
Radii Documentation

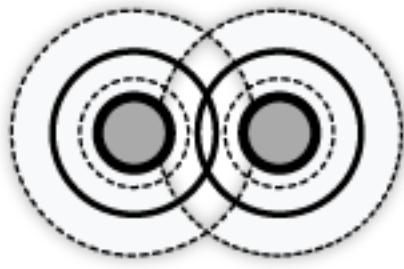
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Gereon Sievi

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RADii

RADii a Cloud platform where you can publish (upload) your 3D Models, share, explore and collaborate on them.

RADii consists of two parts, a Rhino Grasshopper plugin to publish (upload) 3D Models and Viewers for different devices (for PC/Mac, VR Glasses or mobile devices) to receive and explore the models.

RADii is being developed by Thomas Lee since 2020, in 2022 he started a collaboration with Gramazio & Kohler Research at ETHZ for further development of the tool in the context of the Immersive Design Studio. More information, updates and the program can be found at radii.info. Videos about the current development as well as new features are available on the [Arctica Youtube Page](#) This project is still under development, should you find bugs or out of date documentation please notify us on [Github](#)

**CHAPTER
ONE**

DOWNLOAD LINKS

Grashopper Plugin:

- Radii Win/Mac
- Radii Capture Win/Mac

PC Viewers

- Windows 10+
- macOS X

Further viewers for VR, Mobile, Looking Glass and the Webviewer can be found at radii.info.

