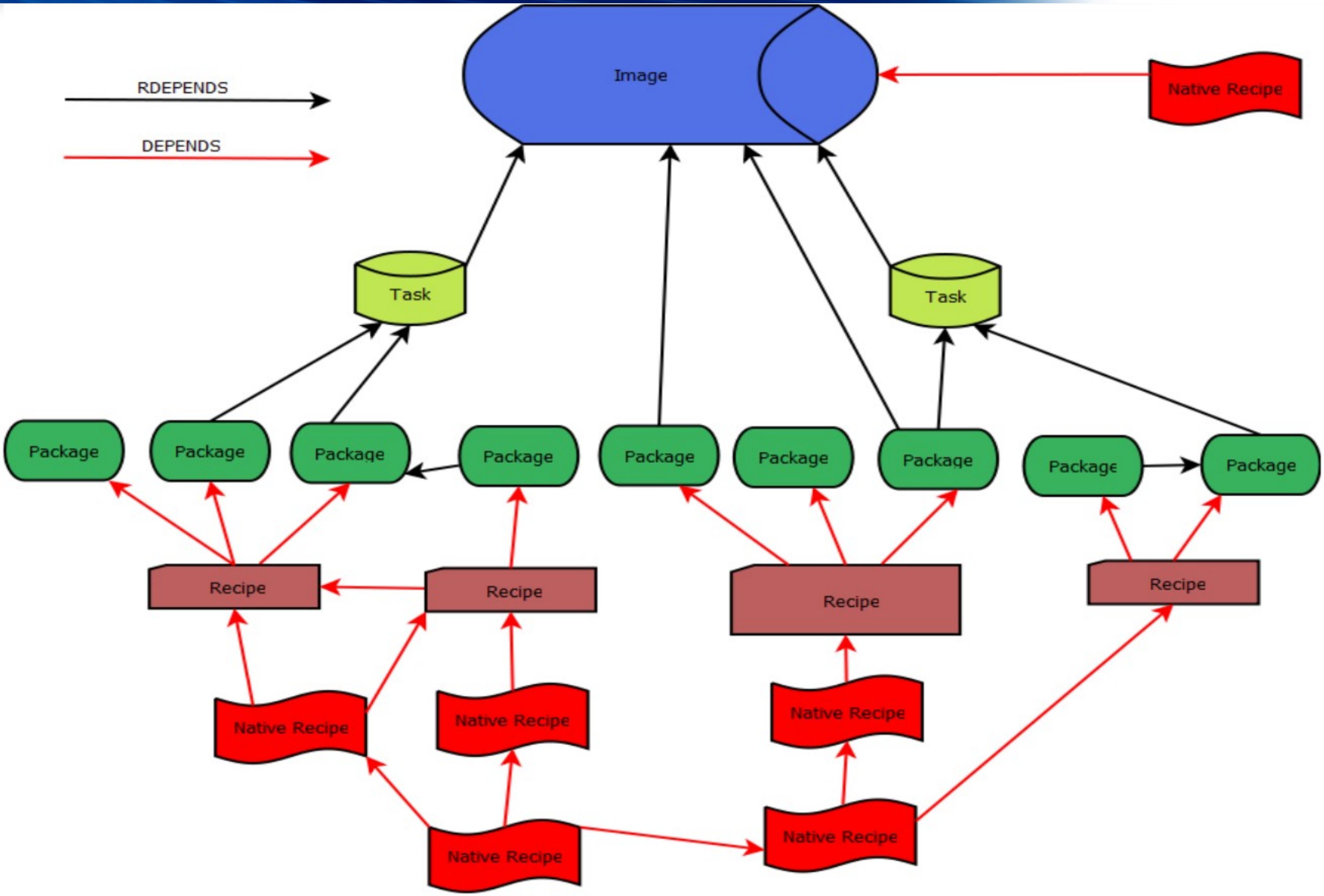
```
inherit autotools pkgconfig

EXTRA_OECONF = "--disable-tcl --enable-shared \
        --enable-threadsafe“

do_compile_prepend() {
  oe_runmake sqlite3.h
  install -m 0644 sqlite3.h ${STAGING_INCDIR}
}
```

