A Taste of Fresco

Mark Linton
Silicon Graphics

linton@sgi.com

Tutorial Outline

- Introduction (20%)
- Object system (20%)
- Resolution-independence (15%)
- Graphical embedding (40%)
- Interoperability with other toolkits (5%)
- Script interpreter (5%)
- Conclusions

Introduction

- What is Fresco?
- What new technology is in Fresco?
- What GUI(s) will Fresco provide?
- How does Fresco relate to
  Xlib? Xt? Motif? InterViews? ...?
- Will Fresco run on
  MS-Windows? MacOS?
- When will Fresco be publicly available?

What is Fresco?

- User interface system
- Broad spectrum infrastructure
  - Graphics <–> Widgets <-> Embedded apps
- API covers Xlib, Xt functionality
  - + Structured graphics
  - + Application embedding
- X Consortium standards effort
- Specification, sample implementation

What is the new technology?

- Standard object model
  - Natural C++ usage
- Distributed objects
- MT-aware (supports concurrency)
- Resolution-independence
- Graphical embedding

Standard object model

- *OMG's CORBA*
- *IDL for defining object interfaces*
- *Choice of implementation languages*
- *Object references instead of pointers*
- *Address space/network transparency*

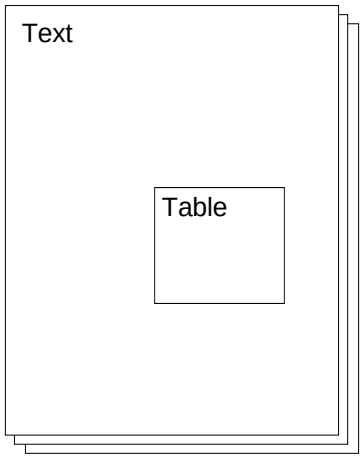
Resolution independence

- *Floating-point coordinates*
- *Stencil/paint drawing operations*
- *Printing (generation of PostScript)*
- *Device-independent graphics state*

Graphical embedding

- *Natural blend of structured graphics and application embedding*
- *Embedded objects may be*
  - *Arbitrary shape (with holes)*
  - *Graphically transformed*
  - *Drawn in 3D*
- *Advance over*
  - *ATK, NextStep, OLE 2.0, OpenDoc*

Embedding example



Why graphical embedding?

- *Allow natural, 3D appearance*
- *Composition in 2D or 3D scenes:*
  - *Editing rotated text in drawing*
  - *Touching up image in virtual gallery*
  - *Setting 3D clock in virtual room*
  - *City buildings in fly-through browser*
- *Simpler, broader architecture*

How does it work?

- *From structured graphics:*
  - *Damage-based update traversal*
  - *Shared state during traversal*
- *From application embedding:*
  - *Input handling, focus, translations*
  - *Menubar and/or palette sharing*
- *From both:*
  - *Attribute propagation*
  - *Transcription*

Distributed embedding

- *Fresco viewers can be remote objects "inside" a window*
- *Applications become objects*
- *User composes objects*
- *Objects may be implemented in different address spaces or on different machines*

What GUI(s) will Fresco provide?

- *Fresco architecture can support multiple GUIs*
- *Fresco 1.0 spec will not include a GUI*
- *Future version will probably specify Motif and/or Chicago*
- *Fresco 1.0 sample implementation will include some Motif-ish widgets*

How does Fresco relate to

- *Xlib*
  - *Replaces all but low-level functionality*
  - *Adds resolution-independence*
  - *Sample implementation uses Xlib*
- *Xt*
  - *Replaces most if not all functionality*
  - *Adds structured graphics, embedding*
  - *Provides gateways for interoperability*
    - *Fresco in XtViewer*
    - *XtWidget in Fresco*

How does Fresco relate to

- *Motif*
  - *Allows re-implementation of widgets for graphical embedding*
  - *Interoperability at Xt level*
- *InterViews*
  - *Replaces object model*
  - *Evolves glyphs, structured graphics*
  - *Adds embedding*

Will Fresco run on

- *Any X platform – Yes*
- *MS-Windows 3.1 – Probably not*
- *MS-Windows Chicago – Maybe*
- *MS-Windows NT – Probably*
- *MacOS – Probably not*
- *DOS - No way*

When will Fresco be available?