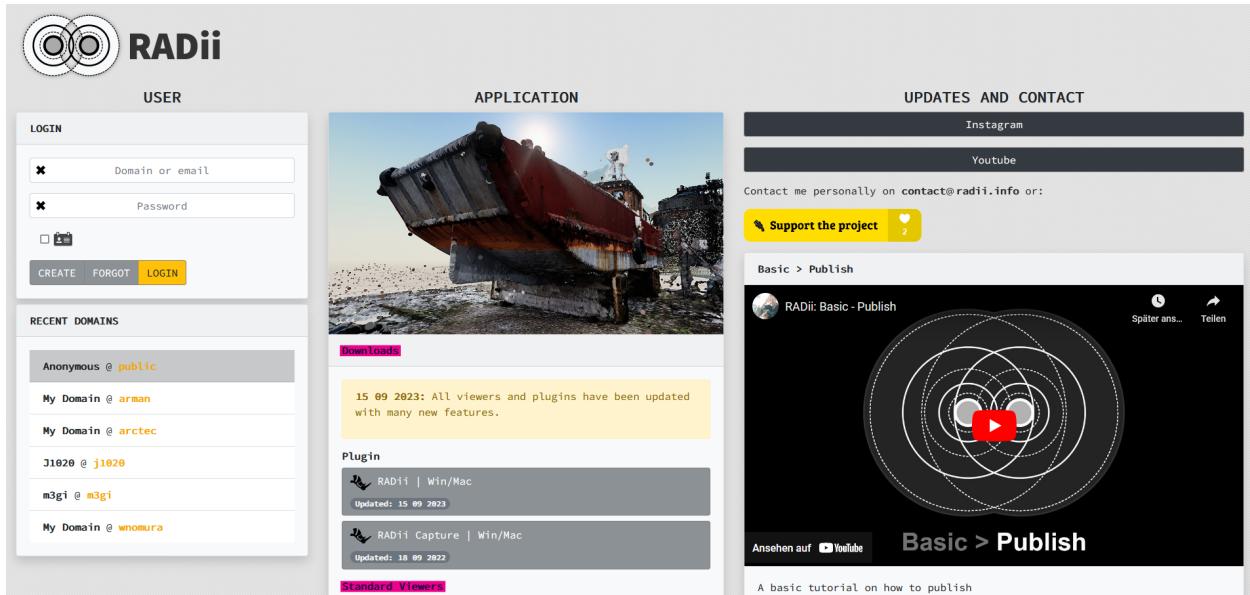
CHAPTER TWO

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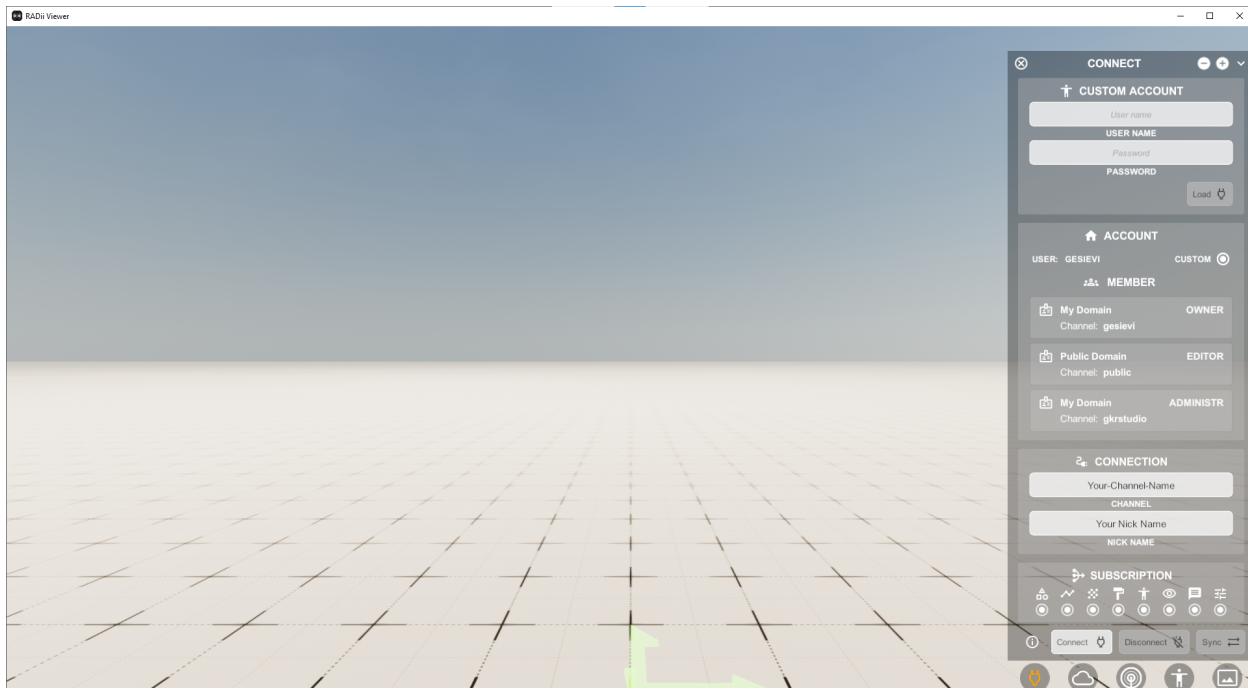
2.1 Setup

2.1.1 Viewer PC/Mac

To explore models in Radii you need a viewer, this is a program that enables you to join a server (we call them channels) and download the models. Viewers are available for a number of different operating systems such as Windows/Mac, iPhone/Android and Oculus. The viewers are generally the same but have some differences, usually due to computing power.



1. Download the latest Radii Viewer from <https://radii.info/>
2. Register in the user panel and confirm your email
 - it is not necessary to set a domain name
3. Install the file
4. Start RADii Viewer

