

What's New in HCL RTist 11

updated for release 2021.10



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Overview

RTist 11 is based on Eclipse 2019.06 (4.12)

- HCL RTist is 100% compatible with IBM RSARTE. All features in IBM RSARTE are also present in HCL RTist. However, HCL RTist contains a few features that do not exist in IBM RSARTE.
 - Those features are marked in this presentation by





Version: 11.0.0.v20210310_2306 Release: 2021.10

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Visit https://RTist.hcldoc.com/help/topic/com.ibm.xtools.rsarte.webdoc/users-guide/overview.html





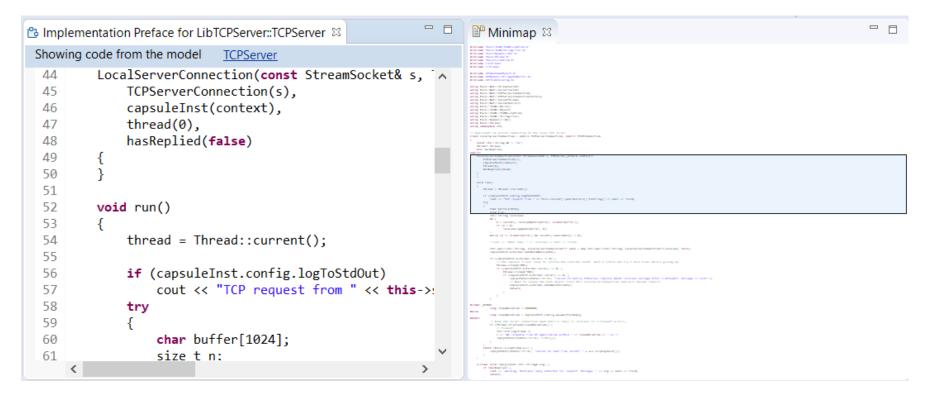
- Compared to RTist 10.3, RTist 11 includes new features from 4 quarterly Eclipse releases:
 - 2018.09 (<u>https://www.eclipse.org/eclipse/news/4.9/platform.php</u>)
 - 2018.12 (<u>https://www.eclipse.org/eclipse/news/4.10/platform.php</u>)
 - 2019.03 (<u>https://www.eclipse.org/eclipse/news/4.11/platform.php</u>)
 - 2019.06 (<u>https://www.eclipse.org/eclipse/news/4.12/platform.php</u>)
- For full information about all improvements and changes in these Eclipse releases see the links above

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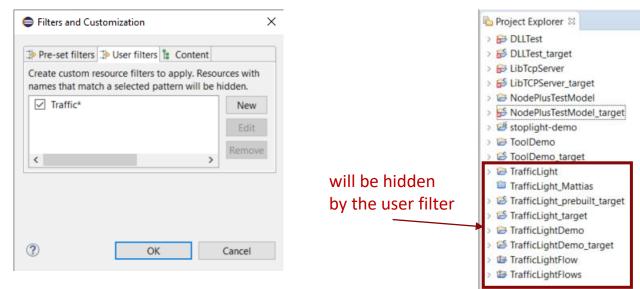
Some highlights are listed in the next few slides...



- ▶ A new Minimap view gives a better overview of the text editor contents (useful when it's large)
 - It's easy to launch it by typing "minimap" in the QuickAccess field



- The Select Workspace dialog now supports auto-completion
 - Allows to pick a workspace more easily by only using the keyboard
- User-defined filtering of the Project Explorer
 - You can now create your own regular expressions for filtering out items from the Project Explorer
 - Can be used as an alternative to working sets



Eclipse IDE Launcher

Select a directory as workspace

Eclipse IDE uses the workspace directory to store its preferences and development artifacts.

Workspace:	D:\eclipse-workspace\	~	1	Browse
Recent Work	D:\eclipse-workspace\BecomeAnRTistTest\		^	
Recent work	D:\eclipse-workspace\common_wksp\			
Copy Setting	D:\eclipse-workspace\composite_state_test\			
	D:\eclipse-workspace\course_compare_merge\			
	D:\eclipse-workspace\diagramEditing\			
	D:\eclipse-workspace\error_parser\			
?	D:\eclipse-workspace\hiot_test\		1	Cancel
	D:\eclipse-workspace\iot_demo\			contect
	D:\eclipse-workspace\license\			
	D:\eclipse-workspace\new_workspace_empty\			
	D:\eclipse-workspace\OneTestEmbedded Experiments\		v	

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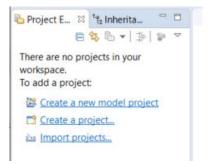
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- Copy/Paste of environment variables
 - Setting up environment variables in a launch configuration is now much easier thanks to copy/paste support
 - Environment variables can be copied from one launch configuration to another, or from a text editor to a launch configuration (or vice versa)

🖹 Main 🚧 Argumen	ts 📧 Environment 🛛 🏇 Debugger 💱 Source 🔲 Common	1
nvironment variable	s to set:	
Main Main	New	
DEBUG		Value True D:\github\poco\bin64;%PATH% Edit
PATH	D:\github\poco\bin64;%PATH%	Selecta
		Edit
		Remove
		Сору
		Paste

🗎 env_vars.txt 🛛	
1 PATH=D:\gi	thub\poco\bin64;%PATH%
2 DEBUG=true	

- Useful quick links for an empty workspace
 - Quick links for creating or importing projects make it easier for new users to get started with an empty workspace
 - Which quick links that are shown depend on the current perspective





- Launch configurations are now accessible from Quick Access
 - Can start either a Run or a Debug session

👏 🖻 🔓 👻	$ \widehat{\bullet} \bullet \widehat{\bullet} \bullet \widehat{\bullet} \widehat{\bullet} \bullet \bullet \bullet \widehat{\bullet} \bullet \widehat{\bullet} \bullet \bullet \bullet \bullet \widehat{\bullet} \bullet $	dePlusT
Editors	prebuilt_MSVS-15-x64.tcjs - NodePlusTestModel/prebuilt_MSVS-15-x64.tcjs	
1	testapp_MSVS.tcjs - NodePlusTestModel/testapp_MSVS.tcjs	
Commands	Share with Git (NodePlusTestModel) - Share the project using Git	
	Share with Git (NodePlusTestModel_target) - Share the project using Git	
Run	NodePlusTestModel_target	
	NodePlusTestModel_target (1)	
Debug	NodePlusTestModel_target	
	NodePlusTestModel_target (1)	

CDT 9.8 (included as part of Eclipse 2019.06)

- Possible to rename a file without triggering a refactoring
 - A checkbox controls if references to the renamed file should be updated

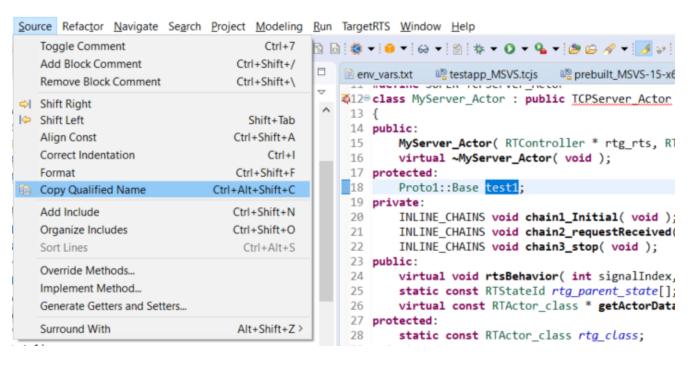
Rename Resource			_		×
New na <u>m</u> e: TOP.cpp					
Open preferences					
	Previe <u>w</u> >	OK		Cancel	

- New preference to address a performance issue with line wrapping a large number of lines in the console
 - C/C++ Build Console Maximum number of lines to enable word wrap for
 - Don't set this too high if Wrap lines on the console is turned on

Preferences			X
type filter text	Console	⇔ <	- • •
 C/C++ Appearance Arduino Autotools Build 	 Always clear console before building Open console when building Bring console to top when building (if present) Wrap lines on the console 		
Build Target	Limit console output (number of lines):	500	
Build Variab	Delay updated between console updates (milliseconds):	75	
Console Environmen	Maximum number of lines to enable word wrap for:	5000	

- Improved dialog for attaching to a C++ application to debug
 - Command-line arguments for the process are now shown (allows to more easily find the process to debug)
 - The dialog now remembers a previously entered filter expression (to make it easier to attach to the same process multiple times)
- Copy the qualified name of a C++ declaration
 - A new command is available in the Source menu
 - Similar usecase as for the Copy button of the Qualified Name for a model element in the Properties view





- CODAN improvements
 - Additional checks implemented, for example to detect C-style casts and goto-statements

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For more information about CDT improvements see <u>https://wiki.eclipse.org/CDT/User/NewIn96</u> <u>https://wiki.eclipse.org/CDT/User/NewIn97</u> <u>https://wiki.eclipse.org/CDT/User/NewIn98</u>

Newer EGit Version in the EGit Integration

- ▶ The EGit integration in RTist has upgraded EGit from 5.0 to 5.4
 - This is the recommended and latest version for Eclipse 2019.06
- This upgrade provides several new features, performance improvements and bug fixes

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 For detailed information about the changes see <u>https://wiki.eclipse.org/EGit/New and Noteworthy/5.1</u> <u>https://wiki.eclipse.org/EGit/New and Noteworthy/5.2</u> <u>https://wiki.eclipse.org/EGit/New and Noteworthy/5.3</u> <u>https://wiki.eclipse.org/EGit/New and Noteworthy/5.4</u>