- *Core part of X11R6*
  - *General release April/May/June*
- *Prereleases available to*
  - *X Consortium members*
  - *Others on an individual basis*
    - *(Contact me personally)*
- *Vendor releases?*
  - *Probably not until ’95*

Status

- Spec defines about 40 interfaces
- Implementation has about 150 classes
- Library is about 20,000 lines of C++
- Separate redisplay thread
- Custom IDL-to-C++ translator (Ix)
- Current focus is transcription

Fresco Summary

- Advanced technology
  - Graphical embedding
  - Distributed objects
- Open standards effort (honest!)
- 1.0 spec, implementation for R6

Object system

- *Defining object interfaces*
- *Transparent object references*
- *Ix – Interface translator*

IDL: Interface Definition Language

- *Defined by CORBA*
- *More abstract than C++*
  (no implementation details)
- *Can be bound to C, C++, ...*
- *Supports distribution*
  (can't use inherently local constructs)

IDL example

```
interface Window {
   void map();
   void unmap();
   boolean is_mapped();
   void raise();
   void lower();
};
```


C++ binding

Typedefs, structs, enums, constants

Interfaces –> abstract classes

Operations –> virtual functions

Attributes –> set/get function pairs

Exceptions –> exceptions or extra param

C++ example

```
class Window : public BaseObject {
protected:
   Window();
   virtual ~Window();
public:
   virtual void map();
   virtual void unmap();
   virtual Boolean is_mapped();

   virtual void raise();
   virtual void lower();
};
```


Parameter passing

IDL defines **in**, **out**, **inout**

- *in – pass value*
- *out – return value*
- *inout – pass and return value*

For C++

- *in – copy or const ref*
- *out – ref*
- *inout – ref*
- *return - value*

Object references

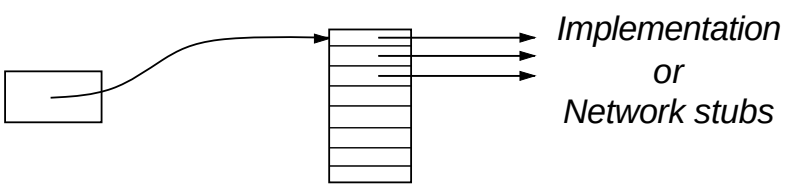
- *Like pointers, but (potentially) across address spaces*
- *Interface type is always reference*
  void set_transient(in Window w)
  –> void set_transient(WindowRef w);
- *ORB tracks object location*
- *All operations are virtual function calls*
  vtbl points to implementation or stubs

Transparency

- *Local or remote machine*
- *Direct memory access or inter-process communication*

	Local	*Remote*
Memory	*Function call*	*Page over network*
IPC	*Context switch*	*Network message*

Transparent object references



Ix: Sample interface translator

- *Generates*
  - *C++ or C header declarations*
  - *Client, server stubs*
  - *Dynamic type information*
- *Filters implementations*
- *Not full IDL*
  - *(contexts, bound sequences)*
- *Usage encapsulated in Imake macros*
  - *MakeHeader, EditImplHeader, EditImpl*

Generating a header file

- *Runs cpp to process #include's*
- *Use -i option to generate #include's*
- *Write out file.h, mark read-only*

```
MakeHeaderFlags(display,-i '<Fresco/drawing.h>')
```


Example: Interfaces/screen.idl

```
interface ScreenObj {
  attribute Coord dpi;

  DisplayObj display();

  Coord width();
  Coord height();

  PixelCoord to_pixels(in Coord c);
  Coord to_coord(in PixelCoord c);
  Coord to_pixels_coord(in Coord c);

  void move_pointer(in Coord x, in Coord y);
  Window application(in Viewer v);
  Window top_level(in Viewer v, in Window group);
  Window transient(in Viewer v, in Window trans);
  Window popup(in Viewer v);
  Window icon(in Viewer v);
};
```

Generated screen.h

```
/* DO NOT EDIT – Automatically generated ... */

#ifndef Interfaces_screen_h
#define Interfaces_screen_h

#include <Fresco/enter-scope.h>
#include <Fresco/drawing.h>
#include <Fresco/types.h>

class ScreenObj : public FrescoObject {
protected:
   ScreenObj();
   virtual ~ScreenObj();
public:
   virtual void dpi(Coord);
   virtual Coord dpi();
   virtual DisplayObjRef display();
   virtual Coord width();
   virtual Coord height();
```


class ScreenObj (cont'd)

```
   virtual PixelCoord to_pixels(Coord c);
   virtual Coord to_coord(PixelCoord p);
   virtual Coord to_pixels_coord(Coord c);
   virtual void move_pointer(Coord x, Coord y);
   virtual WindowRef application(Viewer* v);
   virtual WindowRef top_level(
      Viewer* v, Window* group
   );
   virtual WindowRef transient(
      Viewer* v, Window* trans
   );
   virtual WindowRef popup(Viewer* v);
   virtual WindowRef icon(Viewer* v);
   virtual TypeObjId _tid();

   static ScreenObjRef _narrow(BaseObject*);
   static ScreenObjRef _duplicate(ScreenObj*);
};
```