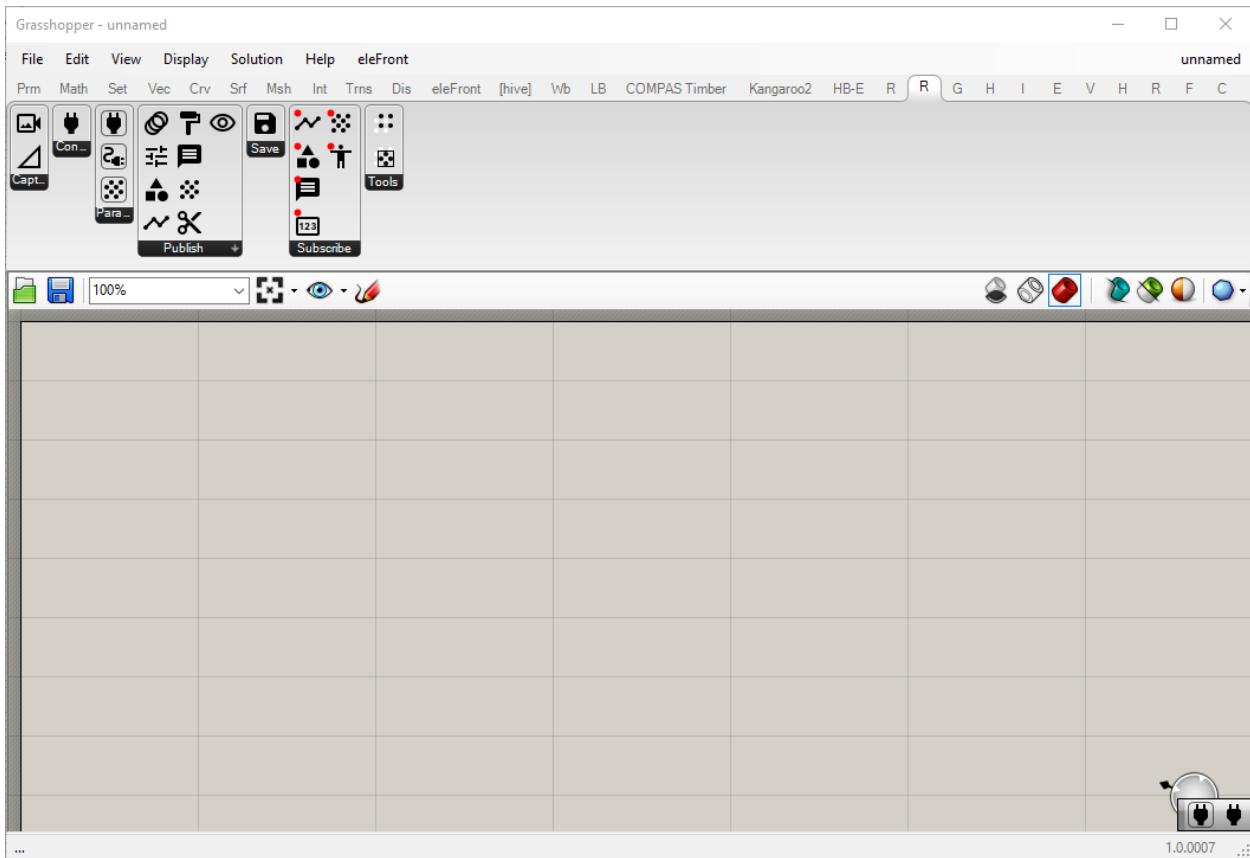


Congratulations you have installed Radii. On how to use Radii consult the Quick Guide and the Viewer documentation

2.1.2 Grashopper Plugin

The plugin enables you to publish (send) 3D models and other geometry. Publishing works similar to a Radio station, geometry can be received by others as long as they are connected to the same channel as the sender.

1. **Download** the latest Radii Plugin from <https://radii.info/>
2. **If you did not already:** Register in the user panel and confirm your email
 - it is not necessary to set a domain name
3. **Unpack** the .Zip file
4. **Drag & drop** the Radii.gha file it into the Rhino Grashopper window, you open it by typing the “grashopper” command in rhino
5. **Check** if the install was successful, it should be visible in one your tabs as shown below.



Congratulations ! you have installed Grashopper Radii. On how to publish consult the Quick Guide and the Radii Grashopper documentation

2.1.3 Oculus

Please be aware that the Oculus and its environments are subject to frequent changes, the following tutorial might be out of date or diverge slightly from the current state. We are hoping to release a viewer through the app store at a later stage.

1. Download the advanced version of sidequest from <https://sidequestvr.com/> and install it
2. Download the .apk file from Radii.info in the Download section
3. Set your Oculus account to developer mode (you have to be part of a developer organization), log in to your account on your device and enable Settings > System > Developer, and then turn on the USB Connection Dialog option.
4. Connect the Oculus to your device and start side on the later
5. Allow for debugging on your Oculus
6. On sidequest select the install .apk file and install

To find the Radii Viewer app on Oculus:

1. Select the app library
2. Filter apps for unknown sources
3. Start Radii Viewer VR

Congratulations you have installed Radii on your Vr device

2.1.4 Technical Prerequisites

To use Radii a Pc with an internet connection and Windows or Mac operating system is needed. The computing and ram capacity can vary greatly depending on the size and detail of the 3D model. The Rhino Grashopper plugin is generally very efficient and can run on older machines. The Radii Viewer for PC as a live renderer need more computing power. It can be necessary to run Rhino on one machine and the viewer on another for a seamless use.

We advice for an absolute minimum of 4GB of RAM, better would be 8GB that is current standard, or more. The deciding technical factor for the viewer is the strength of the used graphic card

During our tests, on a range of devices, we have observed that:

- simple and small models can be viewed and streamed in parallel on a medium strong laptop
- for bigger models we advice for a strong graphic card and at least 16 GB of RAM for the viewer and potentially the use of a second device for publishing with Rhino Grashopper

Server Storage:

By creating an account you get a limited amount of server space that you can use. If your models are bigger you need to apply for more. As member of an affiliated organization your will automatically recognized if you register with your organizations email address.

2.1.5 Preparation, time and infrastructure

Lv 1. A walkthrough with a group:

Preparation and time: 1 Day for the publisher, 20 min. for the group

The publisher: understand the basic of how to stream geometry with Radii Grashopper and the basics on operating the viewer. The observers: Install the viewer, log into the server and navigate

Tech:

The Designer: min. a laptop of medium strength for streaming and running the viewer in parallel The observers: min. a laptop of medium strength for running the viewer

Lv 2. Class of students work and develop their projects through a semester with Radii:

Preparation and time: 3-4 days of preparation to understand the program and be able to teach it.

We teach Radii in 3 seatings throughout the semester in a total of 5 hours, with constant usage in between. This enables the student to test models in Radii as well as present them at the end.