Example recipe (sqlite3, modified) - 2

```
do_stage() {
  oe_libinstall -so libsqlite3 ${STAGING_LIBDIR}
  install -m 0644 sqlite3.h ${STAGING_INCDIR}
}
```

```
PACKAGES = "libsqlite libsqlite-dev libsqlite-doc sqlite3 sqlite3-dbg"

FILES_sqlite3 = "${bindir}/*"

FILES_libsqlite = "${libdir}/*.so.*"

FILES_libsqlite-dev = "${libdir}/*.a ${libdir}/*.la ${libdir}/*.so \
              ${libdir}/pkgconfig ${includedir}"

FILES_libsqlite-doc = "${docdir} ${mandir} ${infodir}"

AUTO_LIBNAME_PKGS = "libsqlite"
```

Stitching it all together

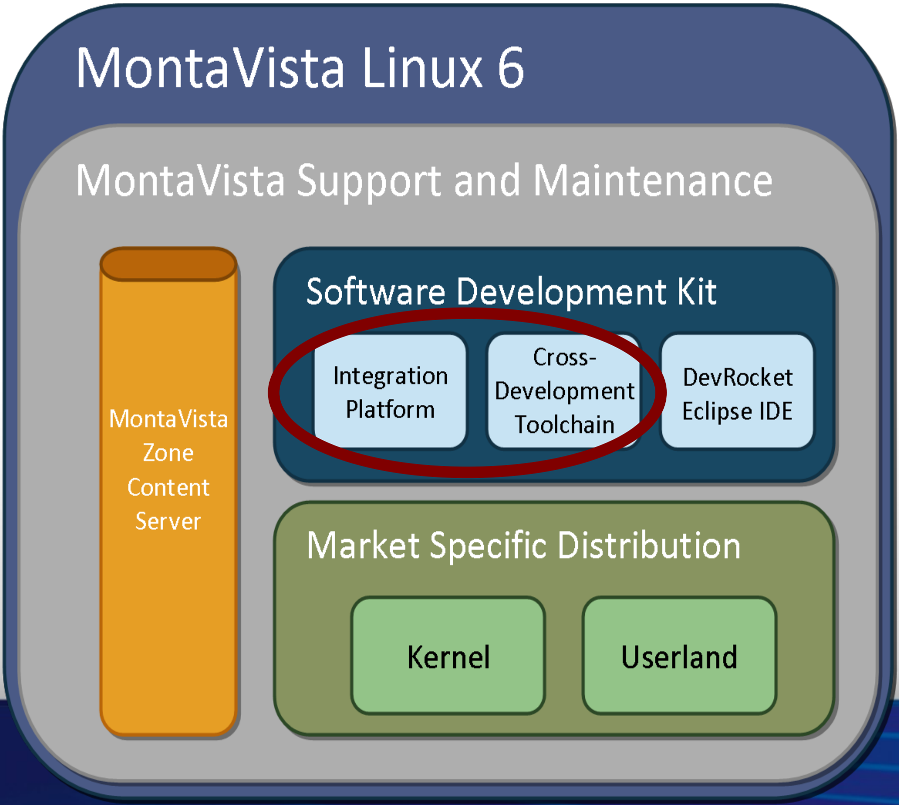


Thumbs up for

OpenEmbedded

- Build a complete embedded system w/ a single line
- Powerful metadata language
- Huge collection of recipes
- Fairly flexible and customizable build options
- Large hardware support
- Strong community

Building



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DevRocket Eclipse IDE

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Do you really want to build everything?

- New to OE and want to toy a little with it?
- My first build completed after 7 hours!!!

Switch to binary distro?

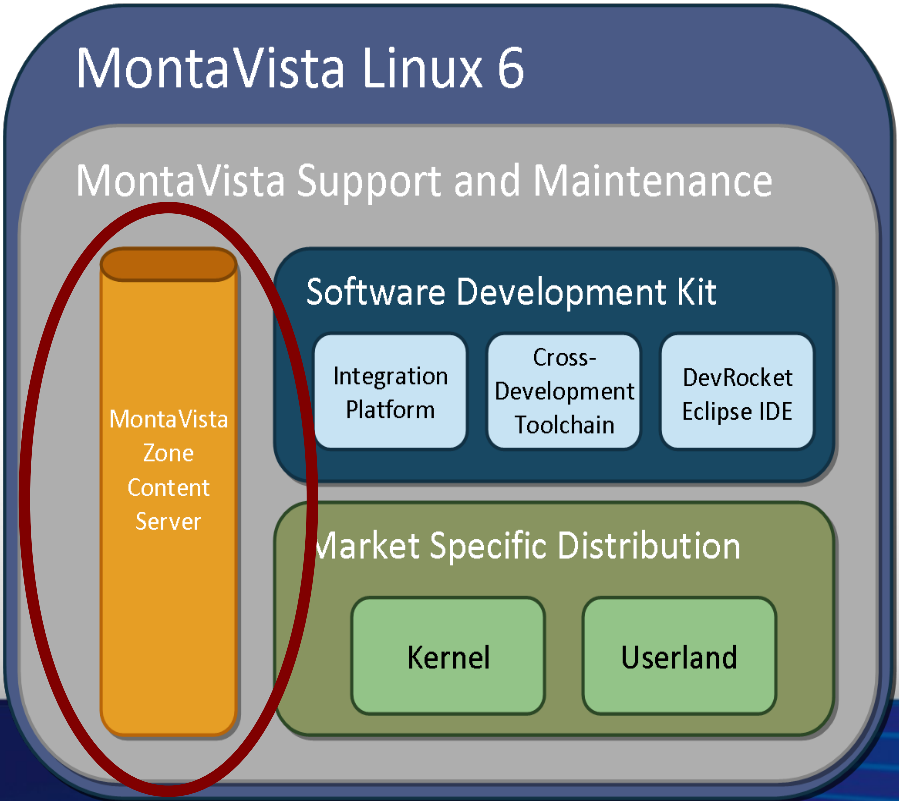
- There is no “one fits all distro”, I want/need control over configure options

