# More on User Interface

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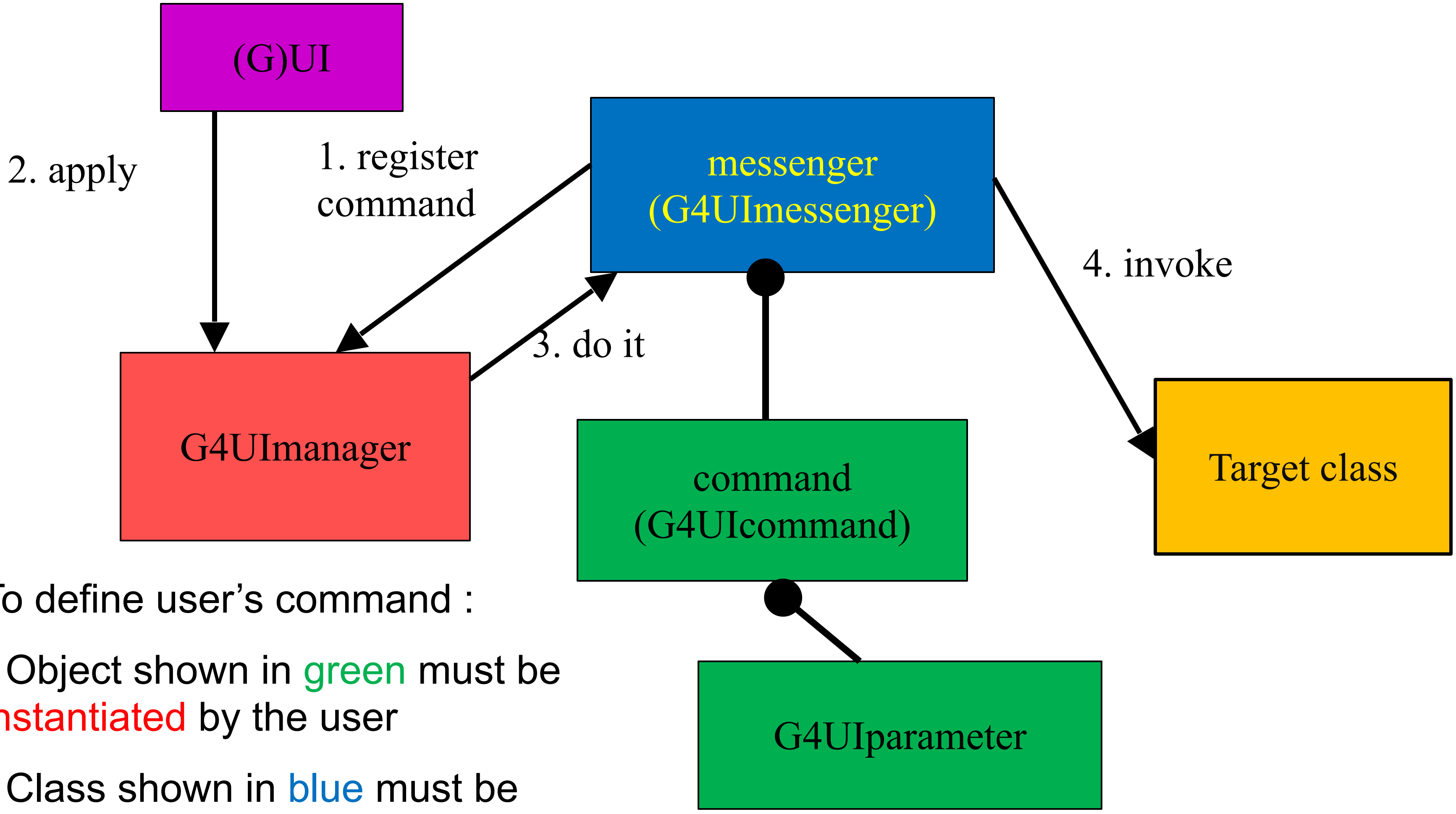
# Mechanism of UI command

# Mechanism of UI command




To define user's command :

- Object shown in green must be instantiated by the user

- Class shown in blue must be implemented and instantiated by the user

# Messenger class

- Each messenger class must be derived from G4UImessenger base class. A messenger class can handle more than one UI commands.
- A messenger class should be instantiated by the constructor of the target class to which commands should be delivered, and should be deleted by the destructor of the target class.
- Methods of messenger class
  - ***Constructor***
    - Define (instantiate) commands / command directories
  - ***Destructor***
    - Delete commands / command directories
  - ***void SetNewValue(G4UIcommand* command, G4String newValue)***
    - Convert "newValue" parameter string to appropriate value(s) and invoke an appropriate method of the target class
    - This method is invoked when a command is issued.
  - ***G4String GetCurrentValue(G4UIcommand* command)***
    - Access to an appropriate get-method of the target class and convert the current value(s) to a string
    - This method is invoked when the current value(s) of parameter(s) of a command is asked by (G)UI.

