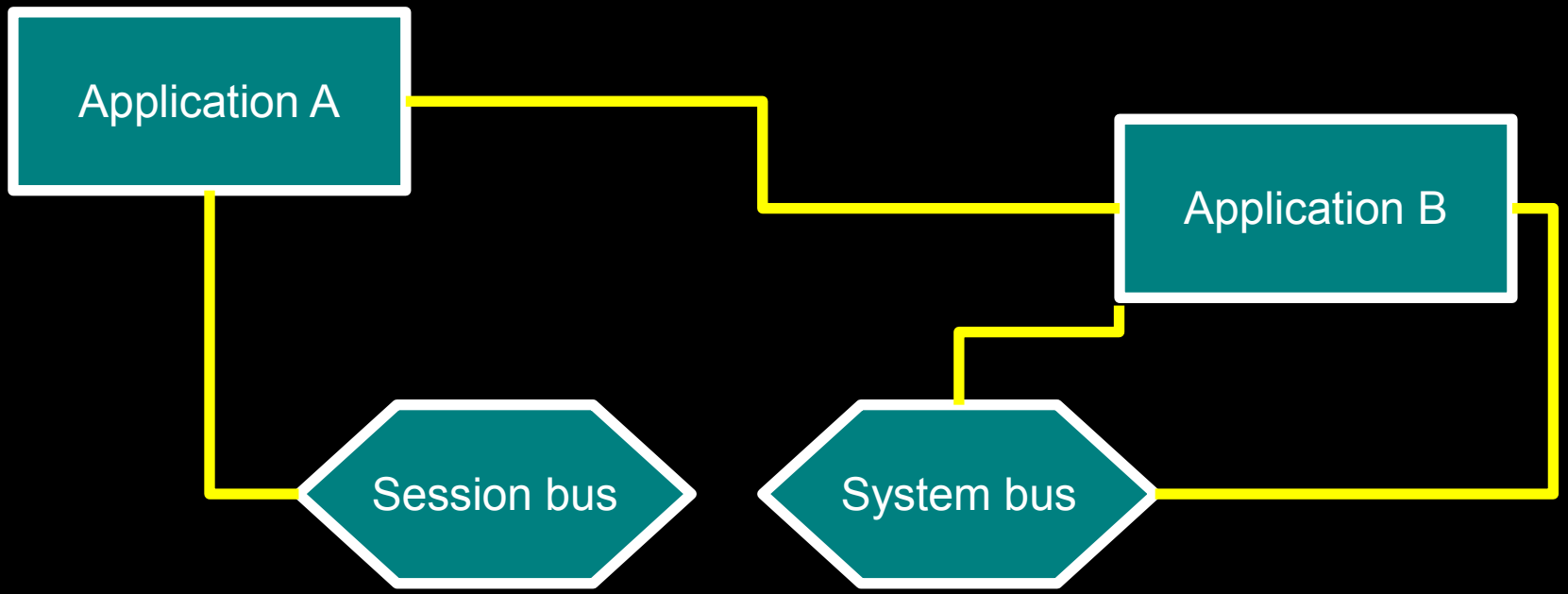
How managed is your D-Bus?

Alp Toker

What is D-Bus?

D-Bus is an inter-process communication framework that lets applications interface with the system event bus as well as allowing them to talk to one another in a peer-to-peer configuration.



What is managed D-Bus?

- A clean-room MIT/X11 implementation of the D-Bus protocol in C# providing full integration with the CLR/.NET type system
- Runs on the Mono and Microsoft Common Language Runtime platforms
- Provides seamless, high-performance access to/from D-Bus using any of several programming languages including C#, IronPython, Boo, VB, Nemerle...

And..?