Why can't I have both (i.e. source / binary)?

Prebuilt binaries

- **BitBake has been modified to:**
  - Compute a unique build ID from conf files
  - Check the existence of compatible prebuilt packages (same build ID)
- **Some recipes and tools had to be modified in order to be fully relocatable**

Fetching Content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Getting things...

- **Many recipes list several sites for download**
  - Bitbake recipes use 6 different algorithms to download sources:
    - git: svn: cvs: http: https: ftp:
    - Some may not play well with company firewalls
  - And yet – files and mirrors disappear
  - OE doesn't keep history recipes
- **What if you need to build same image a year from now!**
  - Imagine if you do not keep the sources around!
- **Reproducibility is a common problem today**

404

Address Not Found

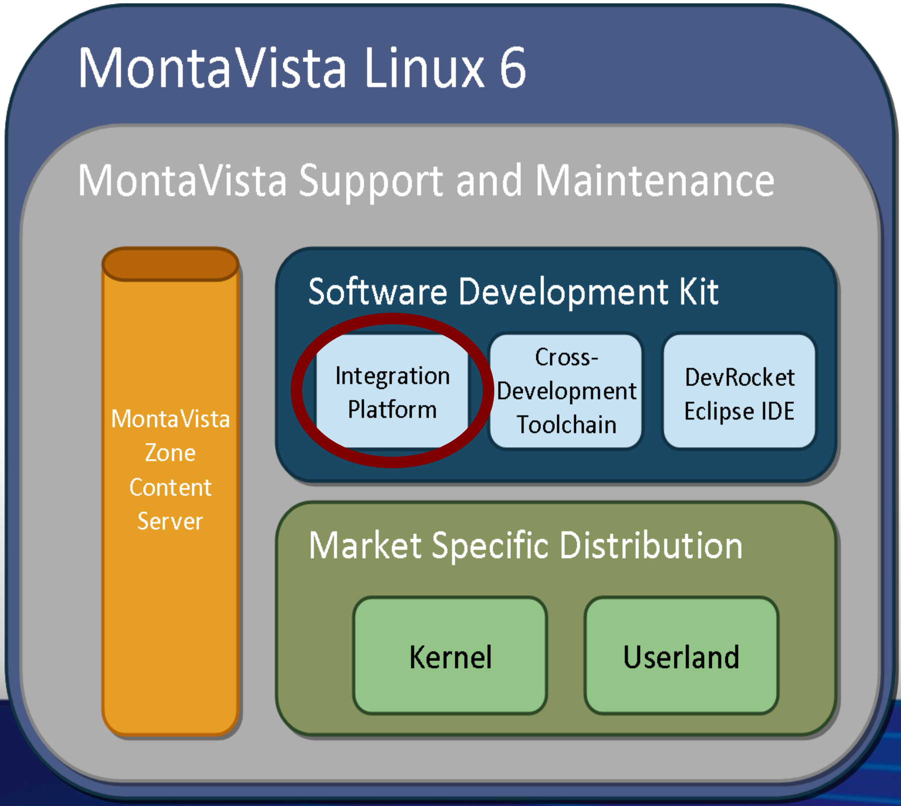
Answer: 3 folds

- **Variety of protocols:**
  - First try to get things from central content server with http
  - Fall back to actual (Internet) fetching algorithm if that fails

- **Dangling links:**
  - Get everything from MontaVista (typically for MontaVista supported recipes) or company server (for e.g. proprietary software)

- **Reproducibility:**
  - Everything is built from source
  - Created project can be put under SCM
  - MontaVista provided tool for creating local mirror

Cherry Picking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Where to find things?