## Defining basic UI command

# Definition (instantiation) of a command

- To be implemented in the constructor of a messenger class.

```
::A01DetectorConstMessenger
(A01DetectorConstruction* tgt)
:target(tgt)
{
  fMydetDir = new G4UIdirectory("/mydet/");
  fMydetDir->SetGuidance("A01 detector setup commands.");

  fArmCmd = new G4UIcmdWithADoubleAndUnit("/mydet/armAngle",
       this);
  fArmCmd->SetGuidance("Rotation angle of the second arm.");
  fArmCmd->SetParameterName("angle",true);
  fA01DetectorConstMessengerArmCmd->SetRange("angle>=0. && angle<180.");
  fArmCmd->SetDefaultValue(30.);
  fArmCmd->SetDefaultUnit("deg");
}
```

- Guidance can (should) be more than one lines. The first line is utilized as a short description of the command.

# G4UIcommand and its derivatives

- G4UIcommand is a class which represent a UI command. G4UIparameter represents a parameter.
- G4UIcommand can be directly used for a UI command. Geant4 provides its derivatives according to the types of associating parameters. These derivative command classes already have necessary parameter class object(s), thus you don’t have to instantiate G4UIparameter object(s).
  - G4UIcmdWithoutParameter
  - G4UIcmdWithAString
  - G4UIcmdWithABool
  - G4UIcmdWithAnInteger
  - G4UIcmdWithADouble, G4UIcmdWithADoubleAndUnit
  - G4UIcmdWith3Vector, G4UIcmdWith3VectorAndUnit
  - G4UIdirectory
- A UI command with other type of parameters must be defined by G4UIcommand base class with G4UIparameter.

# Parameter name(s)

- These methods are available for derivative command classes which take parameter(s).

  ***void SetParameterName(***
      ***const char*parName,***
      ***G4bool omittable,***
      ***G4bool currentAsDefault=false);***

  ***void SetParameterName(***
      ***const char*namX, const char*namY, const char*namZ,***
      ***G4bool omittable,***
      ***G4bool currentAsDefault=false);***

- Parameter names are used in help, and also in the definition of parameter range.
- If "omittable" is true, the command can be issued without this particular parameter, and the default value will be used.
- If "currentAsDefault" is true, current value of the parameter is used as a default value, otherwise default value must be defined with SetDefaultValue() method.

# Range, unit and candidates

**void SetRange(const char* rangeString)**

- Available for a command with numeric-type parameters.
- Range of parameter(s) must be given in C++ syntax.
  **aCmd->SetRange("x>0. && y>z && z<(x+y)");**
- Not only comparison with hard-coded number but also comparison between variables and simple calculation are available.
- Names of variables must be defined by SetParameterName() method.

**void SetDefaultUnit(const char* defUnit)**

**void SetUnitCategory(const char* unitCategory)**

- Available for a command which takes unit.
- Once the default unit is defined, no other unit of different dimension will be accepted.
- Alternatively, you can define a dimension (unit category) without setting a default unit.

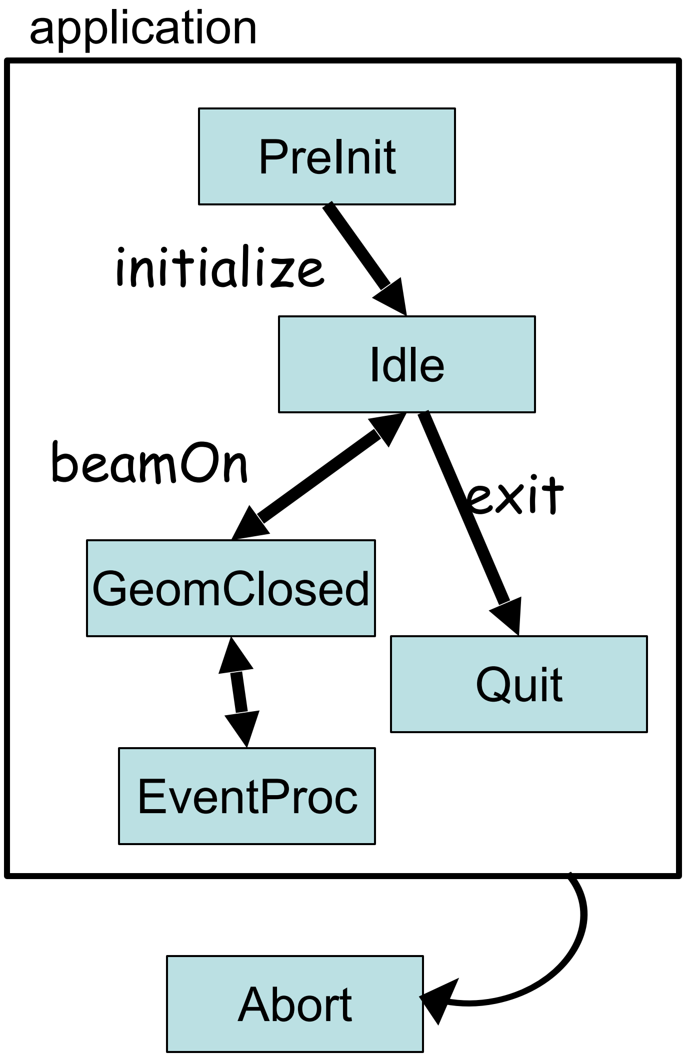
**void SetCandidates(const char* candidateList)**