- Used by over a dozen GNOME applications – everything from single instance detection to complex instant messaging tasks and object componentry
- Managed D-Bus was the first independent implementation of D-Bus, and has encouraged other platform developers who wish to avoid the reference implementation
- Aims to provide a compelling alternative to libdbus

Managed D-Bus features

- Direct mapping to/from C# interfaces and types
- Support for D-Bus structs using C# structures
- Support for typed D-Bus dictionaries using C# generics
- Mapping to/from D-Bus signals to C# events
- Mapping to/from D-Bus errors/CLR exceptions
- Good performance thanks to dynamically compiled optimised marshalers
- Full thread-safety and concurrent messaging support
- Portable: truly build-once run-anywhere

Licensing: Getting it right

libdbus, reference implementation

GPL + AFL = loss

dbus-java, ruby-dbus

LGPL, very reasonable

Managed D-Bus

MIT X11 = win

GLib integration

- Managed D-Bus encourages single-threaded asynchronous messaging where possible
- ndesk-dbus-glib is a simple package that integrates ndesk-dbus with the GLib main loop
- Has its own release cycle and integration with other main loops is possible without modification of the core managed D-Bus library
- Popular with Gtk# applications
- Should not be used in headless apps

Example: Hooking up to HAL

- HAL has a notoriously bad D-Bus API
- We will use it as an example anyway

Defining a D-Bus interface: Hal.Device

```
/* an Interface attribute is applied to mark the D-Bus interface name */
[Interface ("org.freedesktop.Hal.Device")]
public interface Device
{
        /* event definitions map to D-Bus signals */
        event PropertyModifiedHandler PropertyModified;

        /* properties and method calls map to D-Bus calls */
        /* the D-Bus type system is capable of representing generic dictionaries */
        IDictionary<string, object> AllProperties { get; }

        /* further methods and signals omitted for brevity */
}
```

In this example we are only going to import the interface, but exporting it would simply be a matter of implementing the interface in any given class and Register()ing it with the bus.

...and necessary structures and delegates

```
/* D-Bus supports arbitrary structures */
public struct PropertyModification
{
	public string Key;
	public bool Added;
	public bool Removed;
}

public delegate void PropertyModifiedHandler (int modificationsLength,
                                              PropertyModification[] modifications);
```

Bringing it all together: Using HAL

```
/* request a proxy object for the device manager from the system message bus */
Manager mgr = Bus.System.GetObject<Manager> ("org.freedesktop.Hal",
                        new ObjectPath ("/org/freedesktop/Hal/Manager"));

/* enumerate all devices */
foreach (Device dev in mgr.AllDevices) {
        /* print the path of the object  */
        Console.WriteLine (dev.ToString ());

        /* hook up to the PropertyModified signal of the device */
        dev.PropertyModified += delegate (int modificationsLength,
                                PropertyModification[] modifications) {
                /* when properties are modified, print the changes */
                Console.WriteLine ("Properties changed on device {0}:", dev);

                foreach (PropertyModification modification in modifications)
                        Console.WriteLine (modification.Key);
        };
}
```

D-Bus XML Introspection

- Managed D-Bus generates XML introspection data dynamically on demand from ordinary C#/.NET interfaces

```
        <!DOCTYPE node PUBLIC "-//freedesktop//DTD D-BUS Object
Introspection 1.0//EN"

"http://www.freedesktop.org/standards/dbus/1.0/introspect.dtd">
        <node name="/org/freedesktop/sample_object">
          <interface name="org.freedesktop.SampleInterface">
            <method name="Frobate">
              <arg name="foo" type="i" direction="in"/>
              <arg name="bar" type="s" direction="out"/>
              <arg name="baz" type="a{us}" direction="out"/>
              <annotation name="org.freedesktop.DBus.Deprecated"
value="true"/>
            </method>
            <method name="Bazify">
              <arg name="bar" type="(iiu)" direction="in"/>
```