Defining an implementation

- *Subclass from generated class or from another implementation class*
- *Edit subclass source with ix -filter*
  - *EditImplHeader(Xdisplay,$(I)/display.idl)*
  - *EditImpl(Xdisplay,$(I)/display.idl $(I)/viewer.idl)*

Use annotations to specify filtering

```
//+ Interface::Operation
//+ Interface::Attribute[=?]
//+ Subclass(Interface::Operation)
//+ Subclass(Interface::Attribute[=?])
//+ Interface::%init,type,type+dii,stubs, type-stubs
//+
//+ Interface::%client,server
//+
//+ Subclass : Interface
//+
```

ScreenObj example

```
class ScreenImpl : public ScreenObj {
public:
    ScreenImpl(Fresco*, DisplayImpl*, long n);
    ~ScreenImpl();

    //+ ScreenObj::*
    /* FrescoObject */
    Long ref__(Long references);
        ...
    /* ScreenObj */
    void dpi(Coord);
    Coord dpi();
    DisplayObjRef display();
    Coord width();
    Coord height();
    PixelCoord to_pixels(Coord c);
    Coord to_coord(PixelCoord p);
    Coord to_pixels_coord(Coord c);
        ...
    //+
```


ScreenObj example (cont'd)

```
protected:
    SharedFrescoObjectImpl object_;
    Fresco* fresco_;
    DisplayImpl* display_;
    long number_;
    XWindow root_;
    ScreenVisualList* visuals_;
    ScreenImpl::VisualInfo* default_visual_;
        ...
};
```

Xdisplay.cxx

```
#include <Fresco/display.h>
#include <Fresco/drawing.h>
  ...
//+ ScreenImpl(ScreenObj::dpi=c)
void ScreenImpl::dpi(Coord c) {
  if (!Math::equal(c, float(0), float(1e-4))) {
    pixels_ = 72.0 / c;
    points_ = 1 / pixels_;
}

//+ ScreenImpl(ScreenObj::dpi?)
Coord ScreenImpl::dpi() {
  return 72.0 / pixels_;
}

//+ ScreenImpl(ScreenObj::application)
WindowRef ScreenImpl::application(Viewer* v) {
  return new ApplicationWindow(display_, this, v);
}
```


Stubs

```
//+ ScreenObj::%init,type+dii,client
ScreenObj::ScreenObj() { }
ScreenObj::~ScreenObj() { }

TypeObj_OpData _XfScreenObj_methods_[] = {
  { “_set_dpi”, &_Xfvoid_type_, 1 },
  { “_get_dpi”, &_XfCoord_type_, 0 },
  ...
};
TypeObj_Descriptor _XfScreenObj_type_ = {
  /* type */ 0, &_XfScreenObj_tid_, “ScreenObj”,
  _XfScreenObj_parents, /* excepts */ nil,
  _XfScreenObj_methods, _XfScreenObj_params_,
  &_XfScreenObj_receive
};
```

Stubs (cont'd)

```
MarshalBuffer::ArgDesc
  _XfScreenObj_move_pointer_pdesc[4] = {
    3, 4, 37, 37
};
MarshalBuffer::ArgInfo
  _XfScreenObj_move_pointer_pinfo = {
    &_XfScreenObj_tid_, 8,
    _XfScreenObj_move_pointer_pdesc, 0
};

void ScreenObj::move_pointer(Coord x, Coord y) {
  MarshalBuffer _b;
  extern TypeObjId _XfScreenObj_tid_;
  MarshalBuffer::ArgValue _arg[3];
  _arg[1].u_float = x;
  _arg[2].u_float = y;
  _b.invoke(
    this, _XfScreenObj_move_pointer_pinfo, _arg
  );
}
```


Creating objects

- *Constructors are global functions*
  - *Specify implementation class*
  - *Imply address space*
  - *Inappropriate for interfaces*
- *Can use operation on another object*
- *Kits create certain kinds of objects*
  - *Widgets, figures, layout*
- *Fresco accesses other kits*
- *Global function to access Fresco*

Example: Hello, world

```
#include <Fresco/drawing.h>
#include <Fresco/figures.h>
#include <Fresco/fresco.h>

int main(int argc, char** argv) {
   Fresco* f = Fresco_open("test", argc, argv);
   FigureKitRef figures = f->figure_kit();
   f->main(
      nil, figures->label(
         figures->default_style(),
         Fresco::string_ref("Hello, world")
      )
   );
   Fresco::unref(f);
   return 0;
}
```