- A new menu in the menu bar with a few useful commands related to libraries
 - Contains the command for launching the TargetRTS wizard (i.e. the menu replaces the TargetRTS menu)
- Commands for importing the Connexis and TCPServer libraries
 - Available if these features have been installed
 - They import the Connexis or TCPServer library projects from the installation into the workspace

Lib	oraries	<u>W</u> indow	<u>H</u> elp
1	Impo	ort TCPServe	er Library
	Impo	ort Connexi	s Library
Ì	Targe	etRTS Wiza	rd

Converting Between In Events and Out Events

- It's now possible to convert an In Event to an Out Event or an Out Event to an In Event
 - This can be useful for example if you want to change the conjugation of a port, and need to swap the direction of all events in the protocol of the port
- ✓ ০০০ EngineControl

 ✓ stop ()

 ✓ start ()

 > 🖧 (C++ T)

 > ७撬 (CppPr)

 Populate Events View

 > ७撬 (RTClas)

 Change Event Direction

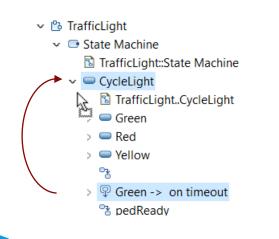
 > ७撬 (RTCon)

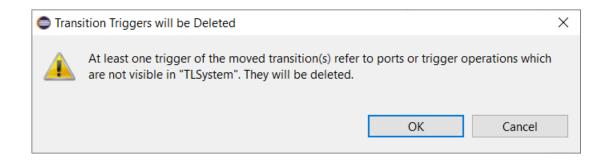
 Refactor
- Use the new "Change Event Direction" command in the Project Explorer context menu of a protocol event (or multiple events)



Moving Transitions in the Project Explorer

- You can now move a transition from one state to another using drag&drop in the Project Explorer
 - Useful for example when refactoring a state machine (moving a transition from a sub state to the container state, or vice versa)
 - Works for transitions in both capsule and passive class state machines
 - The moved transition will initially become a self-transition and a new target state can later be set if needed
- If events/operations referenced by triggers of the moved transition are not available in the target context, a dialog will inform that such triggers will be deleted









Shortened Qualifiers

- Fully qualified names now take the current viewpoint into account
 - In the "Capsule Development Viewpoint" hidden elements such as regions are now excluded from the qualifiers
 - Makes fully qualified names shorter, in particular deeply nested states
 - Applies for a number of different views and dialogs (Project Explorer, Find Named Element, Diagram tooltips etc)

□ Properties 🛛				2	▽ □			
Composite	State> Engine	nit						
General	Qualified Name:	<u>CPPMode</u>	l::TOP::State Machine::Region1::InitServers::Region1::Eng	ginelnit	Сор	y		
			before					
Properties	s 🖾				?			
Composite State> EngineInit								
General	Qualified N	lame: <u>CP</u>	PModel::TOP::State Machine::InitServers::EngineInit	ору				

now

Primitive Type Improvements in Search and Type Completion

- Previously duplicates of primitive C++ types appeared when doing search and type completion
 - As a consequence it was easy to by mistake use the wrong type (and also tedious to have to choose each time)
 - The reasons for getting these duplicates have now been addressed
- ▶ The "C++ Types" package and "C++ Transformations" profile have been removed from the installation
 - They were obsolete and no longer needed
- The support for C code generation is now an optional choice when installing RTist

RTist Extra Functionality	
🗌 🖗 RTist Connexis Feature	11.0.0.v20200529_1347
🗌 🖗 RTist CORBA Support	11.0.0.v20200529_1347
🗌 🖗 RTist Pluglets	11.0.0.v20200529_1347
🗌 🌆 RTist Sketcher Feature	11.0.0.v20200529_1347
RTist Support C	11.0.0.v20200529_1347
🗌 🖗 RTist Transformation Authoring Minimal Feature	11.0.0.v20200529_1347

- New and updated model fixups are now available for updating existing models for these changes
 - Incorrect type references fixup (updated to fix references to removed C++ Types and, optionally, also C types)
 - Obsolete package import removal (new fixup)
 - Obsolete profile application removal (new fixup)
 - Add missing package imports (new fixup for adding the import of CppPrimitiveDatatypes, in case it's missing)

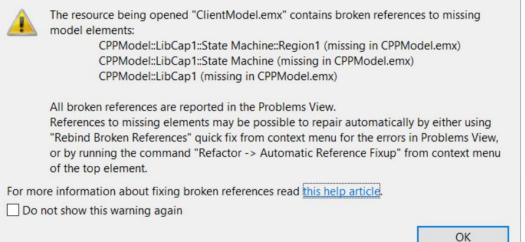
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Fixing Broken References (1/2)

- ▶ The "automatic cleanup" of certain elements with broken references is now removed
 - The preference *RealTime Development Resource Resolution Broken references auto-cleanup* has been removed

Broken References Detected

- By default, when a model with broken references are loaded a warning dialog now appears
 - This dialog replaces the previous Repair Workspace References dialog
 - To repair the broken references, by attempting to rebind them to elements that have been moved to a different file, follow one of the methods suggested by the dialog



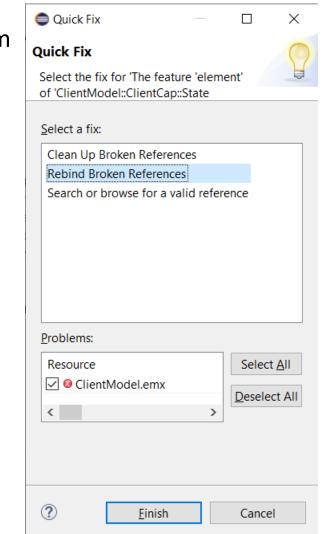
- You can disable this warning dialog using the new preference Modeling Resource Resolution Show warning for broken references when loading a model
- <u>Note</u>: A current limitation is that broken references caused by deleted projects will not appear automatically when loading a model. To see such broken references perform the Validate command on the loaded model.

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Fixing Broken References (2/2)

- Broken references are listed in the Problems view. Right-click on any of them and run a Quick Fix for fixing broken references:
 - Rebind Broken References can fix references to elements that have been moved. It's for example useful after a refactoring that was done without having all referencing models available in the workspace.
 - Clean Up Broken References can fix references to elements that have been deleted (or for some other reason do not exist in the workspace). Broken references will be fixed by resetting them (or in some cases, by deleting the element that contains the reference).
 - Search or browse for a valid reference can be used to rebind the broken reference to a different target element using the Select Element dialog. This Quick Fix only fixes the selected broken reference.
 <u>Note:</u> To be able to browse to the new target element for the reference you may need to first switch to the Model viewpoint (in case the Capsule Development view point filters out the desired target element).



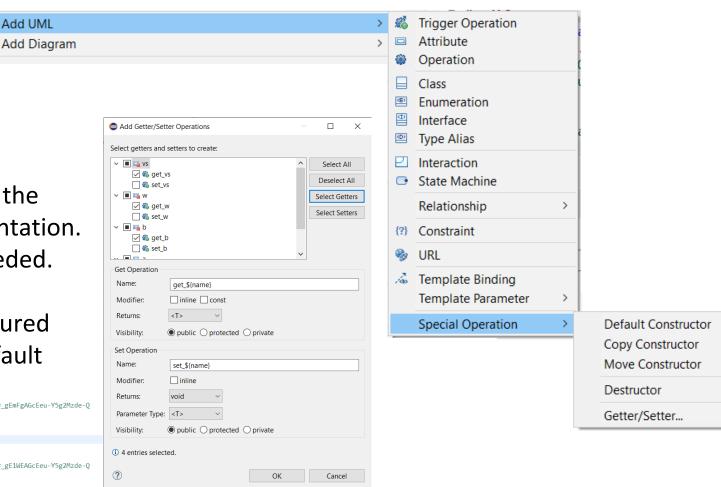
Creating Special Operations

New commands are now available in the Add UML context menu for creating "special operations" on V< L.Y.</p> IUF a capsule or class

Add UML

- Constructors (default, copy, move)
- Destructor
- Getter/Setter operations
- Constructors and destructors will have the correct C++ signature, but no implementation. Write your own implementation as needed.
- Getter/Setter operations can be configured using a dialog, and will have typical default





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Model Debugger Improvements (1/3)

- State instance diagram for a sub state machine can now be opened by double-click
 - Previously the command "Open State Machine Diagram" (Ctrl +T) was the only easy option
 - Now it also works to double-click on the state name (same as when the model is not being debugged)
- The socket timeouts used for communicating with the debugged application are now configurable
 - New preferences on the Run/Debug RealTime Application preference page
 - When debugging remotely over slow connections a too small socket read timeout can cause the debug session to terminate unexpectedly
- The performance of configuring the Trace Editor was significantly improved
 - Now by default only the listed elements are traced

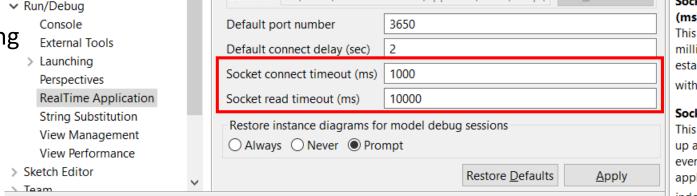
Location | C:\Users\MAITIA~1.MOH\AppData\Local\Temp\ Browse... (ms) This controls the timeout (in milliseconds) that is used to establish socket connection with a target application.

Socket read timeout (ms)

This preference is used to set up a timeout for reading an event from a target application. Use 0 to wait indefinitely.