D-Bus: The protocol

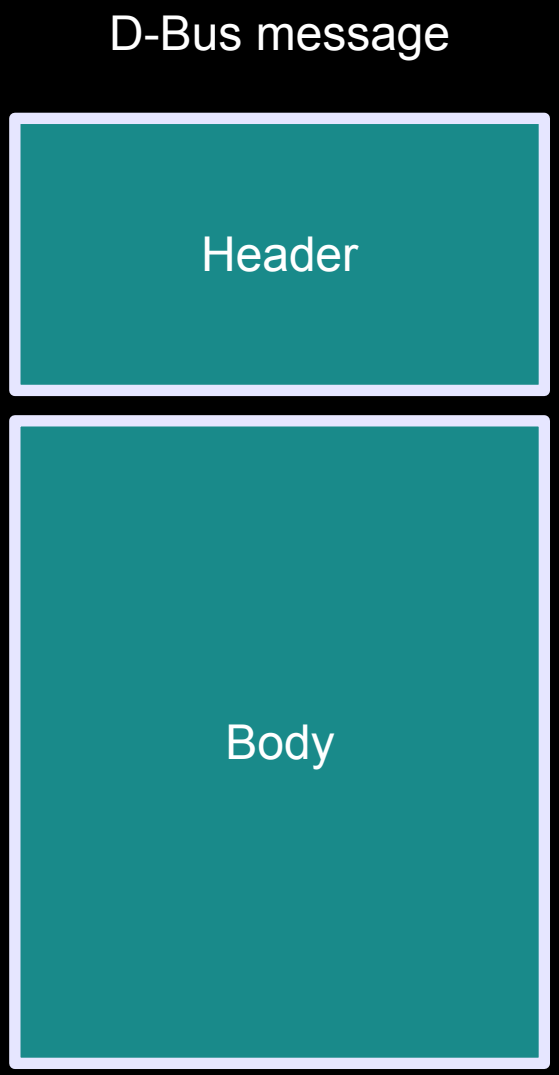
- Binary protocol
- Support for big/little endian messages
- Lies between raw sockets and CORBA in terms of complexity
- Less complex/featured than SOAP and WCF
- More featureful than eg. XML RPC

Conventional Name	Code	Description
BYTE	121 (ASCII 'y')	8-bit unsigned integer
BOOLEAN	98 (ASCII 'b')	Boolean value, 0 is FALSE and 1 is TRUE. Everything else is invalid.
INT16	110 (ASCII 'n')	16-bit signed integer
UINT16	113 (ASCII 'q')	1 eger
INT32	105 (ASCII 'i')	signed
UINT32	117 (ASCII 'u')	2-bit unsigned i
INT64	120 (ASCII 'x')	64-bit signed int
UINT64	116 (ASCII 't')	64-bit unsi r
DOUBLE	100 (ASCII 'd')	IEEE 7
STRING	115 (ASCII 's')	UTF- *must* be valid UTF-8). Must be nul terminated and conta her nul bytes.
OBJECT_PATH	111 (ASCII 'o')	Name of an object instance
SIGNATURE	103 (ASCII 'g')	A typ ure
ARRAY	97 (ASCII 'a')	Array
STRUCT	114 (ASCII 'r'), 40 (ASCII '('), 41 (ASCII ')')	Struct
VARIANT	118 (ASCII 'v')	Variant type (the type of the value is part of the value itself)
DICT_ENTRY	101 (ASCII 'e'), 123 (ASCII '{'), 125 (ASCII '}')	Entry in a dict or map (array of key-value pairs)

Single precision floating point

- **A managed D-Bus protocol extension**
- Type code 'f'
- 32-bit single precision floating point
- Defined by IEEE 754
- Essential for supporting the full range of types in modern execution environments
- Now supported by **dbus-java**, upcoming support in **dbus-ruby**, **dbus-python** and probably other implementations

Talking D-Bus



IronPython and the DLR

- IronPython is an Open Source implementation of Python targeting the CLR
- Predecessor to the Dynamic Language Runtime
- Managed D-Bus can support these platforms
- Can dynamically introspect remote interfaces and construct local proxies for them, much like dbus-python

Legacy-free, API/ABI stable

- Modern, clean API based around the final D-Bus terminology
- No concept of a “service” in D-Bus 1.0 – our API is free of this term
- Very few entry points, all with well-defined behaviour
- The low-level D-Bus API is internal ie. not available in the public API

Hindsight is 20/20

- Learning from previous attempts
  - *Joe Shaw*'s original dbus-sharp binding
    - A good start, but became unmaintained
    - Memory management issues and lack of features (structures, dictionaries etc.)
  - *Adam Lofts*' dbus-sharp (part of the Chatter IM client)
    - Closer to a modern dbus-sharp API; Showed that you don't have to expose low-level API to have a usable binding
    - Still suffered from some memory management issues and lack of features

Distributions and packaging

- Shipping with **Ubuntu** Feisty as part of 'main'
- Sebastian Dröge created and continues to maintain the **Debian**/Ubuntu packages libndesk-dbus1.0-cil and libndesk-dbus-glib1.0-cil
- Going into **SLED/OpenSUSE**
- Going into **Fedora**
- **Gentoo** ebuild available

Part of the future GNOME mobile/embedded platform?