- Available for a command with string type parameter
- Candidates must be delimited by a space.
- Candidates can be dynamically updated.

# Available state

**void AvailableForStates(G4ApplicationState s1,…)**

- Define command's applicability for Geant4 states.
- Geant4 has six application states.
  - G4State_PreInit
  - G4State_Idle
  - G4State_GeomClosed
  - G4State_EventProc
  - (G4State_Quit, G4State_Abort)



# Conversion between string and values

- Derivatives of G4UIcommand with numeric and boolean parameters have corresponding conversion methods.
- From a string to value

  **G4bool GetNewBoolValue(const char*)**

  **G4int GetNewIntValue(const char*)**

  **G4double GetNewDoubleValue(const char*)**

  **G4ThreeVector GetNew3VectorValue(const char*)**

  - To be used in SetNewValue() method in messenger.
  - Unit is taken into account automatically.
- From value to string

  **G4String ConvertToString(...)**

  **G4String ConvertToString(...,const char* unit)**

  - To be used in GetCurrentValue() method in messenger.

# SetNewValue and GetCurrentValue

```
void A01DetectorConstMessenger
::SetNewValue(G4UIcommand* command,G4String newValue)
{
  if( command==fArmCmd )
  { target->SetArmAngle(fArmCmd->GetNewDoubleValue(newValue)); }
}

G4String A01DetectorConstMessenger
::GetCurrentValue(G4UIcommand* command)
{
  G4String cv;
  if( command==fArmCmd ) {
    cv = fArmCmd->ConvertToString(target->GetArmAngle(),"deg");
  }
  return cv;
}
```

# Complex commands

# Complex commands

- Complicated UI command means a UI command with parameters which is not included in the deliverable classes
- Eg. a command which requires two different parameters:

  /path/my_command parA parB

- Such a command can be defined by G4UIcommand class with G4UIparameter.

```
myCmd = new G4UIcommand("/path/my_command", this);
myCmd->SetGuidance("My command with two parameters");

G4UIparameter* parA = new G4UIparameter("parA", 'i', false);
myCmd->SetParameter(parA);
G4UIparameter* parB = new G4UIparameter("parB", 'd', false);
myCmd->SetParameter(parB);
```

# G4GenericMessenger

# G4GenericMessenger

- Since Geant4 9.6 release it is possible to define UI commands using G4GenericMessenger class without a need of implementing your own messenger classed
- The commands can be created in four ways
  - Using G4GenericMessenger::DeclareProperty() / G4GenericMessenger::DeclarePropertyWithUnit()
    - Which associates the command with a class data member (of G4int, G4double, G4String or G4ThreeVector type)
  - Using G4GenericMessenger::DeclareMethod() / G4GenericMessenger::DeclareMethodWithUnit()
    - Which associates the command with a class member function

# Use of Generic Messenger (1/2)

*To define a command associated with a class data member*

MyRunAction.hh

```
class MyRunAction :
        G4UserRunAction
{
  public:
     MyEventAction();
     ~MyEventAction();

   private:
     G4GenericMessenger* fMessenger;
     G4bool  fSaveData;
};
```

MyRunAction.cc

```
MyUserAction::MyRunAction
  : G4UserRunAction(), fMessenger(0)
 {
   fMessenger
     = new G4GenericMessenger(
                    this, "/myRun/", "My run control");

   // Define /myRun/setSaveDatacommand
   G4GenericMessenger::Command& setSaveDataCmd
     = fMessenger
         ->DeclareProperty("setSaveData",
                fSaveData,
                "(In)Activate saving data");

    setSaveDataCmd. SetStates(G4State_Idle);
};
```

# Use of Generic Messenger (2/2)

*To define a command associated with a class member function*

MyDetectorConstruction.hh

```
class MyDetectorConstruction :
        G4VUserDetectorConstruction
{
  public:
    MyUserAction();
    ~MyUserAction();

     void SetMagField();

   private:
    G4GenericMessenger* fMessenger;
};
```