Object system summary

- *IDL for interfaces*
  - *No data members, inlines*
  - *No overloading, templates, const member functions*
- *C++ for implementations*
  - *Parameters are abstract*
- *Create objects with kits*
- *Cleaner, more extensible design*
- *Allow distibution, multiple languages*

Resolution independence

Coordinates and vertices

Regions

Display management

Drawing and printing

Coordinates

```
enum Axis { X_axis, Y_axis, Z_axis };
typedef float Coord;
typedef long PixelCoord;
struct Vertex { Coord x, y, z; };
typedef float Alignment;
```

Transformations

Objects assume real-world units (inch, mm, pt, ...)

Units may be scaled by parent

Relative coordinates – object-defined

Absolute coordinates – fully-transformed

Regions

Describe an arbitrary shape with origin

May be only bounding box

May be full solid geometry

Region interface

```
interface Region {
   struct BoundingSpan {
      Coord begin, end;
      Coord origin, length;
      Alignment align;
   };
   boolean contains(in Vertex v);
   boolean contains_plane(in Vertex v, in Axis a);
   boolean intersects(in Region r);
   void copy(in Region r);
   void merge_intersect(in Region r);
   void merge_union(in Region r);
   void subtract(in Region r);
   void transform(in TransformObj t);
   void bounds(out Vertex lower, out Vertex upper);
   void origin(out Vertex v);
   void span(in Axis a, out Region::BoundingSpan s);
};
```


Display management

DisplayObj – keyboard/mouse/screens

ScreenObj – output area

Window – opaque portion of screen

WindowStyle – customizable information

Drawing and Printing

- *Brush – line width and pattern*
- *Color – maps to device RGB*
- *Font – character shapes*
- *Raster – bitmaps and images*
- *PainterObj – 2d stencil/paint operations*
- *DrawingKit – create paint objects*

Drawing Kit interface

```
interface DrawingKit {
  typedef sequence<long> Data;

  StyleObj style();

  Brush simple_brush(in Coord width);
  Brush dither_brush(in Coord width, in long pattern);
  Brush patterned_brush(
    in Coord width, in DrawingKit::Data pattern
  );

  Color color_rgb(
    in Color::Intensity r, in Color::Intensity g,
    in Color::Intensity b
  );
  Color find_color(in StringObj name);

  Font find_font(in StringObj fullname);
  Font find_font_match(
    in StringObj family, in StringObj style,
    in Coord ptsize
  );
```

DrawingKit interface (cont'd)

```
  Raster bitmap_file(in StringObj filename);
  Raster bitmap_data(
    in DrawingKit::Data data,
    in Raster::Index rows, in Raster::Index columns,
    in Raster::Index origin_row,
    in Raster::Index origin_column
  );
  Raster bitmap_char(in Font f, in CharCode c);

  TransformObj identity_transform();
  TransformObj transform(in TransformObj::Matrix m);

  PainterObj printer(in StringObj output);
};
```


PainterObj interface

```
interface PainterObj {
  Coord to_coord(in PixelCoord p);
  PixelCoord to_pixels(in Coord c);
  Coord to_pixels_coord(in Coord c);

  void begin_path();
  void move_to(in Coord x, in Coord y);
  void line_to(in Coord x, in Coord y);
  void curve_to(
    in Coord x, in Coord y, in Coord x1, in Coord y1,
    in Coord x2, in Coord y2
  );
  void close_path();

  attribute Brush brush_attr;
  attribute Color color_attr;
  attribute Font font_attr;

  void fill();
  void stroke();
```

Painter interface (cont'd)

```
  void character(
    in Font f, in CharCode ch, in Coord width,
    in Coord x, in Coord y
  );
  void image(in Raster r, in Coord x, in Coord y);
  void stencil(in Raster r, in Coord x, in Coord y);

  attribute TransformObj matrix;
  void push_matrix();
  void pop_matrix();
  void transform(in TransformObj t);
  void clip(
    in Coord x0, in Coord y0, in Coord x1, in Coord y1
  );
  void push_clipping();
  void pop_clipping();
  boolean is_visible(in Region r);

  void comment(in StringObj s);
  void page_number(in StringObj s);
};
```


Example: Bevelled rectangle

```
void Beveler::fill_path(
  PainterObjRef p, Vertex* v, long n
) {
  p->begin_path();
  p->move_to(v[0].x, v[0].y);
  for (long i = 1; i < n; i++) {
    p->line_to(v[i].x, v[i].y);
  }
  p->close_path();
  p->fill();
}
```