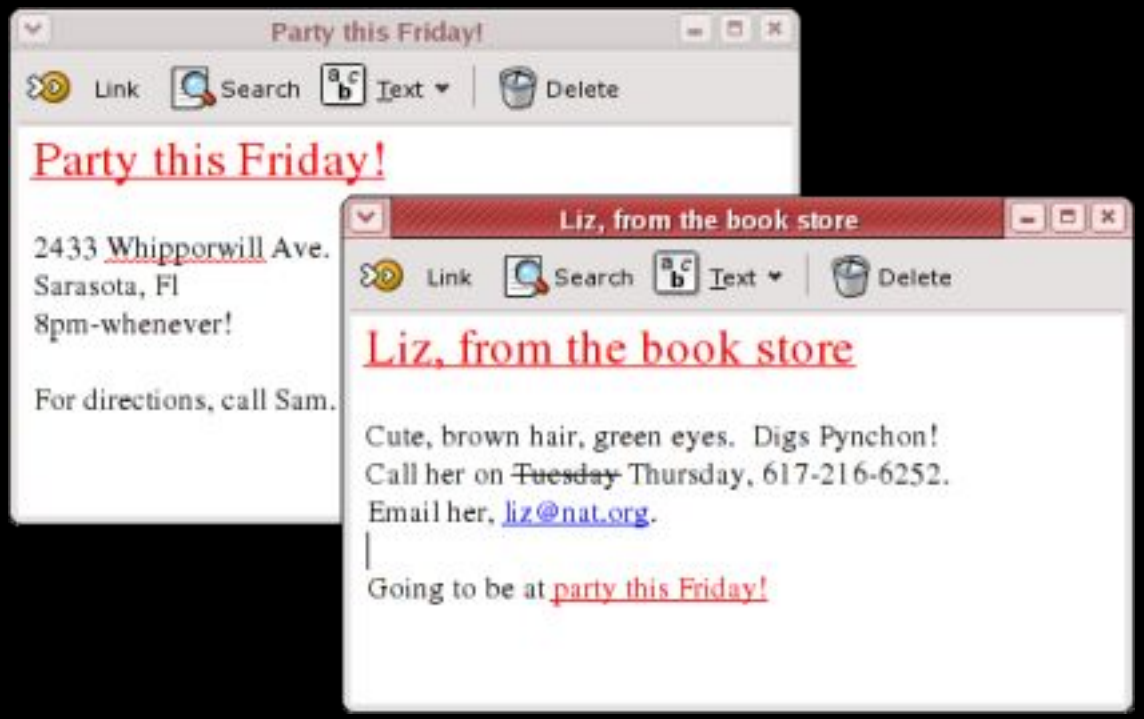
- Works well on eg. the Nokia 770/N800
- Independent of the version of libdbus installed on the device (which has been out of pace with desktop versions in the past)
- High performance thanks to the Mono ARM JIT
- Build on the desktop, run on the device: **No cross-compilation**

GNOME: It's all about the applications

- Infrastructure code like IPC should just work: application developers are not expected to have expertise in this area.
- Infrastructure code is easy and boring... let's take a look at some *applications*