- **OE recipes can be found in the “recipes” directory of the OE source tree:**

  Flat directory with a long list of directories each containing 1 or more recipes and then several versions of them...... lost in heaven?

  => organized recipes into collections: audio, graphics, wireless, ...

  => conf/content-collections.conf can list collections enabled

conf/content-collections.conf

```
COLLECTIONS =  "${TOPDIR}/collections/custom"
COLLECTIONS += "${TOPDIR}/collections/freescale-8349mds-2.6.27/releases/freescale-8349mds-2.6.27-0908010910.tar.bz2"
COLLECTIONS += "${TOPDIR}/collections/core/releases/core-0909090219.tar.bz2"
COLLECTIONS += "${TOPDIR}/collections/foundation/releases/foundation-0909110330.tar.bz2"
```

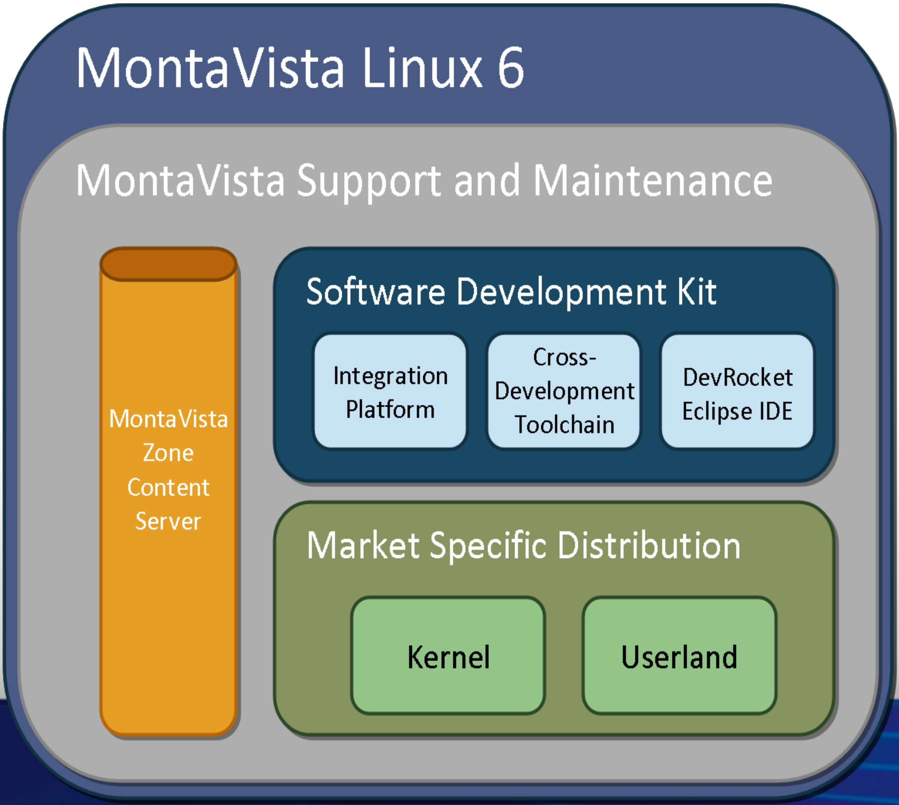
Several options – what to use?

- NetWorkManager vs connman?
- Clutter vs pigment?
- Hostap vs madwifi?
- What works? Which was tested?

==>

- MontaVista introduced the notion of Market Specific Distribution (MSD)
- Combined with collections
- Provide our customers with well-tested and supported building blocks.

Flexibility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Extra tooling

- Tool to import OpenEmbedded recipes into your MVL6 project – tool figures out dependencies such as recipes and bb classes

- Tool to import legacy source RPMs into MVL6 and building with BitBake

- Tool to mirror MontaVista content server where metadata, vanilla source trees, patches and prebuilt binaries are stored