Socket connect timeout





Model Debugger Improvements (2/3)

- A new command "Show Only This Instance" in the Trace Editor context menu
 - Makes it easy to filter the trace to only see trace events related to the selected capsule instance
 - For example useful in order to find out which state a capsule instance is in when sending or receiving an event

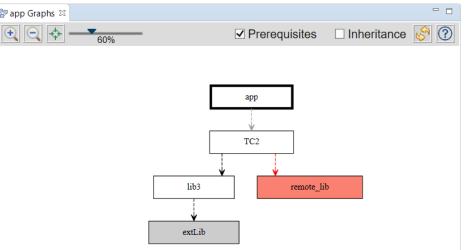
296 & Event Received on P getIncrement int 52 In@result:0 multiplier:0 27857 m	
	IS
297 💺 Event Sent on Port returnIncrement double 1 47402705724 Out@result:0 multiplier:0 27858 m	IS
298 State Activated Navigate dle> multiplier:0 27858 m	IS
299 & Event Received on P returnIncrem Show Only This Instance @mul:0 adder:0 27859 m	IS
Active state when sending the event	Remove the filter
#Trace EventEventDataActionInstanceTime	trace events
291 💺 Event Sent on Port returnIncrement double -4.8215838321 Out@result:0 multiplier:0 27855 ms	
292 State Activated <idle> multiplier:0 27855 ms</idle>	
296 & Event Received on P getIncrement int 52 In@result:0 multiplier:0 27857 ms	
297 🕏 Event Sent on Port returnIncrement double 1.47402705724 Out@result:0 multiplier:0 27858 ms	
298 State Activated <idle> multiplier:0 27858 ms</idle>	

Model Debugger Improvements (3/3)

- Tracing everything related to a capsule
 - Adding a capsule to the list of elements to trace is now a shorthand for adding all its ports and states (including sub states). Previously only incarnation of the capsule was traced in this case.

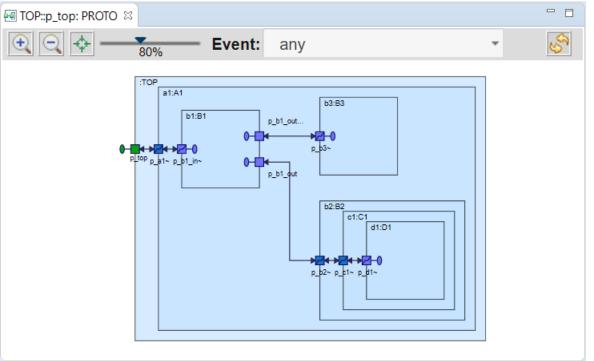
Graphic Visualization of TC Relationships

- The possibility to visualize TC relationships that was available in version 10.2 for TCs in the old file format, is now also supported for TCs in the new .tcjs file format
 - A new command Visualize Explore in Graphs is available in the Project Explorer context menu of a TC
- The visualization uses Graphviz as an external tool for doing the graph layout
 - Graphviz must be separately installed. Specify the path to its "dot" utility in *Preferences – RealTime Development - Visualization* (Rean Graphs)
- ▶ The graph is rendered using SVG in an embedded web browser
 - Support for panning and zooming
 - You can search for texts in the rendered diagram using Ctrl+F
- Prerequisites and/or inheritance relationships can be shown
- Double-click on TCs in the graph to open the TC editor



Event Routing Visualization

- Visualize graphically how a protocol event can be routed in the composite structure of a capsule
 - A new command Visualize Event Routing is available in the context menu of a port (in Project Explorer, diagrams or Code/CDT Editor)
 - Select an event in the drop down menu to see how that event can be routed in the composite structure
- Explore the composite structure interactively
 - Use commands "Go Inside" and "Go Outside" in the ports' context menu in the diagram
- If there are multiple capsule parts typed by the same capsule, they will be replaced by hyperlinks in the diagram to save space
- The graph uses SVG so panning, zooming and text search is supported

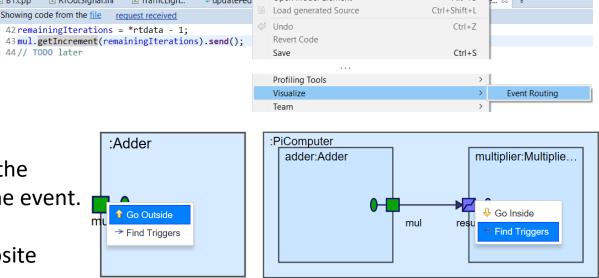


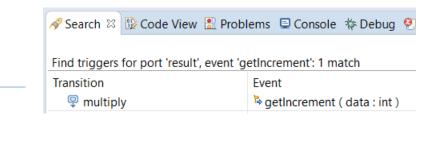


The Event Routing Visualization feature makes it easy to navigate from a place in the code where an event is sent, to the transition(s) that may receive it:

Idle

- 1. Right-click in the Code or CDT editor on a line where an event is sent (or invoked or replied to) and open the Event Routing Visualization graph.
- Follow the arrows from the green port (the port on which the event is sent) to find the possible ports that may receive the event. To see also arrows to ports on enclosing capsules, perform
 Go Outside on the green port to reveal more of the composite structure.
- Right-click on such a port and perform the command Find Triggers. All transitions which may trigger when the event arrives at the port will be shown in the Search View.
- 4. Double-click on a found transition to navigate to it in a diagram





Transformation Configuration Editor Improvements (1/2)

- Syntax highlighting is now available in the Code tab
 - JavaScript parse errors are shown with red color and margin marker tooltip

📲 app.tcjs 🖾 Default Transform Configuration.tcjs app.tcjs 1 let tc = TCF.define(TCF.CPP_TRANSFORM); 2 tc.sources = ['platform:/resource/TL/TrafficLightComponent.emx#_IBTt0KG6EeqtlgTcJcQviQ' 4x): Syntax error: Unexpected token] tc.topCapsule = 'platform:/resource/TL/TrafficLightComponent.emx#_IBTuFaG6EeqtIqTcJcQviQ';

- Content assist ("code completion") is now available in the Code tab
 - Triggered automatically when typing certain "key" characters ('.', '=' etc)
 - Can also be manually triggered using Ctrl + Space
 - Controlled by a new preference RealTime Development Transformation Configuration Editor – Content Assist – Enable auto activation

:++	Executable] app.tcjs
1 le	et tc = TCF.define(TCF.CPP_TRANSFORM);
2 to	c.sources = [
3	'platform:/resource/TL/TrafficLightComponent.emx#_IBTt0KG6EeqtlqTcJcQviQ
4];	
5 to	c.bui
6 to	c.top(o buildLibraryArguments : String
7 to	c.crea
8 to	• buildLibraryCommand : String
9 to	c.com • contextSensitiveLibraryBuild : Boolean
10 to	c.targ



Transformation Configuration Editor Improvements (2/2)

- Marking of occurrences of selected element in the Code tab
 - Controlled by a new preference RealTime Development Transformation Configuration Editor – Mark Occurrences – Mark occurrences of selected element
- Incremental Find is now supported in the Code tab (with the same keyboard bindings as in other Eclipse text editors)

🗟 ap	p.tcjs 🛛				
[C+	+ Executable] app.tcjs	*	e:	28	?
1 2 3 4	/* * Converted from: platform:/resource/VizTest/Default%20Transform%20Configuration.tc */				^
5	let tc = TCF.define(TCF.CPP_TRANSFORM);				
6	tc.sources = [
7	'platform:/resource/VizTest/CPPModel.emx#_vqANcNcFEeqNVcc9uUPglw'				
8];				
9	tc.createTargetProject = false;				
10	tc.parents = [
11	'platform:/resource/VizTest/Generic.tcjs'				
12	<u>];</u>				
13	tc.targetProject = '/CDT_test_project';				
14	tc.type = CppTransformType.Executable;				
15	tc.userLibraries = [
16	'a.lib',				
17	'b.lib'				
18];				

Organize Sources

▶ A new Organize Sources dialog is provided to assist in setting up the Sources of a TC optimally

Sources	
CPPModel::UnusedForNow	Add
	Remove
	Organize Sources

- This is an improved and simplified implementation compared to the similar feature in 10.2
- Elements are proposed to be added to or removed from the Sources list to ensure that no unnecessary elements will be built by the TC. The suggestions are made by analyzing references in the model.
- This feature is also available from the command-line by means of a new model compiler command-line argument --organizeSources
- It can also be launched from the TC Editor toolbar menu (useful for TCs edited only textually in the Code tab)

Organize sources		×			
Review added and removed elements					
Update the Sources list by marking elements in the lists below.					
Elements that are candidates to be added:					
Element Reas	on Relationship Originates Fr	om	Sele	ect All	
✓ TopCap Missi ✓ MgrRegistry	ing Top Capsule ing Type 🕞 reg		Selec	t None	
Show only elements from	n current project OrganizeSource	sTest			
Elements that are candidat	es to be removed:				
Element Reason				ect All	
UnusedForNow Not referenced directly or indirectly from top capsule			Selec	t None	
Show fully qualified names					
?		<u> </u>	Cance	el	