The first 1,5 hours explain the basics on how to use the viewer and the grashopper plugin For the viewer this includes how to connect to a channel and navigate in a model. In grashopper is is about the most basic workflow and most important publishing components. In the second sitting we introduce the saving to the cloud and locally in radii files, how to animate, define views and basics of publish control. The third class goes into detail about the scenario manager that is part of publish control and leaves time for possible subscribe components.

Tech:

- Personal laptops of medium strength for each student
- Min. one strong PC for presentations for the viewer to run on
 - ideally one per group to allow for stronger access and testing
- A bigger screen/projector relative to the size of the class

- Optional:
 - Oculus or other Vr devices (at the time of writing only Oculus is supported)
 - Phones or Ipads for augmented reality usage
 - Open space to walk around in VR/Ar

Lv 3. Interactive collaborative work

TO BE ADDED

2.2 Radii Viewer Overview

The RADii Viewer is a program used to connect to the RADii channels and explore the models. It can be run on Win/Mac, Oculus, iOS 11+ Android 7+ and a browser.

In the following chapters you can find a detailed documentation of all parts of the Radii Viewer. Please keep in mind that this project is still in development and might have changed over time.

In case you might find something unclear, out of date or missing please contact the Chair of Gramazio & Kohler at ETHZ gesievi@ethz.ch

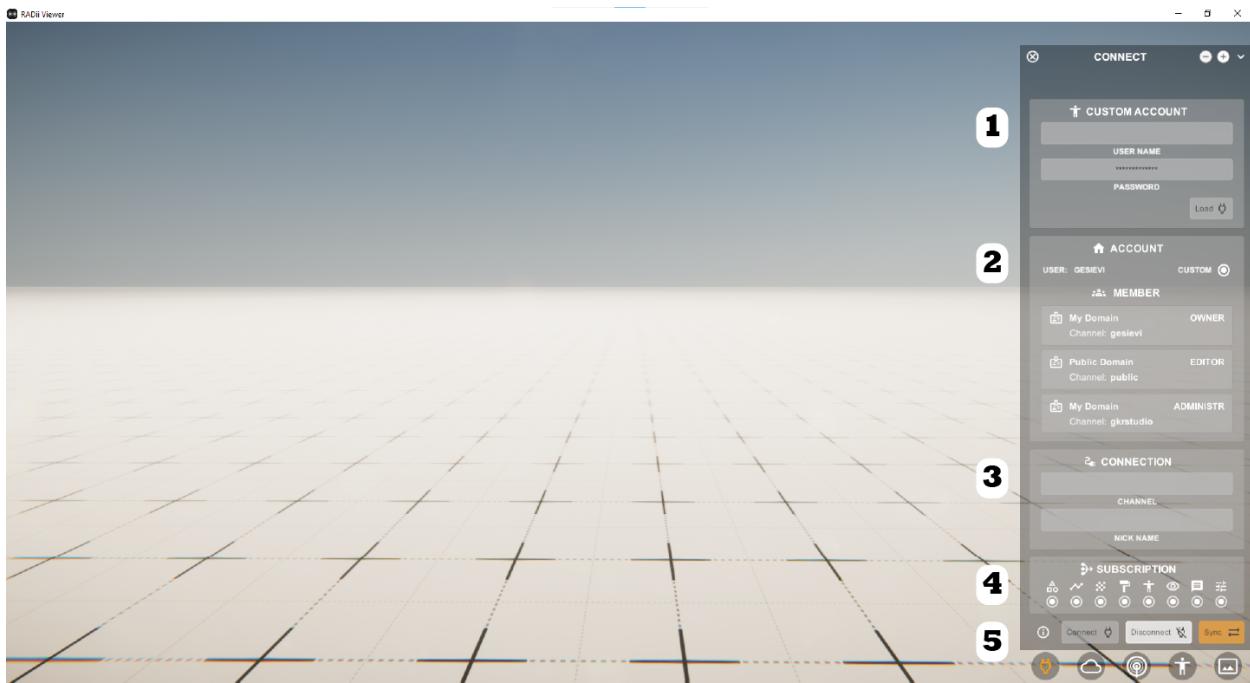
Keyboard Assignments

Movement	W,A,S,D
Jump	Space
Shift	Sprint
Q Fly	Up
E Fly	Down
Right Mouse	Main Menu (open,close)(3.1-3.5)
Left Mouse	Operation Menu (3.6)

Viewer Page Menu:

2.2.1 Connect Menu





1. Custom Account from Radii.info

- Necessary if you want to edit items in cooperation with others

2. Account

- Lists all channels you have access to and your rights (owner/editor/administrator)

3. Connection

- Channel - input the channel address and the subchannel you want to access, separated by a point: channel name.subchannelname
- Nickname - displayed for others on the server