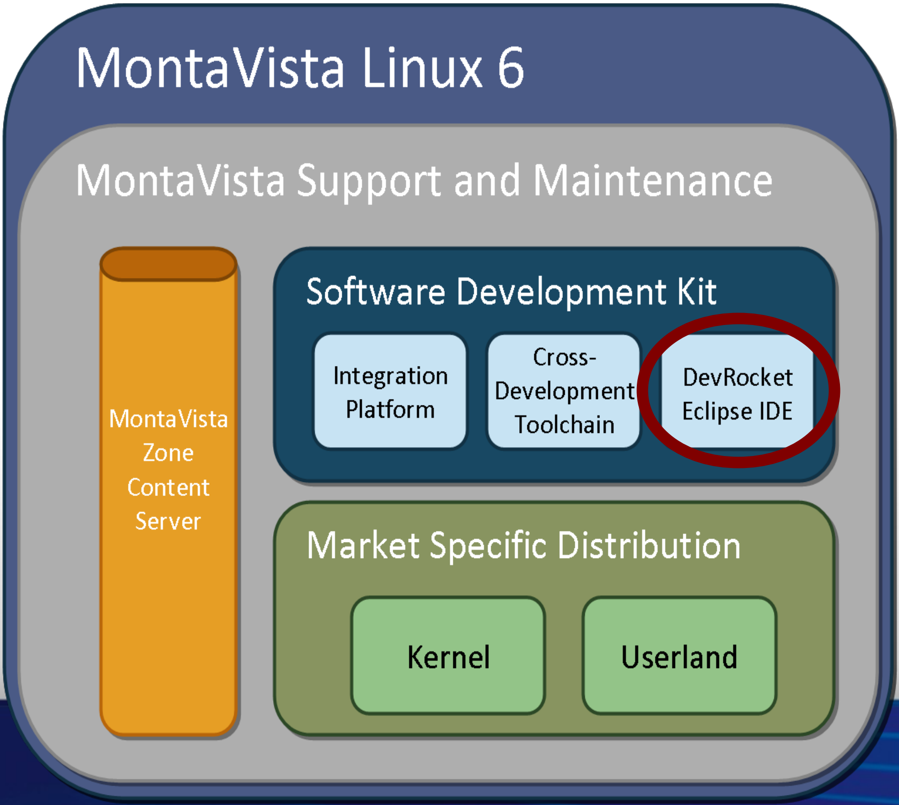
Kernel features

- **Added mechanism to set kernel configuration options from conf files:**
  - KERNEL_CONFIG_*

- **One may also want to queue his own patches:**
  - KERNEL_APPEND_PATCH_SERIES

- **Or use a specific device tree file:**
  - FDT_FILE_local = “mpc8540ads.dts”

Hiding the complexity



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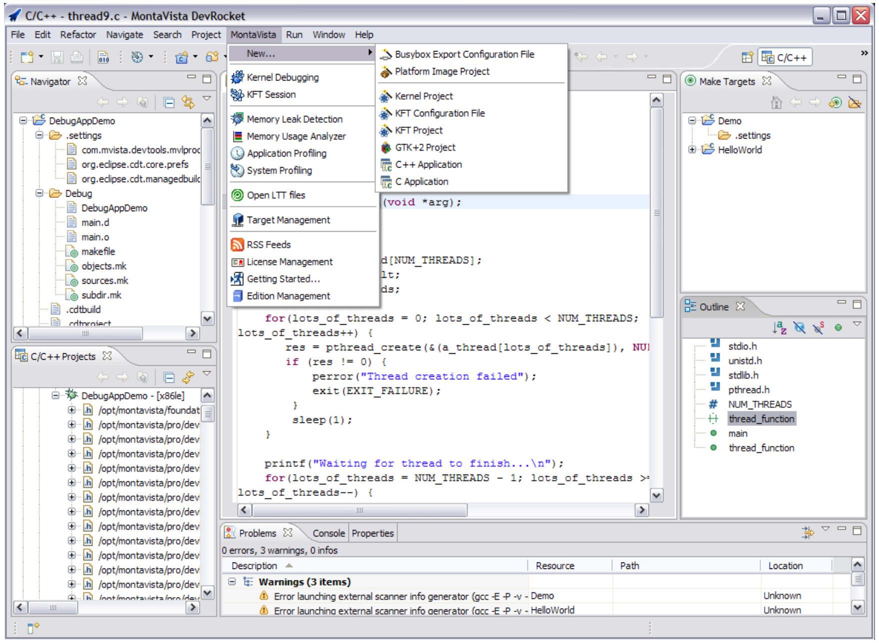
DevRocket Eclipse-based IDE