Example (cont'd)

```
// Bevelled rectangle
Coord left_inside = left + thickness;
Vertex v[10];
/* left edge */
set_color(p, light);
v[0].x = left; v[0].y = bottom;
v[1].x = left; v[1].y = top;
v[2].x = left_inside; v[2].y = top;
v[3].x = left_inside; v[3].y = bottom;
fill_path(p, v, 4);
```


Summary

Coordinate units

Regions, vertices

DisplayObj, ScreenObj, Window

Drawing and printing

Brush
Color
Cursor
DisplayObj
DrawingKit
Font
PainterObj
Raster
Region
ScreenObj
TransformObj
Window
WindowStyle

Graphical embedding

- *Natural blend of*
  - *structured graphics and*
  - *application embedding*
- *Embed a UI application object in*
  - *a graphical scene*
- *Scene may involve*
  - *Arbitrary shapes (including holes)*
  - *Graphical rotatation or zooming*
  - *3D*

Structured graphics

- *Graphical objects*
  - *Shapes, properties, transforms*
  - *Overlays, transparency*
  - *Double-buffering*
  - *Sharing instances*
- *Draw, pick, bounding box*
- *Grouping into composites*
- *Attribute propagation*
- *Transcription – save to file*

Application Embedding

- *Graphical output*
- *Geometry management*
- *Input handling*
- *Attribute propagation*
- *Focus management*
- *Menubar, palette sharing*
- *Transcription – save to a file*

Common framework

- **Viewer** – *user interface to data*
  - *Subtype of structured graphics object*
  - *Input handling, focus management*
  - *Menubar, palette sharing*
- **Glyph** – *graphical output*
  - *Geometry management*
  - *Screen update with instancing*
- **Style** – *attribute propagation*

Advantages of common framework

- *Simplicity – fewer overall concepts*
- *Scalability – span range of granularity*
- *Interoperability – mix and match*
- *Flexibility – 3d friendly*
- *Power – editing rotated text in drawing*

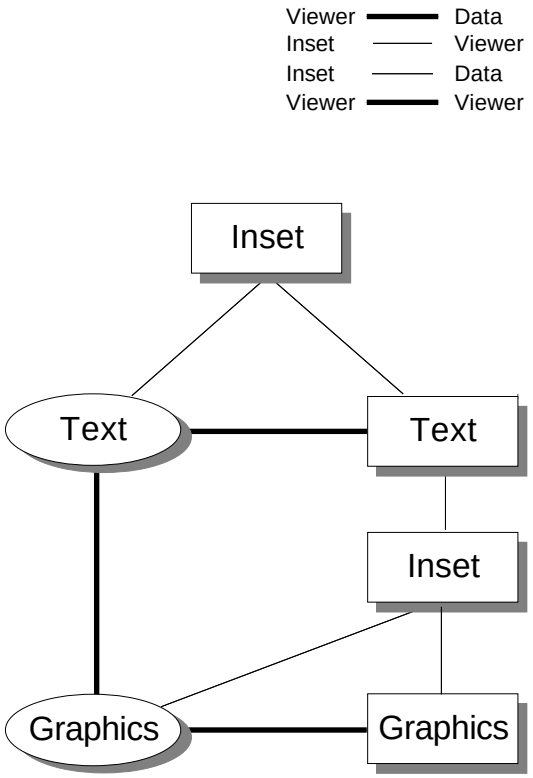
Viewers - UI to data

- *Present and possibly edit*
- *Like ATK views, OLE edit-in-place, Xt widgets (with extensions)*
- *Wide range of sizes and functionality*
  - *Button, Hypertext link, Field editor*
  - *Movie order form, Table editor*
  - *Image viewer, Drawing editor, Builder*
  - *Word processor*
  - *Interactive encyclopedia*

Viewer hierarchy

- *Viewer children correspond to embedded data*
- *Embedded “inset” contains data and default viewer information*
- *“Main” viewer at root implements focus, sharing menubars, palettes*

Inset example



Viewer interface

```
interface Viewer : Glyph {
  Viewer parent_viewer();
  Viewer next_viewer();
  Viewer prev_viewer();
  Viewer first_viewer();
  Viewer last_viewer();

  void insert_next_viewer(in Viewer v);
  void insert_prev_viewer(in Viewer v);
  void insert_first_viewer(in Viewer v);
  void insert_last_viewer(in Viewer v);
  void link_next(in Viewer v);
  void link_prev(in Viewer v);
  void remove();
  void insertion(in Viewer v);
  void removal(in Viewer v);
```