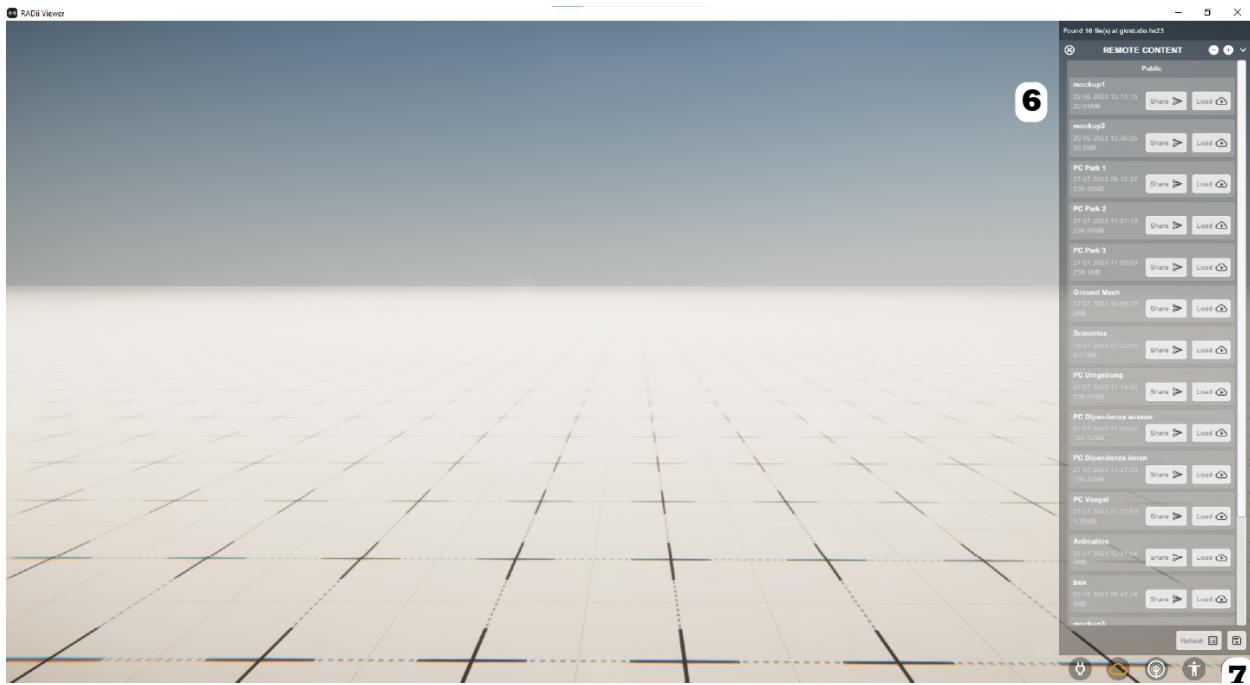
4. Subscription

- The types of data you receive: geometry, lines, point-clouds, textures, other players, views, messages, settings

5. Server

- I - Info menu with version number, radii.info, Privacy Policy and Terms and Conditions
- Press Connect after setting the channel name
- Disconnect to leave the channel
- Sync - synchronize
 - you will receive all data that is being sent to the channel at the moment