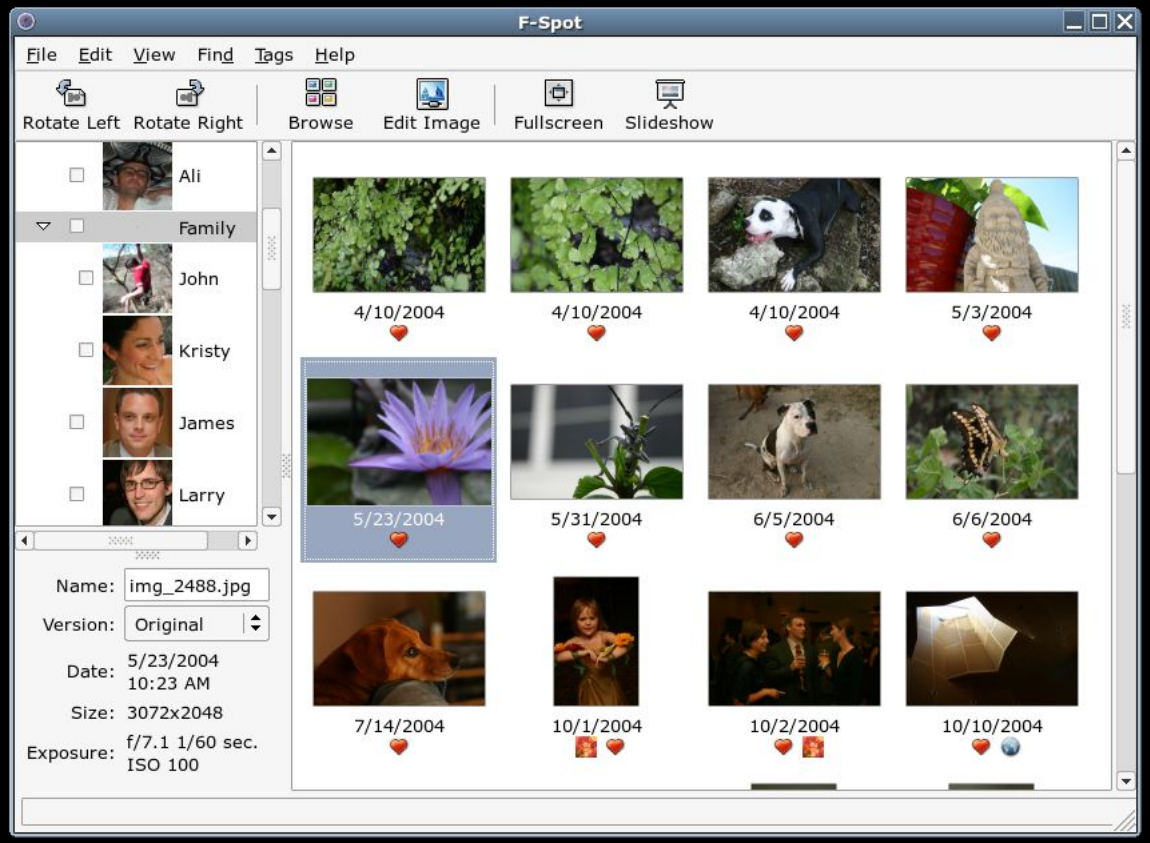
Users of managed D-Bus: Tomboy

Uses D-Bus for single instance detection, shell remote control and more recently for note synchronisation with Conduit



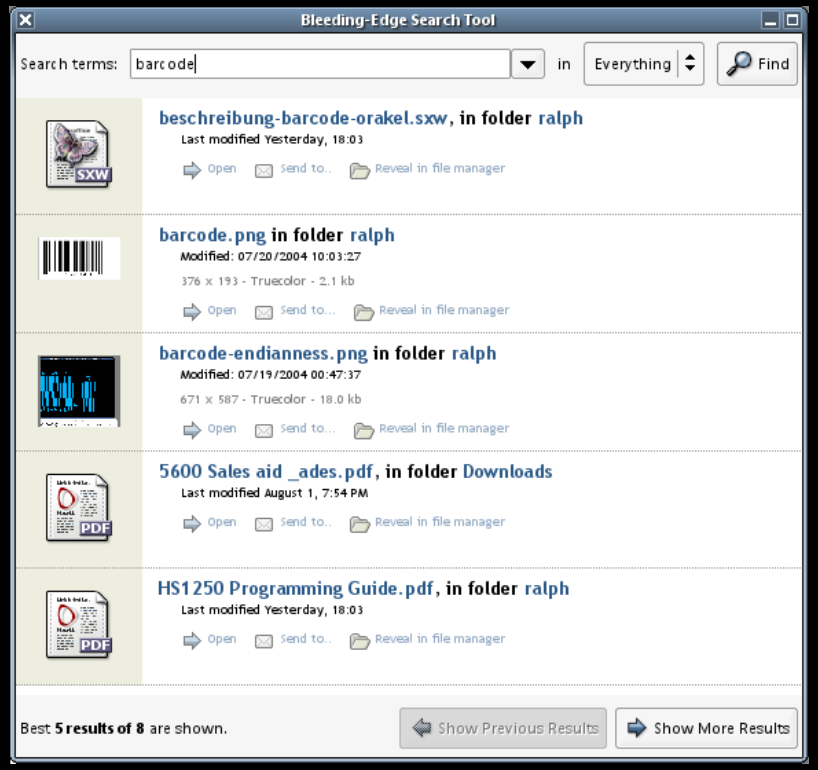
Users of managed D-Bus: F-Spot

Uses D-Bus for single instance detection, shell remote control. There is current interest in exposing more of F-Spot's database to the desktop.