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Cleaning TCs

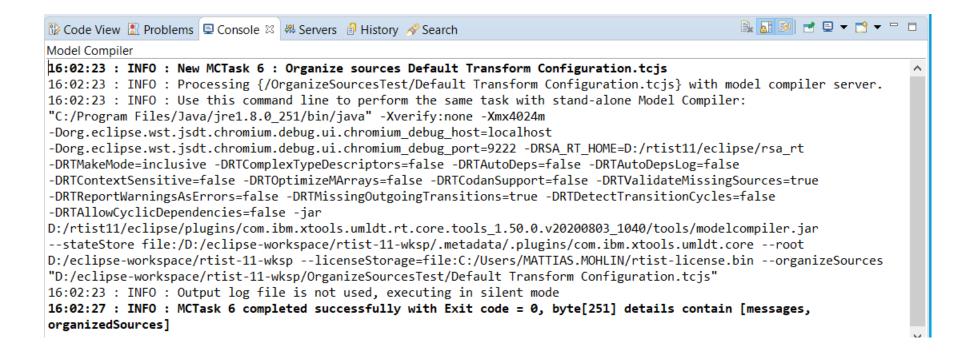
- External Library TCs have a new "Clean Command" property
 - Use for example "make clean", invoke a "clean script" or something else
- When it has been specified it's possible to use the Clean command also on external library TCs
 - Currently this only works when cleaning from the command-line (using the makefile generated by the model compiler)
- When build variants are used, the Clean dialog now shows the Build Variants user interface
 - Allows setting the build variant settings which may influence on the behavior of clean, and clean build

Build command:	echo "Build command for external Lib04"	
Build folder:		
Clean command:	echo "Clean command for external Lib04"	
	Build folder:	

Clean s

uild Variants	
Configuration:	New configuration from build variants ~ Save As
Target platforr	
	es onlyse
V Dullu selecte	d transformation configuration after clean

- A new "Model Compiler" console is now available
 - Helps troubleshooting commands that involves calls to the model compiler
 - Makes it easier to know how a model-compiler command should be invoked from the command-line



Incremental Compilation for Models with External Code

- This feature worked in the classic builder by means of a Perl script (rtcppdep.pl)
- The model compiler now also supports this, by relying on the compiler's ability to generate dependency files
 - Currently only supported for GCC compilers, and only for recursive make files
- The file libset.mk in the TargetRTS must be updated to enable this feature
 - The variable \$(DEP_OPTS) should be added to LIBSETCCFLAGS
 - Note that \$(DEP_OPTS) is a new variable in the file default.mk. In this file is also another variable \$(DEP_EXT) which specifies the file extension for dependency files (.d). If this variable is not defined, dependency files will not be included in the generated makefile.

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Note: A clean build will take slightly longer when this feature is enabled (due to dependency file generation), but subsequent builds will be faster since only the minimal number of .cpp files will be recompiled when something in the external code has been changed.

Code Preview

- A preview of what generated code will look like can now be generated
 - Use the new command **Generate Code Preview** in the Project Explorer context menu of a model element
- Preview code is placed in a special project (by default called "_CODE_PREVIEW")
- Old versions of preview code files are marked with ~

_	
	🖻 TOP.cpp
	TOP.cpp~
	🖻 TOP.h
	TOP.h~

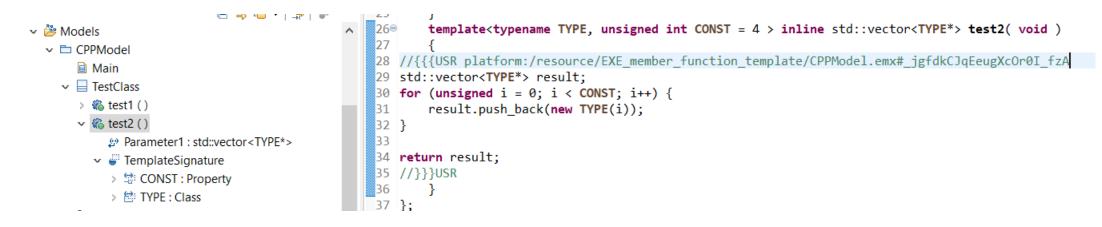
🗸 🛱 CODE PREVIEW

EXPERIMENTAL Generate Code Preview for Selected Model	Elements ×
CPPModel::TOP	
Preview location Workspace path: /_CODE_PREVIEW	Browse
?	OK Cancel

- You can compare old and new file versions using Compare With – Each Other to easily understand how a change in the model have affected the generated code
- Both code and makefiles can be previewed and compared in the same way
- This is currently an experimental feature

Improved Support for Templates (1/2)

- The model compiler now supports member functions with template parameters
 - Both type and non-type template parameters are supported
 - Note that most compilers require such operations to be declared as inline



- The Project Explorer representation of template parameters is now more compact
 - Easier to recognize type template parameters by means of the word "typename" in the label
- - 🗸 🖑 RedefinableTemplateSignature
 - SIZE : Property
 SIZE : int
 - ✓ INPE : Class
 TYPE

before

✓ □ ObjectFactory
 ☆ typename TYPE
 ☆ SIZE : int

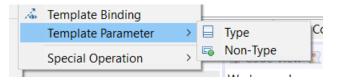


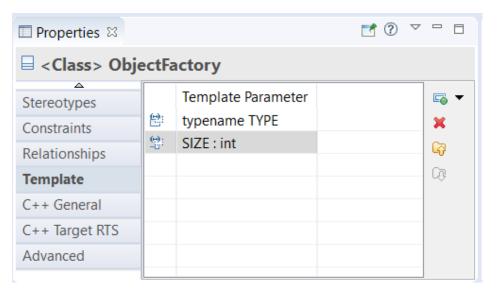


Improved Support for Templates (2/2)

- The Templates page of the Properties view has been much improved
 - Consistent look-and-feel with other property pages
 - Support for reordering template parameters using either up/down buttons or by drag&drop
 - Improved textual representation of template parameters, more aligned with the C++ syntax

- Improved context menu for creating template parameters
 - Now aligned with C++ terminology (type and non-type template parameters)





C++ 11 Improvements (1/4)

- The final modifier can now be used on classes, capsules and operations
 - Use it to specify that a class/capsule cannot be inherited from, or an operation cannot be redefined
- **auto** attributes are now supported by the model compiler
 - The C++ compiler will deduce the type of the corresponding member variable from its initializer value
 - Type completion now works for auto, and it can be selected as any other type
- Attributes with in-class initialization (brace or equal) are no longer also initialized in the constructor
- ▶ Some C++ 11 types were missing in the CppPrimitiveDatatypes package and have now been added
 - Iong long
 - unsigned long long

14 2	Properties				
	□ <class> Class1</class>				
	General	Qualified Na	ame: <u>TrafficLightComponent</u> :: <u>Class1</u> Copy		
	Dependencies	Name:	Class1		
	Attributes	Visibility:	Public Private Protected		
1	Operations	NA 110			
100	Nested Types	Modifiers:	Abstract Final		

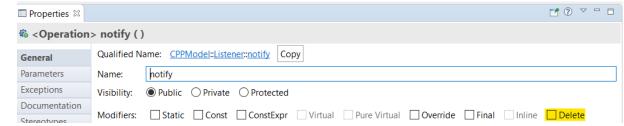
🖨 Select Element for Type 🛛 🗆 🗙					
Search	Browse				
Select an element (? = any character, * = any string):					
auto	auto				
🖭 auto - CppPrimitiveDatatypes::auto					

C++ 11 Improvements (2/4)

- The override keyword is now specified for functions that redefine virtual functions from the TargetRTS. Also, the nullptr constant is now used instead of 0 for representing a null pointer.
 - Both generated code and the TargetRTS code was changed
 - Avoids warnings when compiling generated code
 - For GCC compilers, the warnings –Wsuggest-override and –Wzero-as-null-pointer-constant are now set when compiling to detect these problems also in user code snippets
 - <u>Note:</u> Starting with these changes it's now required to use a C++ 11 compiler for compiling generated code. You can use the new preference *RealTime Development Build/Transformation C++ code standard* if you need to compile generated code with a compiler that doesn't support C++ 11.

C++ code standard	C++ 11 ~
Make entions	C++ 11
	Older than C++ 11

Operations can now be marked as deleted, and destructors can be marked as default or delete



Destructor		
Generate	🗹 Virtual 🗌 Inline 🔲 Default 🗹 Delete	
Visibility:	● public ○ protected ○ private	

C++ 11 Improvements (3/4)

• C++ 11 type aliases are now supported in the user interface and model compiler

📑 🗕 🖬 👘	Add UML	> E	Package
陷 Project Explore	Add Diagram Add Shortcut	> ~ 	Protocol Capsule
v 遾 Models	New	>	
✓ ☐ Traffi Image: March of the second se	Open Close	ि	Enumeration
> 🔤 CI > 🕒 DI	Close All Save As		Type Alias State Machine

Properties		
🕮 <data th="" type<=""><th>> IntList =</th><th>std::list<unsigned int=""></unsigned></th></data>	> IntList =	std::list <unsigned int=""></unsigned>
General	Qualified Na	ame: <u>CPPModel::IntList</u> Copy
Attributes	Name:	IntList
Operations	Visibility:	Public Private Protected
Documentation	Alias Type:	std::list <unsigned int=""></unsigned>
Stereotypes	raido Type.	

- In the model a DataType with a new "Alias Type" property is used
- The main benefit with using type aliases instead of traditional typedefs is that they can have template parameters

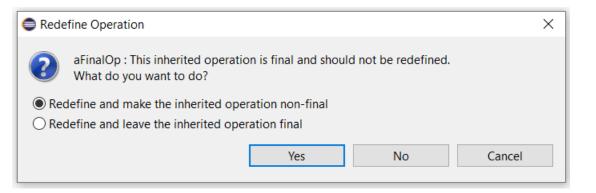
```
template<typename TYPE > using GenericList = std::list<TYPE*>;
```

 You can write a type descriptor for type aliases in the same way as you currently can for typedefs. The "Type Descriptor Hint" property is also supported, to automatically generate a type descriptor for type aliases of commonly used STL collection types (list, set, map etc).