Viewer interface (cont'd)

```
  Focus request_focus(
    in Viewer v, in boolean temporary
  );
  boolean receive_focus(
    in Focus f, in boolean primary
  );
  void lose_focus(in boolean temporary);
  boolean first_focus();
  boolean last_focus();
  boolean next_focus();
  boolean prev_focus();

  boolean handle(in GlyphTraversal t, in Event e);
  void close();
};
```

Focus interface

```
interface Focus : FrescoObject {
  void add_focus_interest(in Viewer v);
  void receive_focus_below(
    in Viewer v, in boolean temporary
  );
  void lose_focus_below(
    in Viewer v, in boolean temporary
  );
  void map_keystroke(
    in Event::KeySym k, in Action a
  );
  void map_keychord(
    in Event::KeyChord k, in Action a
  );
};
```


Implementation classes

#include <Fresco/Impls/viewers.h>

ViewerImpl

- implements hierarchy, input operations
  - move, press, drag, release,
  - double_click, other

ActiveViewer

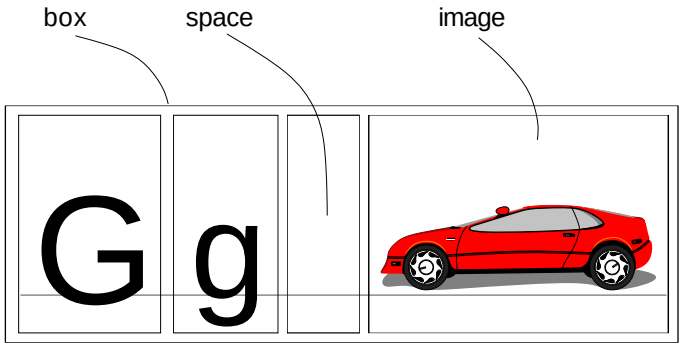
- enter, leave

MainViewer

- implements focus, damage

Glyphs - objects that draw

Think of a glyph as a character



Glyph composition

- *Directed acyclic graph (dag)*
- *Glyphs are nodes*
- *GlyphOffsets are edges*
- *Offset implementations knows about parent implementation*
- *GlyphTraversal*
  - *Shared state during a traversal*
  - *Path (“trail”) from root to current node*

Glyph interface

```
interface Glyph : FrescoObject {
  struct Requirement {
    boolean defined;
    Coord natural, maximum, minimum;
    Alignment alignment;
  };
  struct Requisition {
    Requirement x, y, z;
    boolean preserve_aspect;
  };
  struct AllocationInfo {
    Region allocation;
    TransformObj transform;
    DamageObj damage;
  };
  typedef sequence<AllocationInfo> AllocationInfoList;

  attribute StyleObj style;
  TransformObj transform();
```


Glyph interface (cont'd)

```
  void request(out Glyph::Requisition r);
  void extension(
    in Glyph::AllocationInfo a, in Region r
  );
  void shape(in Region r);

  void traverse(in GlyphTraversal t);
  void draw(in GlyphTraversal t);
  void pick(in GlyphTraversal t);

  attribute Glyph body;

  GlyphOffset append(in Glyph g);
  GlyphOffset prepend(in Glyph g);

  Tag add_parent(in GlyphOffset parent_offset);
  void remove_parent(in Tag add_tag);

  void visit_children(in GlyphVisitor v);
  void visit_children_reversed(in GlyphVisitor v);
  void visit_parents(in GlyphVisitor v);
```

Glyph interface (cont'd.)

```
    // screen update
    void allocations(out Glyph::AllocationInfoList a);
    void need_redraw();
    void need_redraw_region(in Region r);
    void need_resize();
};
```


Geometry management

Requisition - what a glyph wants

- *Requirement per axis*
- *Returned by Glyph::request*

Allocation - region a glyph gets

- *BoundingSpan per axis*
- *Passed as part of GlyphTraversal*

Extension - bounds of glyph output

- *Computed by Glyph::extension*
- *Useful for update, culling*

Offsets

```
interface GlyphOffset : FrescoObject {
  Glyph parent();
  Glyph child();
  void allocations(out Glyph::AllocationInfoList a);
  GlyphOffset insert(in Glyph g);
  void replace(in Glyph g);
  void remove();
  void notify();
};
```


Traversals

```
enum Operation {
  draw, pick_top, pick_any, pick_all, other
};

Operation op();
Operation swap_op(in Operation op);

void begin_trail(in Viewer v);
void end_trail();

void traverse_child(
  in GlyphOffset o, in Region allocation
);
void visit();

GlyphTraversal trail();
Viewer current_viewer();
Glyph current_glyph();
GlyphOffset offset();
void forward();
void backward();
```