- **Eclipse-based plugins**
- **One click edit-compile-debug**
  - Automated to reduce mistakes
- **File system management**
  - Manage detailed package information



```
(void *arg);

d[NUM_THREADS];
lt;
ds;

    for(lots_of_threads = 0; lots_of_threads < NUM_THREADS;
lots_of_threads++) {
        res = pthread_create(&(a_thread[lots_of_threads]), NUI
        if (res != 0) {
            perror("Thread creation failed");
            exit(EXIT_FAILURE);
         }
         sleep(1);
    }

    printf("Waiting for thread to finish...\n");
    for(lots_of_threads = NUM_THREADS - 1; lots_of_threads >=
lots_of_threads--) {
```

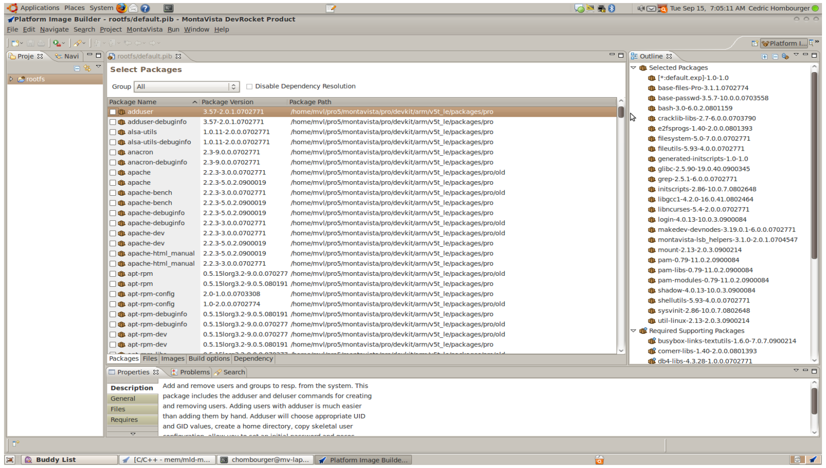
0 errors, 3 warnings, 0 infos

Description	Resource	Path	Location
Warnings (3 items)			
Error launching external scanner info generator (gcc -E -P -v -	Demo		Unknown
Error launching external scanner info generator (gcc -E -P -v -	HelloWorld		Unknown

  - Prune files, keep only what you need
- **Performance Analysis**
  - MemTraq memory leak detection and usage analysis
  - System and application profiling
  - Tracing

Visual assembly

- **Platform Image Builder:**
  - Initially created to assemble binary RPMs
  - Front-end to image optimization tools:
    - Pre-linking
    - Library optimization
    - Strip objects
  - Create target file-systems
  - Visual representation of dependencies
  - Search tool in package metadata