2.2.2 Remote Content Menu

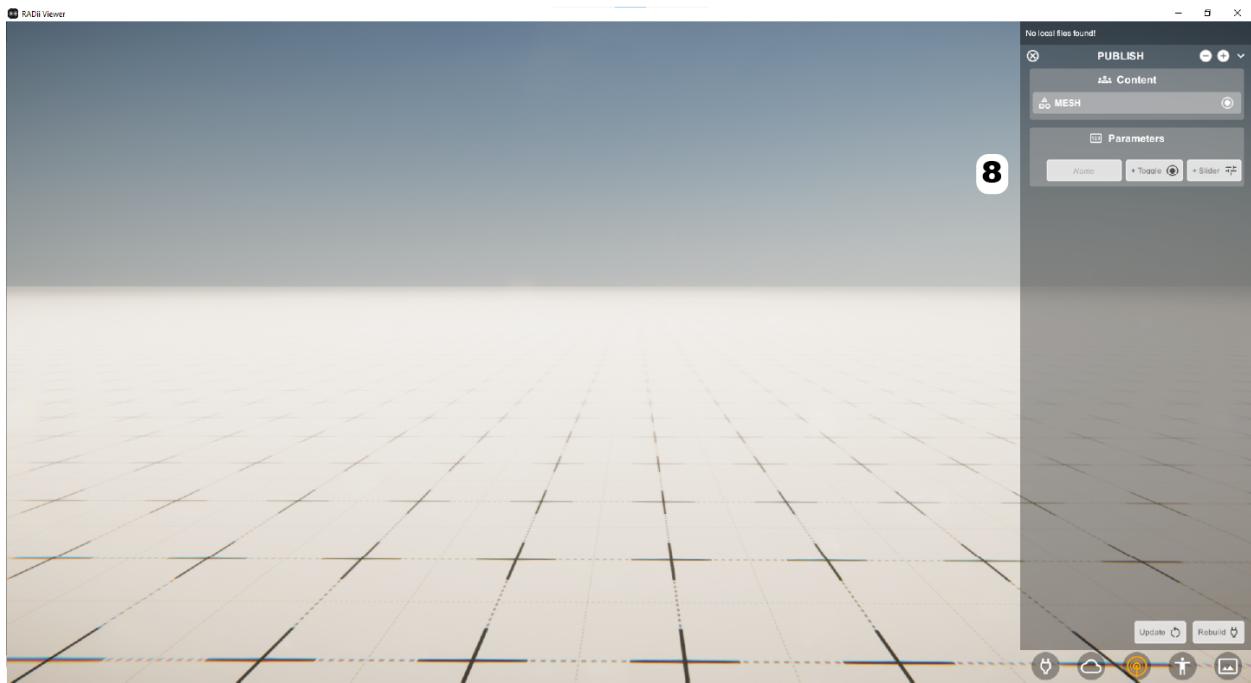


6. This menu displays data stored on the channel, once you input the channel address.

7. Opens the save menu

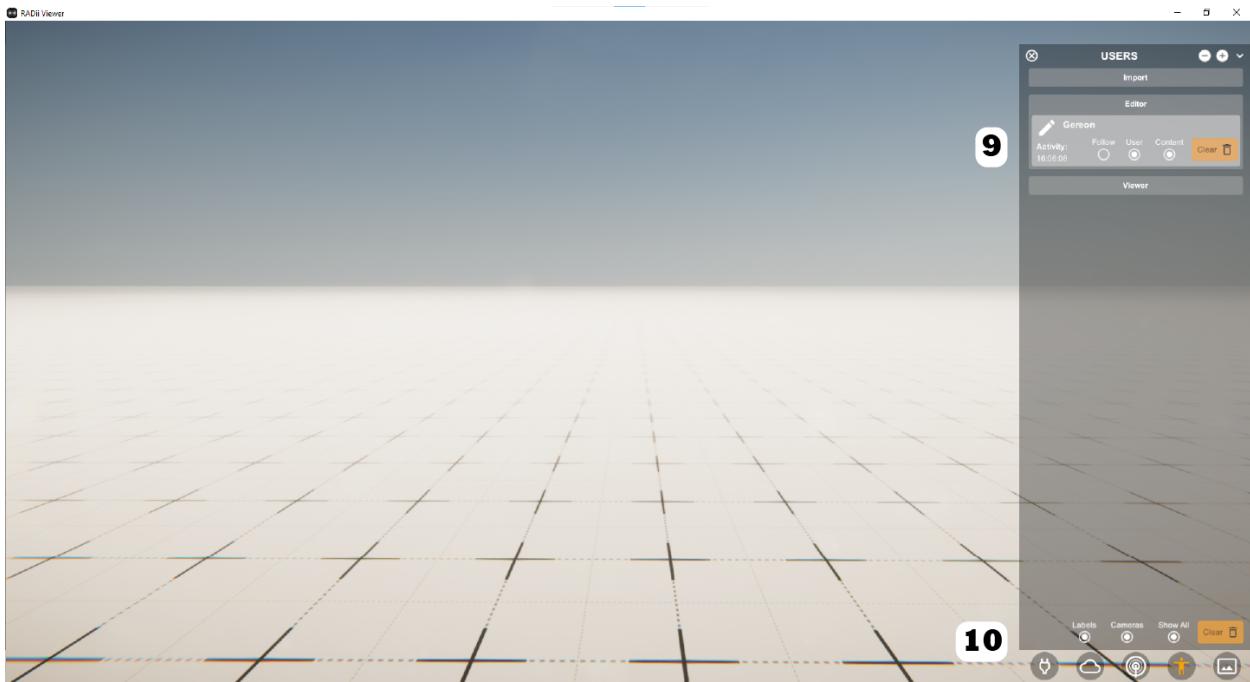
- Export = exports a radii locally
- Import = imports a radii file from a path
- Save = saves a radii file locally in a standard path

2.2.3 Publish Menu



8. Parameters - send parameters back to grasshopper
 - **Add by typing a name and click:**
 - Boolean (on/off)
 - Slider (Number between 0 and 1)
 - To receive them in grasshopper use the `SubscribeParameter` component