C++ 11 Improvements (4/4)

- When overriding an operation in the UI, its 'override' property is automatically set
 - If the overridden operation is final, a new dialog appears and suggests to make it non-final



For redefined operations, the "override" property is automatically set (and cannot be unset)

Modifiers:	Static Const	ConstExpr	Virtual	Pure Virtual	Override	🗌 Final	Inline
Return Type:						Select	Туре
Signature:	register ()						
Redefined Op	peration: <u>TrafficLigh</u>	tComponent::Ba	seClass::regi	ster Set (Clear		



Removal of C-style Casts

- Both generated code and the TargetRTS have been changed by removing all C-style casts
- Each cast has either been removed, or replaced with a corresponding C++ cast
 - static_cast (in most cases) or reinterpret_cast (in a few cases)
 - Note: We don't generate dynamic_cast since we cannot assume code is compiled with run-time type information



A benefit is that the TargetRTS now can be compiled without the -fpermissive flag with GCC (without warnings)

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- Helped to detect a couple of bugs in the TargetRTS specific to 64-bit platforms now fixed!
- With GCC the TargetRTS is now compiled with new flags to detect issues related to casts

```
-Wuseless-cast and -Wold-style-cast
```

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Removed Compatibility with Old Rose-RT Versions

- The TargetRTS file RTCompatibility.h was removed
 - It contained macros, typedefs etc. for compatibility with very old versions of Rose-RT (6.4 and earlier)
- Migrated models that still use old Rose-RT names should be updated
 - RTDATA -> rtdata
 - Integer -> RTInteger
 - ... etc.
- It's recommended to update your models, but if you want to keep using these old names, you can keep RTCompatibility.h from the old TargetRTS version



Dependencies for Interfaces and Enumerations

- The Dependencies property page is now available also for Interfaces and Enumerations
 - Makes it easier to specify dependencies for these elements
 - Helps for example when an interface operation references another type which must be included or forward declared in the interface header file

✓ 🖺 Liste > ‰ n ⊒ Even	otify	/ (e : Eve	nt)		
Properties ¤					
<pre>Interface></pre>	List	tener			
General		Name	Target Element	Kind In Header	Kind In Implemen
Dependencies	2		Event	inclusion	none
Attributes					

Changing Default Values for Property Set Properties

- Most of the properties shown on the "C++ General" and "C++ Target RTS" property pages have customizable default values
 - Before, the only way to change the default values of these so called "property set" properties was to do it from the Property Sets property page on the top-level package.
 - The drawback was that it was necessary to do this on all models that needed a customized default value!
- Now, a new preference is available which makes it possible to set new default values globally, without modifying any model
 - Modeling Profiles Property Sets Defaults
- An example of when this can be useful is when you want custom names for generated getter/setter operations

 Properties ⋈ Properties ⋈ Package> CPPModel General Property Values: Documentation Language: C++ ♥ Stereotypes Constraints Group: DataType ♥ Generate File: Implementation ♥ Header Header Preface: Property Sets Profiles Preferences Profiles Profiles Stereotype style Stereotype style Stereotype style Stereotype style Stereotype style Style: Decoration and Text Properties View settings General Style: Decoration and Text Style: Decoration and Text Style: Defaults: Pre-defined defaults Change Stereotype Attributes for Search Madel Add 		
General Defaults: Pre-defined defaults Choose Profiles Property Values: Language: C++ ▼ Documentation Language: C++ ▼ Stereotypes Type: DataType ▼ Constraints Group: General ▼ Group: General ▼ Relationships Generate File: ✓ Implementation ✓ Header Language Header Preface: ✓ Property Sets Profiles ✓ ✓ ✓ Modeling Stereotype style Stereotype style ✓ ✓ Modeling Stereotype style Stereotype style ✓ ✓ Modeling Stereotype style ✓ ✓ ✓ Modeling ✓ Stereotype style ✓ ✓ Modeling ✓ ✓ Ø Show suppressed stereotypes and properties ✓ Miscellaneous ✓ Ø Ø Ø Ø Ø Warn when using non-released profile Ø Ø Ø Ø Ø Warn when using non-released profile Ø Ø Ø Ø Ø Warn when using non-released profile Ø	🔲 Properties 🛛	
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Documentation Language: C++ ▼ Stereotypes Type: DataType Constraints Group: General ▼ Capabilities Generate File: Implementation ♥ Header Language Header Preface: Property Sets Profiles Modeling Active Language Appearance Default Diagrai General Miscellaneous Property Sets Show suppressed stereotypes and properties Miscellaneous Property Sets Defaults: Predefined defaults Change Stereotype Attributes for Search Add 	General	Defaults: Pre-defined defaults Choose
Stereotypes Type: DataType Constraints Group: General Capabilities Generate File: Implementation Relationships Generate File: Implementation Language Header Preface: Property Sets Profiles Modeling Active Languag Appearance Default Diagrai General Stereotype style Style: Decoration and Text Properties View settings General Miscellaneous Printing Profiles Queries Reminders Resource Resol Stereotype Attributes for Search Add 	Profiles	Property Values:
Constraints Capabilities Capabilities Relationships Generate File: Language Property Sets Preferences Vodeling Active Language Appearance Default Diagra Generation and Text Properties View settings Generation and Text Property Sets Default: Pre-defined defaults Change Stereotype Attributes for Search Text Add	Documentation	Language: C++ V
Constraints Group: General ▼ Relationships Generate File: Implementation ☑ Header Language Header Preface: Property Sets Profiles ✓ Modeling Active Languag Active Languag Stereotype style ✓ Modeling Yer Eites Ø Stereotype style ✓ ✓ Modeling Yer Eites Ø Stereotype style ✓ Ø Varn when using non-released profile Ø Property Sets Ø Defaults: Pre-defined defaults Change Ø Stereotype Attributes for Search ✓	Stereotypes	Type: DataType
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Property Sets Header Preface: Property Sets Profiles Modeling Active Languag A		Generate File: 🗹 Implementation 🗹 Header
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	 Modeling Active La Appeara Default I General Miscellar Path May Printing Profiles Queries Reminde Resource Text 	Profiles Stereotype style Style: Decoration and Text Properties View settings Show suppressed stereotypes and properties Miscellaneous Warn when using non-released profile Property Sets Defaults: Pre-defined defaults Change Stereotype Attributes for Search Add

Moving Elements in the Properties View using Drag&Drop

- It's now possible to move elements in tables of the Properties view by means of drag&drop
 - More convenient than using the Up / Down buttons if there are many elements in the table
 - Multiple elements can be moved at the same time and will then all be inserted at the drop location (shown by a line in the table)

□ Properties 🛛					
••• < Protocol > i	Гrа	fficLightSign	als		
General		Name		Data Class	
In Events	R	red		void	
Out Events	R,	yellow 💦	red	void	void
Outevents	R,	green		void	
Dependencies		green 2			

Help for the Properties View

- The Properties View now provides context sensitive help
 - Use the new toolbar button for showing help for the properties currently visible in the view (or press F1)
 - The new property documentation helps understand what properties mean, and how they affect the generated code

Properties		🖬 🕐 🎽 🗖 🌆 Help 🛛	
ය <capsule> 1</capsule>	ГорСар	Properties Help Contents 🌮 Sea	rch 📽 Related Topics 🕮 Bookmarks 🖼 Index
General		(Overridden) Apply Defaults C++ General	^
Ports	Generate File:	✓ Implementation ✓ Header Generate File By default both an in	nplementation and header file is generated for
Dependencies	Header Preface:		You can unmark these checkboxes to suppress
Attributes		1 // Some necessary includes	both of these files.
Operations		2 #include <iostream></iostream>	
Nested Types) Hinslude (chains)	II be inserted at the beginning of the C++
Documentation			nerated for the selected element.
Stereotypes	Header Ending:	Edit	
Constraints		1 Header Ending This code snippet wi	Il be inserted at the end of the C++ header file
Relationships			the selected element.
C++ General		< >	
Advanced	Implementation Preface:	Edit Implementation Pr This code snippet wi	eface II be inserted at the beginning of the C++
			that is generated for the selected element.
		V V Implementation En	dina 🗸



- The Java APIs for creating UML-RT models programmatically have been extended
 - Creating a capsule part

RTCapsulePart RTCapsule.createCapsulePart(String name, RTCapsule type);

Setting the multiplicity of a capsule part, and its kind (fixed, optional or plugin)

void RTCapsulePart.setMultiplicityAndKind(int lower, int upper, AggregationKind kind);

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Creating a connector between two ports on capsule parts

Connector RTModelOperations.createConnector(RTCapsulePart sourcePart, RTPortRedefinition sourcePort, RTCapsulePart targetPart, RTPortRedefinition targetPort) throws ConnectionError;

The UML RT SDK sample has been updated to use these new APIs



Usage of CDATA when Storing Models

- A new preference can be set to store code snippets and documentation texts using CDATA in the model XML files
- This avoids use of XML escape characters which makes such texts more readable when viewed in a text editor
 - Example (without CDATA)
 <headerPreface xmi:id="_irLY4NitEeqes4xYsqINtA"
 body="// Some necessary
 includes
#include
 <iostream>
#include
 <string>
#include
 <string>

#define OPEN
 1
#define CLOSED 0"/>
 - Example (with CDATA)

#define OPEN 1
#define CLOSED 0]]></body>
 </headerPreface>

Preferences	— D X
type filter text	Modeling $\Leftrightarrow \checkmark \Rightarrow \checkmark$
> General	Attempt to open models with unrecognized content O Always O Never O Prompt
Code View > Data Managemen	Preserve unrecognized model content on save
Experimental Feat Help Install/Update Java 	Profile migration Migrate outdated profile applications to their latest version when loading models O Always O Never O Prompt Skip migration when loading read-only models
 Logic Diagrams Model Editor Model Publishing Model Validation 	 Save artifacts to newer version without prompting Migrate default appearance properties Show Reload Model dialog only if save is needed
 Modeling Plug-in Developm RealTime Develop Report Design 	Fragment file name pattern \$(NAME)\$(OPT_INDEX) Perform navigation during undo/redo operations Use CDATA when saving model files
Run/Debug	Restore <u>D</u> efaults <u>A</u> pply
? 🖬 🗹	Apply and Close Cancel

Note: Use of CDATA does not affect backwards compatibility.