Select Packages

Group: All

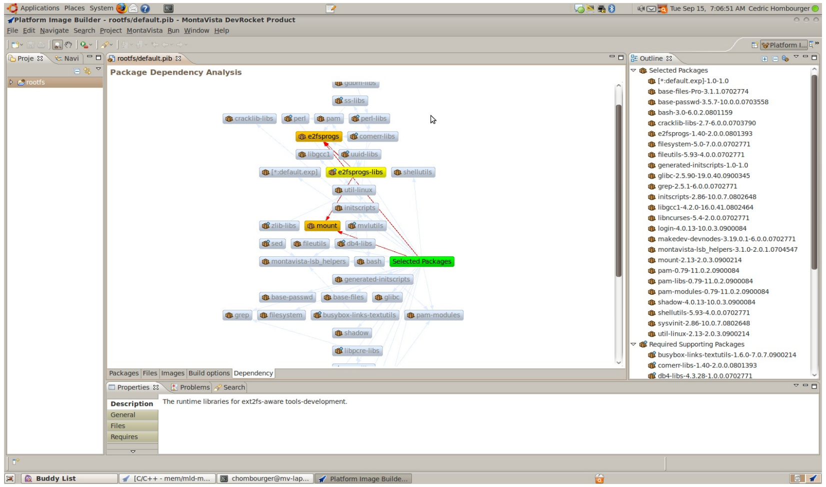
☐ Disable Dependency Resolution

Package Name	Package Version	Package Path
☐ adduser	3.57-2.0.1.0702771	/home/mvl/pro5/montavista/pro/devkit/arm/v5t_le/packages/pro
☐ adduser-debuginfo	3.57-2.0.1.0702771	/home/mvl/pro5/montavista/pro/devkit/arm/v5t_le/packages/pro
☐ alsa-utils	1.0.11-2.0.0.0702771	/home/mvl/pro5/montavista/pro/devkit/arm/v5t_le/packages/pro
☐ alsa-utils-debuginfo	1.0.11-2.0.0.0702771	/home/mvl/pro5/montavista/pro/devkit/arm/v5t_le/packages/pro
☐ anacron	2.3-9.0.0.0702771	/home/mvl/pro5/montavista/pro/devkit/arm/v5t_le/packages/pro
☐ anacron-debuginfo	2.3-9.0.0.0702771	/home/mvl/pro5/montavista/pro/devkit/arm/v5t_le/packages/pro
☐ apache	2.2.3-3.0.0.0702771	/home/mvl/pro5/montavista/pro/devkit/arm/v5t_le/packages/pro/old
☐ apache	2.2.3-5.0.2.0900019	/home/mvl/pro5/montavista/pro/devkit/arm/v5t_le/packages/pro
☐ apache-bench	2.2.3-3.0.0.0702771	/home/mvl/pro5/montavista/pro/devkit/arm/v5t_le/packages/pro/old
☐ apache-bench	2.2.3-5.0.2.0900019	/home/mvl/pro5/montavista/pro/devkit/arm/v5t_le/packages/pro
☐ apache-debuginfo	2.2.3-5.0.2.0900019	/home/mvl/pro5/montavista/pro/devkit/arm/v5t_le/packages/pro
☐ apache-debuginfo	2.2.3-3.0.0.0702771	/home/mvl/pro5/montavista/pro/devkit/arm/v5t_le/packages/pro/old
☐ apache-dev	2.2.3-3.0.0.0702771	/home/mvl/pro5/montavista/pro/devkit/arm/v5t_le/packages/pro/old
☐ apache-dev	2.2.3-5.0.2.0900019	/home/mvl/pro5/montavista/pro/devkit/arm/v5t_le/packages/pro
☐ apache-html_manual	2.2.3-5.0.2.0900019	/home/mvl/pro5/montavista/pro/devkit/arm/v5t_le/packages/pro
☐ apache-html_manual	2.2.3-3.0.0.0702771	/home/mvl/pro5/montavista/pro/devkit/arm/v5t_le/packages/pro
☐ apt-rpm	0.5.15lorg3.2-9.0.0.070277	/home/mvl/pro5/montavista/pro/devkit/arm/v5t_le/packages/pro/old
☐ apt-rpm	0.5.15lorg3.2-9.0.5.080191	/home/mvl/pro5/montavista/pro/devkit/arm/v5t_le/packages/pro
☐ apt-rpm-config	2.0-1.0.0.0703308	/home/mvl/pro5/montavista/pro/devkit/arm/v5t_le/packages/pro
☐ apt-rpm-config	1.0-2.0.0.0702774	/home/mvl/pro5/montavista/pro/devkit/arm/v5t_le/packages/pro/old
☐ apt-rpm-debuginfo	0.5.15lorg3.2-9.0.5.080191	/home/mvl/pro5/montavista/pro/devkit/arm/v5t_le/packages/pro
☐ apt-rpm-debuginfo	0.5.15lorg3.2-9.0.0.070277	/home/mvl/pro5/montavista/pro/devkit/arm/v5t_le/packages/pro/old
☐ apt-rpm-dev	0.5.15lorg3.2-9.0.0.070277	/home/mvl/pro5/montavista/pro/devkit/arm/v5t_le/packages/pro/old
☐ apt-rpm-dev	0.5.15lorg3.2-9.0.5.080191	/home/mvl/pro5/montavista/pro/devkit/arm/v5t_le/packages/pro

Selected Packages
- [*:default.exp]-1.0-1.0
- base-files-Pro-3.1.1.0702774
- base-passwd-3.5.7-10.0.0.0703558
- bash-3.0-6.0.2.0801159
- cracklib-libs-2.7-6.0.0.0703790
- e2fsprogs-1.40-2.0.0.0801393
- filesystem-5.0-7.0.0.0702771
- fileutils-5.93-4.0.0.0702771
- generated-initscripts-1.0-1.0
- glibc-2.5.90-19.0.40.0900345
- grep-2.5.1-6.0.0.0702771
- initscripts-2.86-10.0.7.0802648
- libgcc1-4.2.0-16.0.41.0802464
- libncurses-5.4-2.0.0.0702771
- login-4.0.13-10.0.3.0900084
- makedev-devnodes-3.19.0.1-6.0.0.0702771
- montavista-lsb_helpers-3.1.0-2.0.1.0704547
- mount-2.13-2.0.3.0900214
- pam-0.79-11.0.2.0900084
- pam-libs-0.79-11.0.2.0900084
- pam-modules-0.79-11.0.2.0900084
- shadow-4.0.13-10.0.3.0900084
- shellutils-5.93-4.0.0.0702771
- sysvinit-2.86-10.0.7.0802648
- util-linux-2.13-2.0.3.0900214