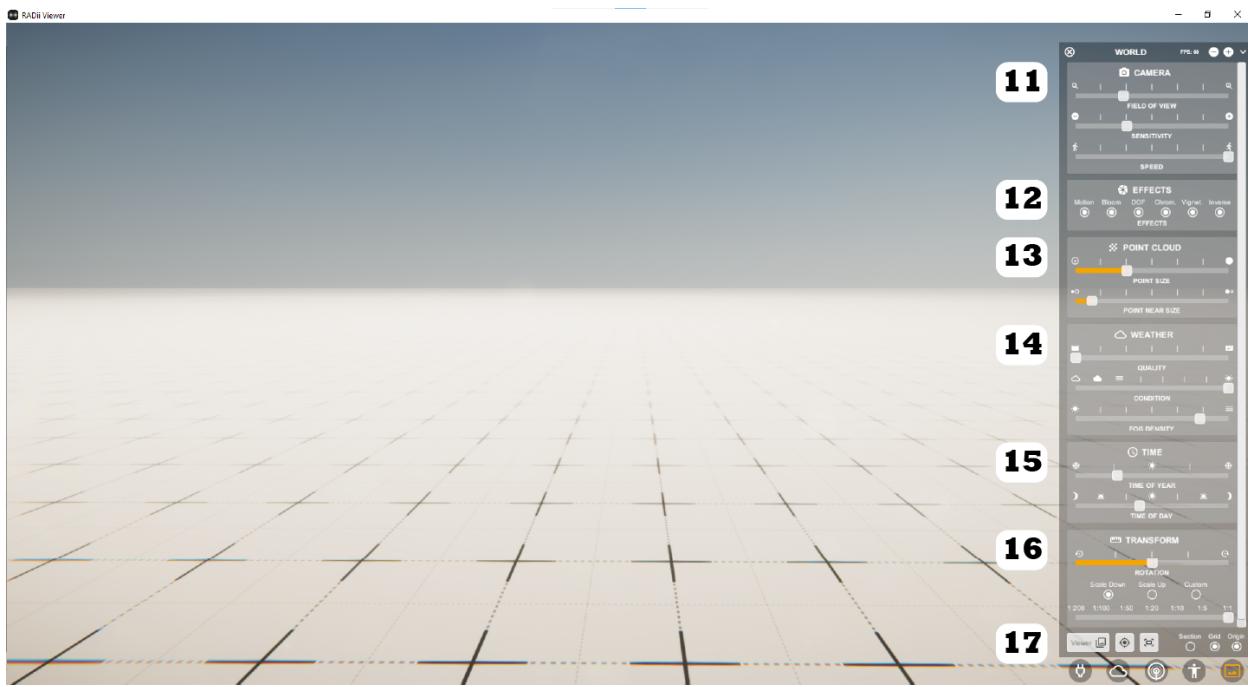
2.2.4 Users Menu



Users - List of all data in the viewer

9. Import / Editor / Viewer
 - Import = data loaded from RADii file
 - Content - toggle content
 - Clear - delete content from viewer
 - Editor = data that was sent from RhinoGrashopper
 - Follow - follow the rhino view of the user
 - User toggle avatar
 - Content - toggle content
 - Clear - delete content from viewer
 - Viewer all other viewers that are on the channel
10. Data & Cameras = toggle labels
 - Clear = delete all content from viewer

2.2.5 World Menu



11. Camera

- Field of view - controls the field of view at the cost of some distortion
- Sensitivity - mouse sensitivity
- Speed - movement speed

Note: turn slow when someone is following you through the project

12. Effects

- turning them off increases performance

- Motion = motion blur
- Bloom = makes bright spots bleed at the edges, simulating a real camera
- DOF = depth of field - distance between closest and furthest part of an image that are in focus
- Chrom = chromatic effect - adds artifacts to the image, simulating a poor len
- Vignet = darkening on the edges of images, simulating real cameras
- Inverse = clipping/sectioning leaves a ghost of the hidden geometry

13. Point Cloud

- Point Size
- Point near size = increases point sizes near you

Note: point clouds are disabled in IOS/Android viewers because they require a lot of computing power

14. Weather

- Quality = resolution of the sky, above lv3 not significantly better
- Condition = types of weather: rainy, foggy and sunny
- Fog density = can hide the horizon but also your model

Note: for better performance: turn weather to sunny, fog off, quality to lowest

15. Time

16. Transform

- Rotation = rotates all models around the 0 point
- Scale

17. Select Viewer

- **Standard**

- Stereo Shutter = for active 3D glasses
- Chroma Key = a virtual green screen
- Pepper Ghost = displays the model in a virtual box
- Augmented Reality (AR) = displays virtual model in a real environment - available on IOs, Android, Oculus