Old versions of RTist can still load model files that use CDATA. But if saved in old tool versions, CDATA will of course not be used. A new model fixup is available for converting all model files to use the new file format with CDATA.

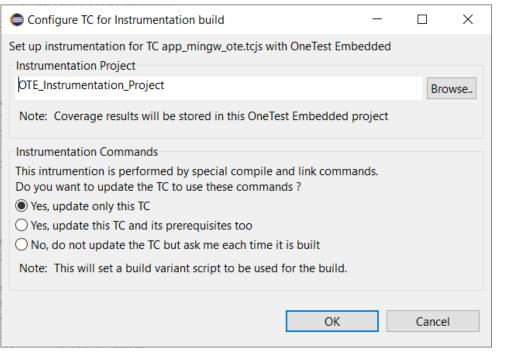
OneTest Embedded Integration (1/2)

- A new install component of HCL RTist
 - Note: The OneTest Embedded Integration is not available in IBM RSARTE
- Computes and visualizes run-time coverage for UML-RT state machines
 - Which states and transitions have been executed in the state machine?
 - What parts have not executed at all? May indicate too little test coverage.
 - What parts have executed the most? Special focus may be spent on optimizing the performance of those parts.
- Based on building an instrumented version of the RTist application that collects coverage data when it runs
 - You can either create special versions of your TC(s) for building an instrumented application, or use build variants which will prompt you each time it's built

-7

Git integration for Eclipse - experimental features (incubation)
 Java implementation of Git
 NodePlus
 RTist Core
 RTist Extra Functionality
 RTist Integrations
 OneTest Embedded Integration
 RTist EGit Integration

Name





OneTest Embedded Integration (2/2)

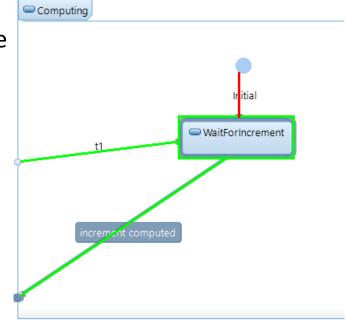
- Coverage can be accumulated from several executions of the RT application (e.g. running multiple tests)
 - You can look at the combined coverage from multiple executions of the application
- Coverage can be shown in a table
 - Gives full details of how many times different elements have executed

🗳 executable.	EXE.49160.1615534496 🛛	🕸 _TC.tcjs	🔁 StatemachineDiagram1	🖹 Adde
Coverage				
Executable:	executable.EXE			
Executed:	Fri Mar 12 08:34:56 CET 202	21		
Built by:	TC.tcjs			
Coverage				
Model Ele	ment		Coverage Count	^
P			0	
P			1	
₽ldle ->	on getIncrement		1	
WaitFor	Computation -> on result		1	
🖓 ldle ->	on compute		1	
P more in	crements? ->		1	
Coverage				

- Coverage can be shown in state chart diagrams
 - Gives an overview of what elements have or have not executed at least once
- This is currently an experimental feature and currently only supported for the MinGW compiler on Windows



- 🗸 📂 OTE_InstrProj
 - 🗸 🤌 Test
 - v 🔯 Application Result
 - 🖬 executable.EXE 2021-mar-03 14:23:13
 - ti executable.EXE 2021-mar-03 14:21:52 €
 - Le executable.EXE 2021-mar-03 11:38:31
 - 🖬 executable.EXE 2021-mar-03 11:37:33
 - 🖬 executable.EXE 2021-mar-03 11:23:09
 - € executable.EXE 2021-mar-03 10:52:32
 - ti executable.EXE 2021-mar-03 09:35:17



L7 HCL SOFTWARE

NodePlus



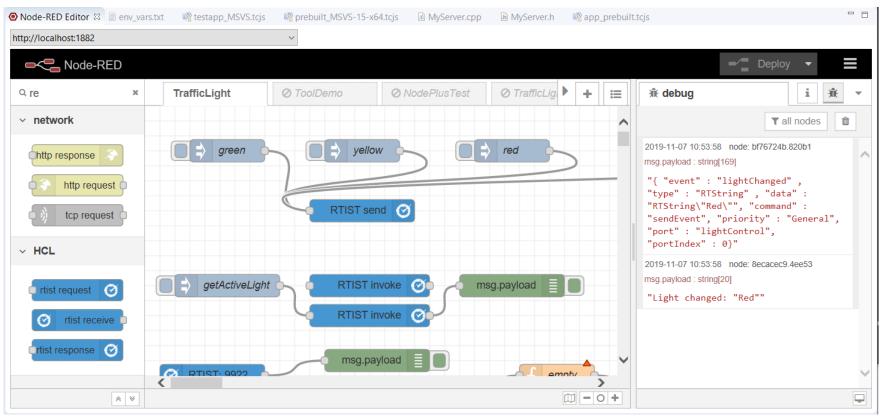
- ► HCL NodePlus is a new install component of HCL RTist
 - Note: NodePlus is not available in IBM RSARTE
- NodePlus provides all necessary tooling for developing IoT applications using Node-RED (and related technologies)
 - Node-RED projects both for creating Node-RED nodes and flows of interconnected nodes
 - Node-RED server for convenient deployment of Node-RED flows within the Eclipse workbench
 - Node.js projects for creating Node.js applications
 - Node.js server for convenient deployment of Node.js applications within the Eclipse workbench
 - Swagger for specifying APIs using Swagger documents
 - Node.js Debugger for debugging Node.js applications
 - Pug (formerly known as Jade) for template-based rendering of web pages
 - Unit test
 - Code coverage

Name
> 🗌 🚥 Git integration for Eclipse
> 🗌 🚥 Git integration for Eclipse - experimental features (incubation)
> 🔲 💷 Java implementation of Git
> 🔽 🚥 NodePlus
> 🔲 💷 RTist Core
> 🔲 💷 RTist Extra Functionality
> RTist Integrations

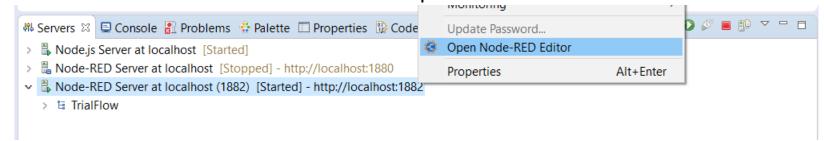


- Node-RED editor
 - Configure nodes and wire them together into flows
 - Deploy changes to the Node-RED server

- View debug output and execution within the flow
- Install new nodes to the palette (e.g. from the public library)



- Node-RED Flow Projects
 - Flows can be created directly in the Node-RED editor, but creating them as Eclipse projects has many benefits (e.g. team development using SCM integration)
 - An intuitive wizard for creating Node-RED Flow projects
 - Either create a flow from scratch or start from one of the existing flows in the public library
- Node-RED Server
 - A dedicated Servers view lets you create, start and stop Node-RED local and remote servers within the Eclipse workbench
 - Deploy a Node-RED flow onto a selected server and open its Node-RED editor







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Remote Node-RED Server

- You don't need to run the Node-RED server locally. You can instead connect to a server that runs remotely (for example on a server or on a device)
- Create a new server in the Servers view and enter the URL to the remote server
- You can then connect to the server in order to open the Node-RED editor for it (other operations on a remote server are currently not supported).

	Monitoring	>
🖏 Servers 🛛 🖹 Problems 🔲 Prope	Update Password	e
> 🖏 Node.js Server at localhost [Sta	Properties Alt+Enter	
🖥 Node-RED Server at https://ma 📥	Connect	ł

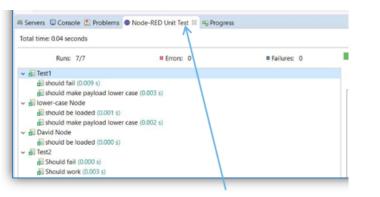
Node-RED Tools in NodePlus



HCL SOFTWARE

- Node-RED Node Projects
 - More than 2500 nodes exist in the public library, but sometimes you may need to create you own specific node
 - An intuitive wizard for creating Node-RED Node projects
 - Benefit from all the usual Eclipse features when developing your node (e.g. SCM integration)
 - Either create a node from scratch or start from one of the existing nodes in the public library
- Unit test of Node-RED nodes
 - Unit tests are created using the Mocha framework and results are shown in a special Node-RED Unit Test view