Required Supporting Packages
- busybox-links-textutils-1.6.0-7.0.7.0900214
- comerr-libs-1.40-2.0.0.0801393
- db4-libs-4.3.28-1.0.0.0702771

Description: Add and remove users and groups to resp. from the system. This package includes the adduser and deluser commands for creating and removing users. Adding users with adduser is much easier than adding them by hand. Adduser will choose appropriate UID and GID values, create a home directory, copy skeletal user



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- grep-2.5.1-6.0.0.0702771
- initscripts-2.86-10.0.7.0802648
- libgcc1-4.2.0-16.0.41.0802464
- libncurses-5.4-2.0.0.0702771
- login-4.0.13-10.0.3.0900084
- makedev-devnodes-3.19.0.1-6.0.0.0702771
- montavista-lsb_helpers-3.1.0-2.0.1.0704547
- mount-2.13-2.0.3.0900214
- pam-0.79-11.0.2.0900084
- pam-libs-0.79-11.0.2.0900084
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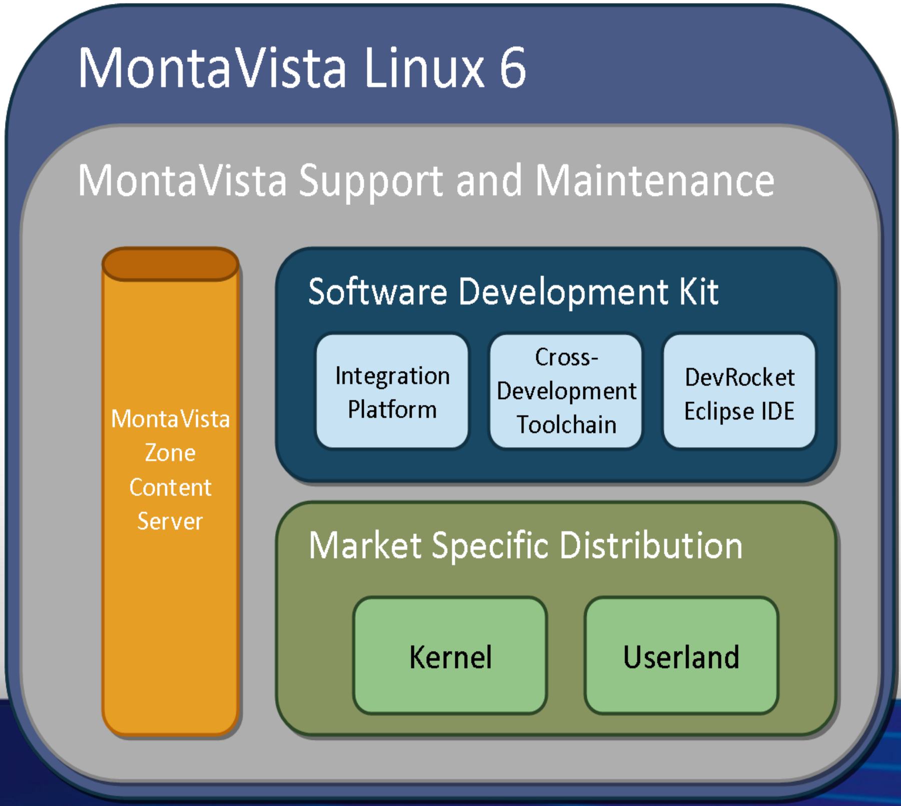
Description: The runtime libraries for ext2fs-aware tools-development.

Conclusion



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MV Misc. contributions to OE

- Option to use git patchtool mechanism by setting PATCHTOOL=git => now honors the permission information
- Fixes for cross-compilation issues (e.g. setting of NM for libtool-cross)
- Improve recipe sanity checks
- Improved error reporting
- Many bug fixes (e.g. report an error in cases where a missing rdepend for a package did not cause a failure in do_rootfs task)
- …

Regular commits to OE git tree

BitBake-based MVIP Features – Summarized

1. Based on open source standard
2. Always original source + patches
3. Comply with applicable open source licenses
4. Build your entire product line with one tool
5. Structure customizations with collections
6. Build compatible with thousands of community packages
7. Complements and integrates with existing SCM system
8. Commercially supported and maintained

Thank you!

Q & A
and/or
Feedback on your OE experience