Traversals (cont'd)

```
  attribute PainterObj painter;
  DisplayObj display();
  ScreenObj screen();

  Region allocation();
  boolean bounds(
    out Vertex lower, out Vertex upper, out Vertex origin
  );
  boolean origin(out Vertex origin);
  boolean span(in Axis a, out Region::BoundingSpan s);

  DamageObj damage();

  void hit();
  attribute long hit_info;
  GlyphTraversal picked();
  void clear();
};
```


Glyphs are lightweight

- *Simple set of operations*
- *No required base class storage*
- *Pass context during traversal*
- *Can be shared*

Of course, they may be heavyweight

Screen update

- *need_redraw*
  - *Damage all allocations for glyph*
- *need_resize*
  - *Damage old/new allocations for glyph*
- *Root object is drawn to repair damage*
- *Output is clipped to damage*
- *Objects may check if they are visible*
  - *If not then avoid drawing children*

Advantages

- *Objects can share area*
  - *e.g., a label on top of an image*
- *Output may be double-buffered*
  - *Supports smooth interaction, animation*
  - *Sample implementation uses pixmaps*
- *Objects control granularity of update*
  - *Cheap objects just draw*

Attribute management

- *Separate for independent use*
- *Loosely-coupled to structured graphics*
- *Tightly-coupled to embedding*
- *FrescoObject – observability, notification*
- *Action – callbacks*
- *StyleObj – inherited name-value pairs*
- *StyleValue – associated value*

StyleObj interface

```
interface StyleObj : FrescoObject {
  attribute StringObj name;
  void alias(in StringObj s);

  StyleObj new_style();
  StyleObj parent_style();
  void link_parent(in StyleObj parent);
  void unlink_parent();
  Tag link_child(in StyleObj child);
  void unlink_child(in Tag link_tag);
  void merge(in StyleObj s);
```

StyleObj interface (cont'd)

```
    boolean is_on(in StringObj name);
    StyleValue bind(in StringObj name);
    StyleValue resolve(in StringObj name);
    void unbind(in StringObj name);

    void visit_aliases(in StyleVisitor v);
    void visit_attributes(in StyleVisitor v);
    void visit_children(in StyleVisitor v);

    void lock();
    void unlock();
};
```


StyleValue interface

```
interface StyleValue : FrescoObject {
    StringObj name();
    boolean uninitialized();
    attribute long priority;

    boolean is_on();
    boolean read_boolean(out boolean b);
    void write_boolean(in boolean b);

    boolean read_string(out StringObj s);
    void write_string(in StringObj s);

    boolean read_coord(out Coord c);
    void write_coord(in Coord c);

    boolean read_value(out FrescoObject v);
    void write_value(in FrescoObject v);

    void lock();
    void unlock();
};
```

FrescoObject

```
// reference counting

// observability
Tag attach(in FrescoObject observer);
void detach(in Tag attach_tag);
void disconnect();

// notication
void notify_observers();
void update();
```


Callbacks

```
interface Action {
   void execute();
   boolean reversible();
   void unexecute();
};
```

Example

```
#include <Fresco/figures.h>
#include <Fresco/fresco.h>
#include <Fresco/layouts.h>
#include <Fresco/widgets.h>
#include <Fresco/Impls/action.h>
#include <stdio.h>

class App {
public:
  App() { }
  ~App() { }

  int main(int argc, char** argv);
private:
  void push_me();
};

declareActionCallback(App)
implementActionCallback(App)

void App::push_me() { printf("pushed\n"); }
```


Example (cont'd)

```
int main(int argc, char** argv) {
  App a;
  return a.main(argc, argv);
}

int App::main(int argc, char** argv) {
  Fresco* f = Fresco_open("Test", argc, argv);
  FigureKitRef figures = f->figure_kit();
  WidgetKit widgets = f->widget_kit();
  LayoutKitRef layouts = f->layout_kit();
  ButtonRef b = widgets->push_button(
    figures->label(
      figures->default_style(),
      Fresco::string_ref("Push me")
    ),
    new ActionCallback(App)(this, &App::push_me)
  );
  f->main(b, layouts->margin(b, 10.0));
  return 0;
}
```

Graphical embedding summary

- Unify structured graphics and embedding
- Glyphs
  - Graphics, layout, lightweight,
  - Shared, damage-based update
- Viewers
  - User interface to data
  - Input handling and focus management
  - Menubar, palette sharing
- Distributed embedding “for free”