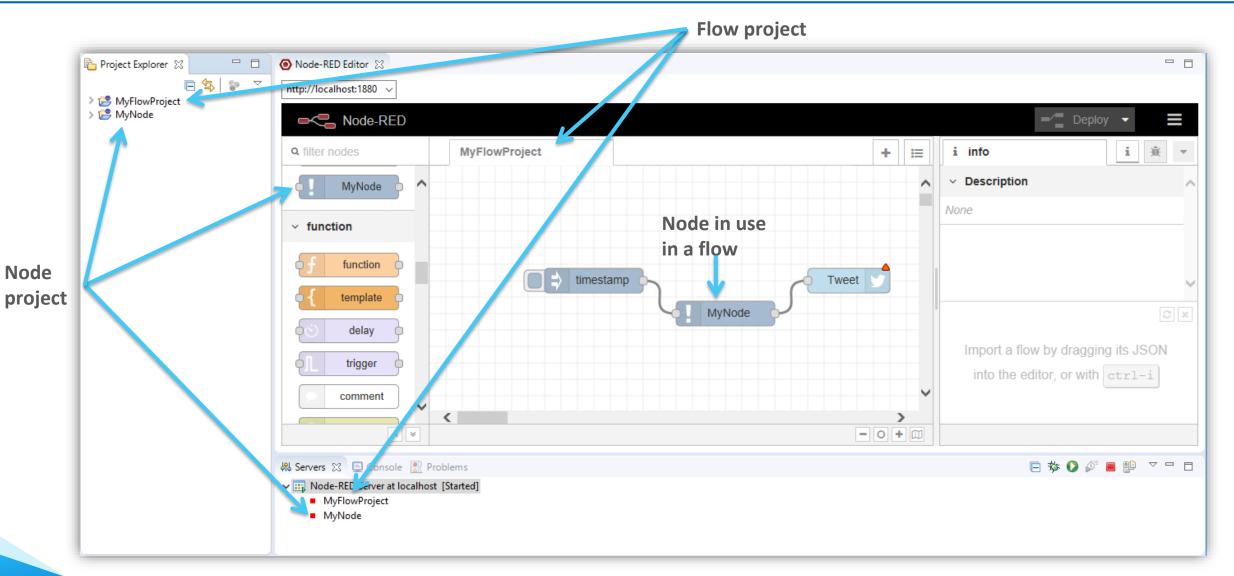
Node-RE	D Node					×
Node-RED	Node					r
Create a No	de-RED No	de Project				
Description:	MySpecial	Node				
Version:	1.0.0					
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Category:	input				\sim	Add.
Number of Number of						
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(?)		< Back	Next >	Finish	Cance	-



Custom "Unit Test" view

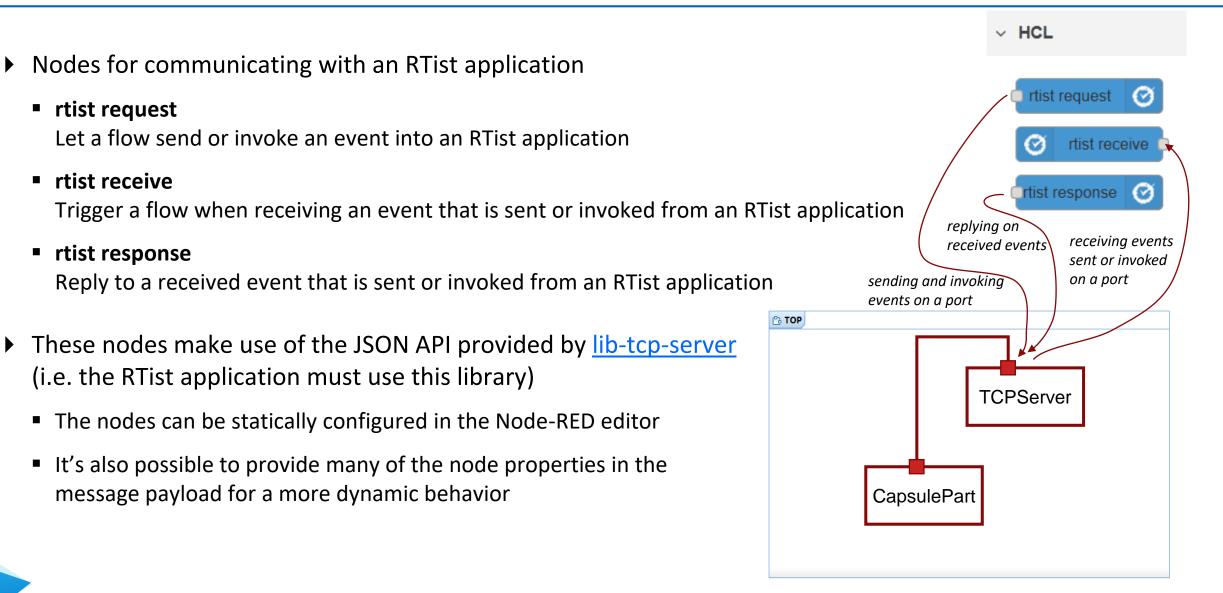
Node-RED Tools in NodePlus





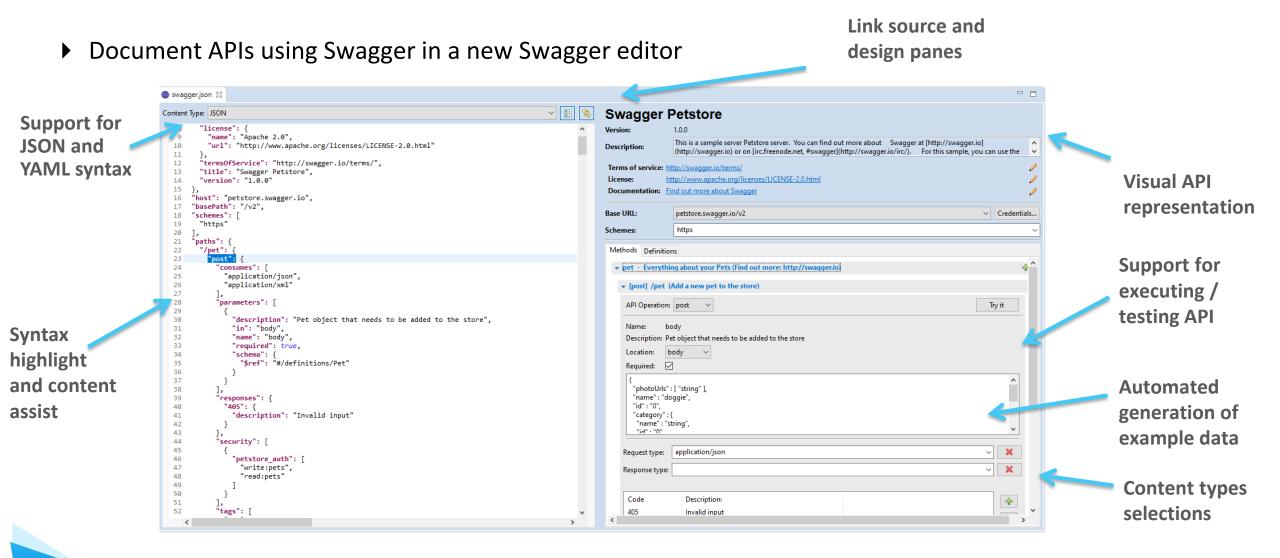
Node-RED Tools in NodePlus





Swagger Support in NodePlus



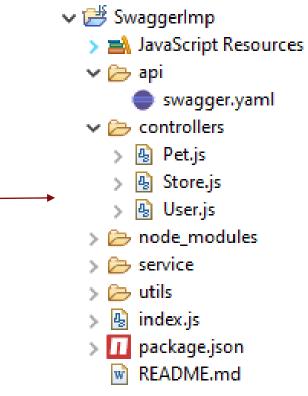


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 Create development projects in different languages, such as Java, JavaScript, NodeJS, Python, etc. from a swagger specification with the Swagger Code Generator Wizard

tion"							~
•							×
Swagger Cod	e Generator						
This wizard he can be *.json (lp you to generate an l or *.yml	Project skeleton base	d on swagger file	, the file			
Input file:	C:\\ Set \\ base a	tre ler onlynd	an golloee	swag	ger.jso	Brov	vse
Language:	nodejs-server					~	
Project name:	SwaggerImp						
?		< <u>B</u> ack	<u>N</u> ext >	<u>F</u> inish		Cance	1
(nout "		_	_				



- Wizard for creating Node.js projects
- Create, start and stop a Node.js server from within the Eclipse workbench
- Debug Node.js applications with a modern JavaScript debugger
- New editor for developing HTML pages for your Node.js application using the Pug template engine

🕒 simplePrimitiveTest.js 🛛 🗟 primitiveTest.js	- 8	🗱 🗣 Breakpoints	Expressions
<pre>1 let myString = "hello"; 2 let myBoolean = true;</pre>	^ _	Name 🗸 🔷 local	Value Object
3 let myNumber = 99;		> 🔷 exports	Object
<pre> 4 console.log(""); 5 console.log("DONE!"); </pre>		> 🔷 require	function require(path) {\n try {\n
6		> 🔷 module	Module
		_filename	"E:\\installs\\eclipses\\photonHIO
		_dirname	"E:\\installs\\eclipses\\photonHIO
		myString	"hello"
		myBoolean	true
		myNumber	99
		> 🗢 this	Object
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E Console 🛛 🖹 Problems 🕖 Debug Shell			■ X 3
SimpleNodeJSServer_src_simplePrimitiveTest.js [HioT Node.js Application] E:\install			
Debugger listening on ws://127.0.0.1:9229/8d50582a-02b5-47db- For help see https://nodejs.org/en/docs/inspector	8cf9-4961	d4727d7e	





Node.js Tools in NodePlus



- Deploy NPM packages into the NPM repository
- Deprecate / Unpublish NPM packages from the NPM repository