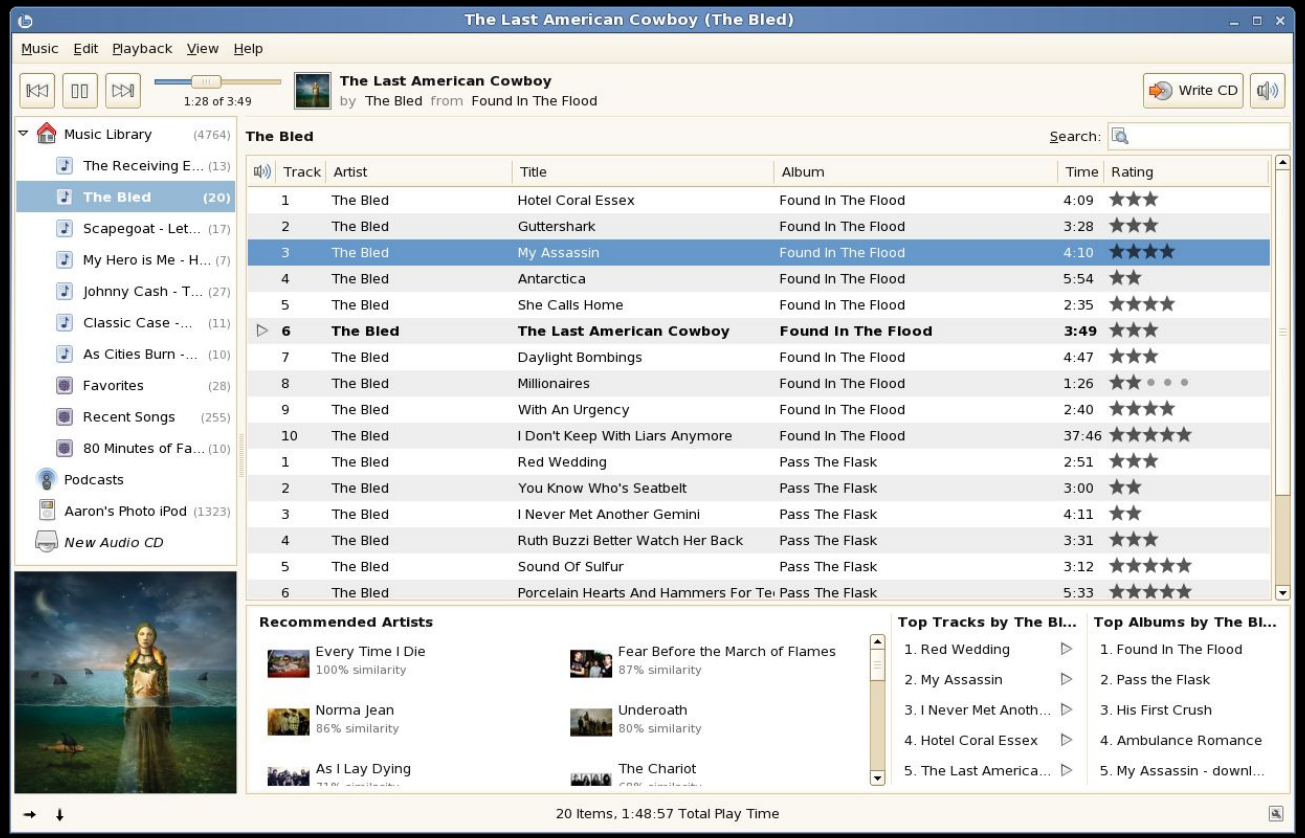
Users of managed D-Bus: Beagle/Xesam

Beagle is working towards supporting the Xesam search specification using managed D-Bus, enabling interoperability between different desktop search systems and user interfaces.