Interfaces

- Action
- Adjustment
- DamageObj
- Event
- Focus
- Glyph
- GlyphOffset
- GlyphTraversal
- GlyphVisitor
- StyleObj
- StyleValue
- StyleVisitor
- Viewer

Interoperability with other toolkits

- *Structured graphics may be used inside another toolkit*
- *Viewers may be implemented with X subwindows, use Xlib drawing*
- *Partial functionality – embedding without full graphics support*
- *Gateway objects to/from Xt*

XtfviewerWidgetClass example

```
#include <Fresco/Impls/XtIntrinsic.h>
#include <Fresco/Impls/Xdefs.h>
#include <X11/StringDefs.h>
  ...
#include <Fresco/Impls/Xundefs.h>
#include <Fresco/figures.h>
#include <Fresco/layouts.h>
#include <Fresco/Impls/XtfFresco.h>
#include <Fresco/Impls/XtfViewer.h>

static void exit_callback(Widget, XtPointer, XtPointer) {
  exit(0);
}

int main(int argc, char** argv) {
  XtToolkitInitialize();
  XtAppContext app = XtCreateApplicationContext();
  XDisplay* xdisplay = XtOpenDisplay(
    app, NULL, “xtcircle”, “XtCircle”, NULL, 0,
    &argc, argv
  );
```

Xtf example (cont'd)

```
Arg arglist[2];
XtSetArg(arglist[0], XtNallowShellResize, FALSE);
Widget toplevel = XtAppCreateShell(
  "XtTest", NULL, applicationShellWidgetClass,
  xdisplay, arglist, 1
);

Widget paned = XtCreateManagedWidget(
  "paned", panedWidgetClass, toplevel, NULL, 0
);
Widget buttons = XtCreateManagedWidget(
  "buttons", panedWidgetClass, paned, NULL, 0
);
Widget quit_button = XtCreateManagedWidget(
  "quit", commandWidgetClass, buttons, NULL, 0
);

XtfFresco* f = XtfFresco_init(
  app, xdisplay, "XtTest", argc, argv
);
```


Xtf example (cont'd)

```
  FigureKitRef figures = f->figure_kit();
  GlyphRef g = figures->figure_root(
    figures->circle(
      FigureKit::fill, figures->default_style(),
      0.0, 0.0, 100.0
    )
  );

  Widget fw = XtCreateManagedWidget(
    "circle", XtfviewerWidgetClass, paned, nil, 0
  );
  f->init_widget_glyph(fw, g);

  XtRealizeWidget(toplevel);
  XtMapWidget(fw);
  XtAppMainLoop(app);
  Fresco::unref(f);
  return 0;
}
```

Script interpretation

- *CORBA Dynamic invocation*
- *Tcl scripting language*
- *Dish interpreter*

CORBA Dynamic invocation

- *Create request object*
- *Fill in operation name (as a string)*
- *Fill in parameters*
- *Call invoke on request*
- *Examine result*

Tcl scripting language

- *Shell-like: cmd args ...*
- *Everything is a string*
- *Variables (set, $var)*
- *Procedures, if, for, while*
- *Nested function calls*
- *Commands may be compiled functions*

Dish: Dynamic invocation shell

- *Standard Tcl interpreter*
- *Interactive or batch script*
- *Fresco class operations builtin*
- *Unknown cmd uses dynamic invocation to convert parameters, invoke method, and convert back results (including out parameters)*
- *Tcl command registry is automatic*

Example: Hello, world

```
main 0 [
   figure_kit label [figure_kit default_style] “Hello, world”
]
```

Another example: circle

```
set style [figure_kit default_style]
main 0 [
   figure_kit figure_root [
      figure_kit circle 0 style 0 0 100
   ]
]
```


Button example

```
   proc push_me {message} {
      puts $message
      flush stdout
   }

   set button {
      widget_kit push_button [
         figure_kit label [figure_kit default_style] “Push me”]
[
         action push_me “pushed”
      ]
   ]

   main button [layout_kit margin button 10.0]
```

Conclusions

- *Fresco is a new user interface system*
- *Broad spectrum of functionality*
- *Technology advances:*
  - *Graphical embedding*
  - *CORBA-based*
  - *Scripting access is automatic*
  - *Multithreading*
- *Working toward X Consortium standard*
  - *Sample implementation on R6*

What to do now?

- *XCI member:*
  - *Get current snapshot*
  - *Send feedback to mailing list*
- *Non-member:*
  - *Join XCI, or*
  - *Contact me*

What's after Fresco 1.0?

- *Media viewers – Text, Image, ...*
- *Standard widget set*
- *Time Elasticity (Pacers)*
- *...*