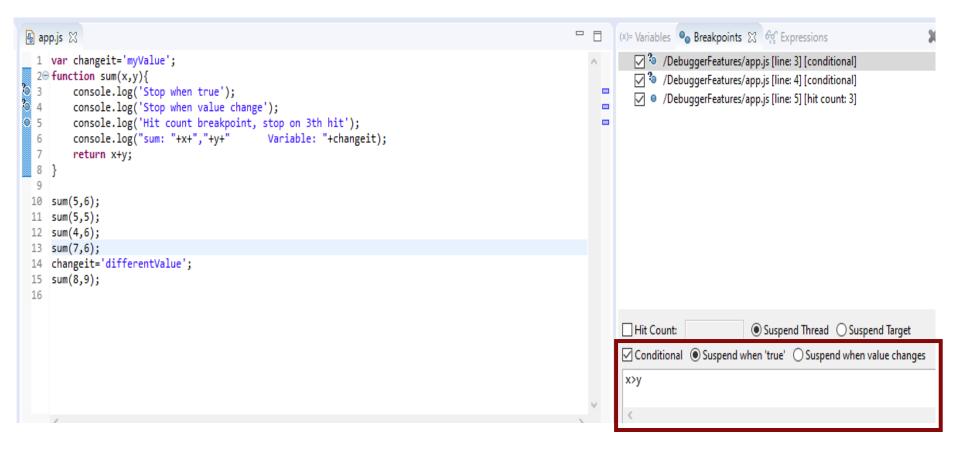
🏟 Publish node to npm and Node-RED library 🦳		×
Packaging Information	Ť	
This section allows you to select files to be included in your node	4	
node-red-contrib- hcl-lower-case-test		Verify
✓ Publish to Node-RED library		
Select the files to be included in your Node publish		
✓ ☑ 🥵 MyNode		
 ✓ iproject ✓ isettings 		
MyNode.html		
✓ ☐ MyNode.js ✓ ☐ Readme.md		
package-lock.json		
🖂 📄 package.json		
ext > Einish Einish	Cano	el :

🔹 Un-Publish npm package	– 🗆 X
NPM Credentials Information This section will validate your credentials before accessing the NPM registry	
User:	
Password: •••••	Save Credentials
Repository: https://registry.npmjs.org	✓ Add Repository
Validate Account Log out Already logged in as user:	Don't have an account?
0	< Back Next > Finish Cancel

			- [) ×
age ions that will be deprecated/unpublished				\bigcirc
All ONPM Only ONode-RED Only	S	earch Filter:		
ser				
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< Page 1/1	>			
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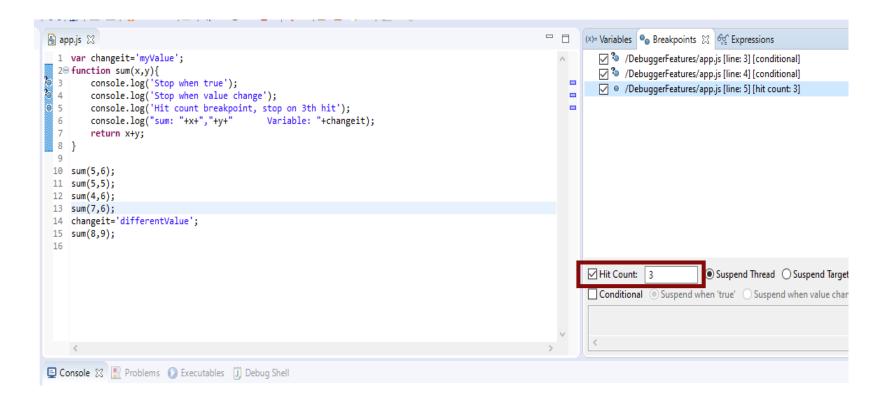


- Support for conditional breakpoints
 - The Node.js debugger can be set to suspend when the conditional expression is true or when it changes





- Support for Hit Count breakpoints
 - The Node.js debugger can be set to suspend when a breakpoint has been hit a certain number of times



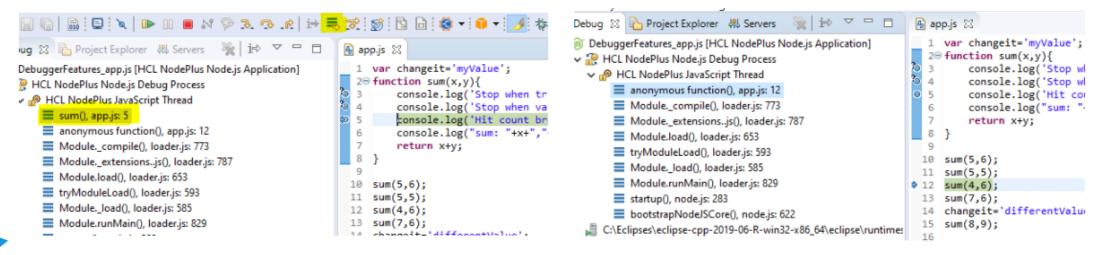


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▶ In the Expressions tab the Node.js debugger can now evaluate a JavaScript expression in real time

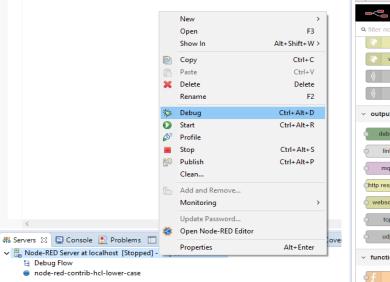
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buggerFeatures_app.js [HCL NodePlus Node.js Application]	1 var changeit='myValue';	^	Name	Value
HCL NodePlus Node.js Debug Process	2⊖ function sum(x,y){ 3 console.log('Stop when true');		X+y =?" "changeit.toUpperCase()+" "+x+","+y"	"DIFFERENTVALUE 8,9"
P HCL NodePlus JavaScript Thread	<pre>2 4 console.log('Stop when value change');</pre>		Add new expression	
sum(), app.js: 4	<pre>ocnsole.log('Hit count breakpoint, stop on 3th hit');</pre>			
anonymous function(), app.js: 15	<pre>6 console.log("sum: "+x+","+y+" Variable: "+changeit);</pre>			
Modulecompile(), loader.js: 773	7 return x+y;			
Moduleextensionsjs(), loader.js: 787	8 }			
Module.load(), loader.js: 653	9 10 sum(5,6);			
tryModuleLoad(), loader.js: 593	10 sum(5,5); 11 sum(5,5);			
Moduleload(), loader.js: 585	12 sum(4,6);			
Module.runMain(), loader.js: 829	13 sum(7,6);		"DIFFERENTVALUE 8,9"	
startup(), node.js: 283	14 changeit='differentValue';			
bootstrapNodeJSCore(), node.js: 622	15 sum(8,9);			
C:\Eclipses\eclipse-cpp-2019-06-R-win32-x86_64\eclipse\runtimes	16			
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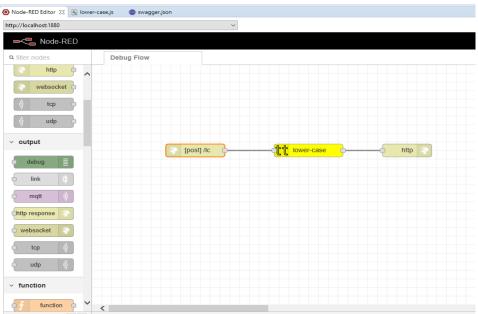
- Support for "Drop to Frame"
 - When the application is suspended you can select a stack frame and press the "Drop to Frame" button to restart execution from there





 You can use NodePlus to debug nodes deployed into Node-RED by enabling 'run in debug' mode





💿 Node-RED Editor 🛛 🚯 lower-case.js 💥 🌑 swagger.json	🖓 🗖 🔅 Variables 🔀 💁 Breakpoints 🚭	<pre></pre>
<pre>1 module.exports = function(RED) { 2 function LowerCaseNode(config) { </pre>	^	🏝 🎫 🕞 🧬 🗱
<pre>3 RED.nodes.createNode(this,config);</pre>	Name	Value
4 var node = this;	V 🔷 local	LowerCaseNode
5 6 mode en(limit) function(ere) (V 🔷 msg	Object
<pre>6 node.on('input', function(msg) { 10 7 msg.payload = msg.payload.toString().toLowerCase(); </pre>	🖕 🔷 _msgid	"b83d8c7a.1520b"
8 node.send(msg);	> 🔷 req	IncomingMessage
9 });	> 🔷 res	Object
10 }	payload	"DEBUG Sample"
	> 🔷proto	Object
<pre>12 RED.nodes.registerType("lower-case", LowerCaseNode); 13 };</pre>	[[StableObjectId]]	2
14	[[StableObjectId]]	1
	> 🔷 this	LowerCaseNode
	> 🔷 closure (LowerCaseNode)	
	> > closure (module.exports)	
	> 🔷 global	



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You can now debug Node.js applications that are running on Cloud Foundry

Debug Configurations			- 🗆 X	Cons	Probl	🖏 Progr 🧯	Error	Debu	🍠 Termi	🎋 Debug 😒	● Break	해 Servers	Palette	- 0
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3			Debug Close											

Unit Testing with Mocha



- Node-RED nodes and Node.js applications can be unit tested using the Mocha framework
 - Unit tests can also be debugged

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- Using the TCP Server library in an RTist application makes it possible to test it too with Mocha
 - An example is here <u>https://github.com/hcl-pnp-rtist/rt-test-probe</u>
- Results from unit testing are shown in a JavaScript Unit Test view

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Relationary BEYOND THE CONTRACT

\$7 BILLION ENTERPRISE | **110,000** IDEAPRENEURS | **31** COUNTRIES