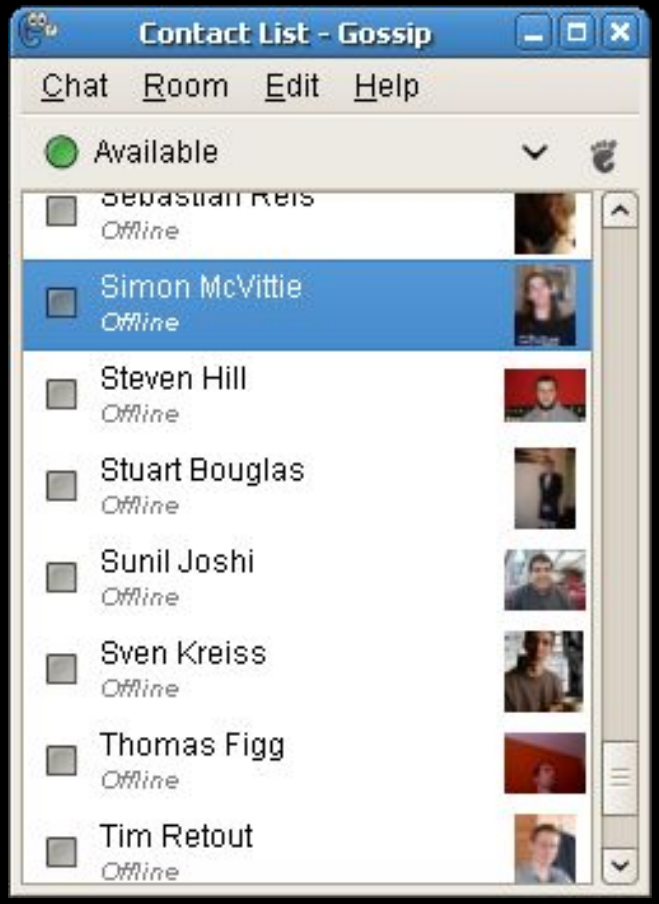


Complex users of managed D-Bus: Banshee

Aaron Bockover's next-generation Banshee backend exposes its media collection framework to the desktop over D-Bus as a re-usable component



Complex users of managed D-Bus: Telepathy



Facebook connection manager using Mono.Facebook

Telepathy-based IM clients and connection managers have proved to be the acid test for completeness of the binding

Complex users of managed D-Bus: Banter

- Telepathy-based
- Uses telepathy-sharp
- The first application to make heavy use of managed D-Bus thread safety and concurrency features

Applications and bindings (1)

- **telepathy-sharp**
- **Tapioca** VoIP and IM application development framework (tapioca-sharp)
- **Landell** VoIP and IM client using Gtk#
- Gnome **NetworkManager** binding
- Gnome **Power Manager** binding
- **Banshee** provides and uses a media player API, and uses Gnome Power Manager, Gnome NetworkManager, Helix, notify-sharp, org.gnome.SettingsDaemon
- **Helix D-Bus** for remote control of the media stream
- **hal-sharp** is provides access to HAL, the Hardware Abstraction Layer
- **NotifySharp** provides a client implementation for Desktop Notifications and works as a libnotify client replacement
- **F-Spot** personal photo management application, for single-instance detection [1]
- **Tomboy** simple note taking application, for remote control and single-instance detection
- **dcsharp** file sharing client using the Direct Connect protocol, for notifications, single instance and remote control
- **LAT** LDAP Administration Tool
- **VMX Manager**, Virtual Machine Manager), GNOME SVN

Applications and bindings (2)

- **NewStuffManager**, a plugin update/download service
- **last-exit**, a music player for Last.fm
- **Muine**, a music player for GNOME
- **The Fuzz**, process security manager with GUI
- **GShare**, file sharing utility
- **Chatter** (Telepathy GnomeUI) VoIP and IM client using Gtk#
- Babuine **TimeTracker**
- **gnome-keyring-sharp** GNOME Keyring implementation, to get the keyring socket address
- Novell **eIDconfig-belgium** configuration toolkit for the Belgian eID middleware
- **PodSleuth** iPod model information discovery/export tool, using hal-sharp
- Novell **Banter** collaboration client (Telepathy)
- **circ** IRC client
- **Beagle** xesam-adapter desktop search API
- **Many more?**

Get managed D-Bus!

http://www.ndesk.org/DBusSharp

IRC: #managed-dbus / GIMPNet

Managed D-Bus
stable, fast, fun to use