MyDetectorConstruction.cc

```
MyDetectorConstruction::MyDetectorConstruction
 : G4VUserDetectorConstruction(), fMessenger(0)
{
  fMessenger
    = new G4GenericMessenger(
                  this, "/myDet/", "My detector control");

  // Define /myDet/setMagField command
  G4GenericMessenger::Command& setMagFieldCmd
     = fMessenger
         ->DeclareMethod("setMagField",
              &B4DetectorConstruction::SetMagField,
              "Define magnetic field value (in X direction");

   setMagFieldCmd.SetUnitCategory("Magnetic flux”);
};
```

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# G4GenericMessenger : Command properties (1/2)

- The commands can be given their guidance, unit, unit category, range, candidates, applicable states via their set methods:
  - SetStates(G4ApplicationState s0);
  - SetRange(const G4String& range);
  - SetGuidance(const G4String& s) ;
  - SetUnit(const G4String&, unitSpec = UnitDefault);
  - SetUnitCategory(const G4String& u);
  - SetCandidates(const G4String&);
  - ...

# G4GenericMessenger : Command properties (2/2)

- Setting properties can be chained
  - No interim local variable is then needed

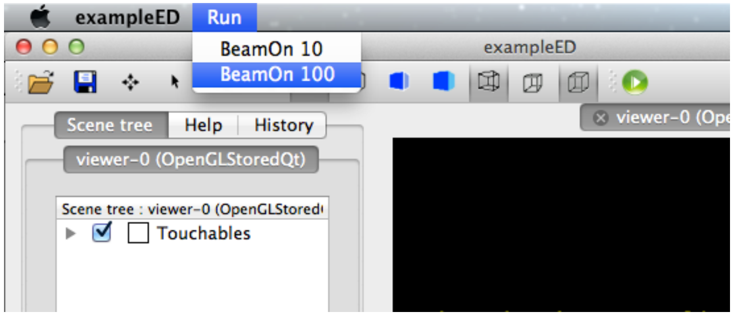
```
// Define /myRun/setSize command
G4GenericMessenger::Command& setSizeCmd
  = fMessenger
      ->DeclareProperty("setSize",
           fSize,
           "Set size of something");

 setSizeCmd. SetStates(G4State_PreInit);
 setSizeCmd. SetUnitCategory("Length");
 setSizeCmd. SetDefaultUnit("cm");
```

```
// Define /myRun/setSize command
fMessenger
  ->DeclareProperty("setSize",
        fSize,
         "Set size of something")
        .SetStates(G4State_PreInit)
        .SetUnitCategory("Length")
        .SetDefaultUnit("cm");
```

# Extending GUI

- Add menus in your graphical user interface

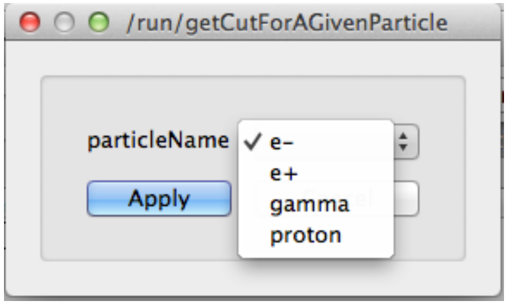
**/gui/addMenu   Run Run**
**/gui/addButton Run «BeamOn 10» «/run/beamOn 10»**
**/gui/addButton Run «BeamOn 100» «/run/beamOn 100»**



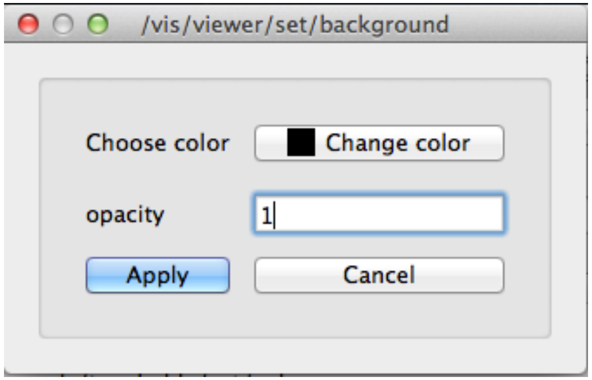

- Usually, commands setting GUI are grouped in a macro file called «gui.mac»

- Add icons in your GUI (available only for Qt driver):
  - **/gui/addIcon**
    - predefine icons: move, pick, zoom_out, zoom_in, rotate, hidden_line_removal, hidden_line_and_surface_removal, solid, wireframe, perspective, ortho
- User defined icons :
  - **/gui/addIcon "Run beam on" user_icon "/run/beamOn 1" run.png**

- /gui/addButton or /gui/addMenu without any parameters will open a popup to choose parameters
  - `/gui/addButton Run "Set cuts for a given particle" "/run/getCutForAGivenParticle"`




  - `/addButton Run "change background color" "/vis/viewer/set/background"`



Question ?