- Tracker Method = setting for AR devices

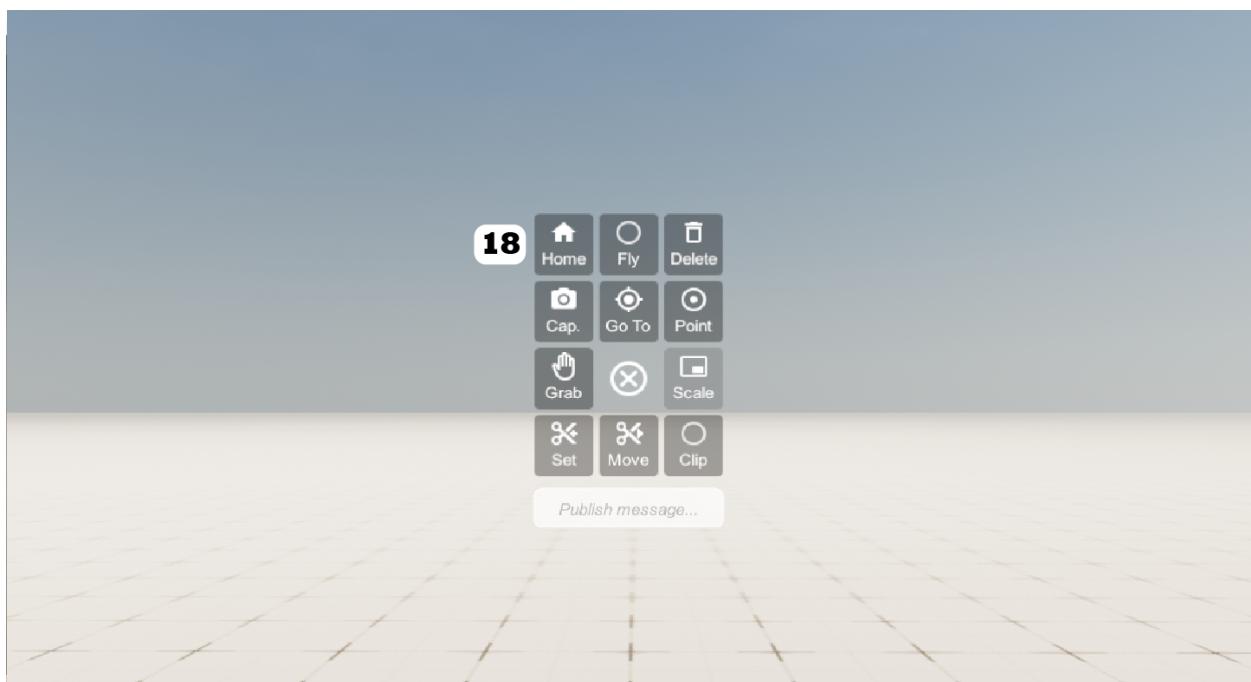
- **Projection = screen size settings**

- you can also edit the overall scale, height of horizon

- Grid = toggles the default floor

- Origin = toggles the origin point

2.2.6 Operation Menu



Open the Operation menu with a left click, close it with a right click

Home = moves you to the origin	Fly = makes you fly and turns off collision for you	Delete = delete selected object
Cap = screen capture	Go To = move to a point	Point = (laser) pointer visible to all in the same channel
Grab = move a part of a model - changes made are visible to others if geometry is published as shared to <i>copy</i> : point on geometry hold Ctrl + Left mouse	X = left click to close the menu or right click anywhere	Scale = scale a selected model
Set = set the section	Move = move the section	Clip = toggles sections - to display the geometry shadow toggle World menu -> Effects -> Inverse

2.3 Grashopper Overview



There are 6 types of components:

Connect is the fundamental component to connect to a channel, it is always connected to all components that are in use.

Params relay the described datatype

Publishing components can send data to a channel and its connected receivers.

Save enables you to save locally to .radii files or on a channel in the cloud.

Subscribe imports data from a connected channel to your local Rhino Grashopper session. The data can then be further processed or saved.

Tools to modify point clouds

2.3.1 Grashopper Components

Publish Components

Connect

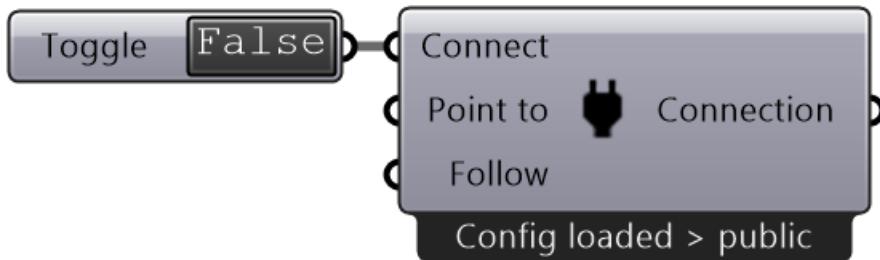
The connect component is the central component of the radii plugin, every other component is connected to the connection part.

Input

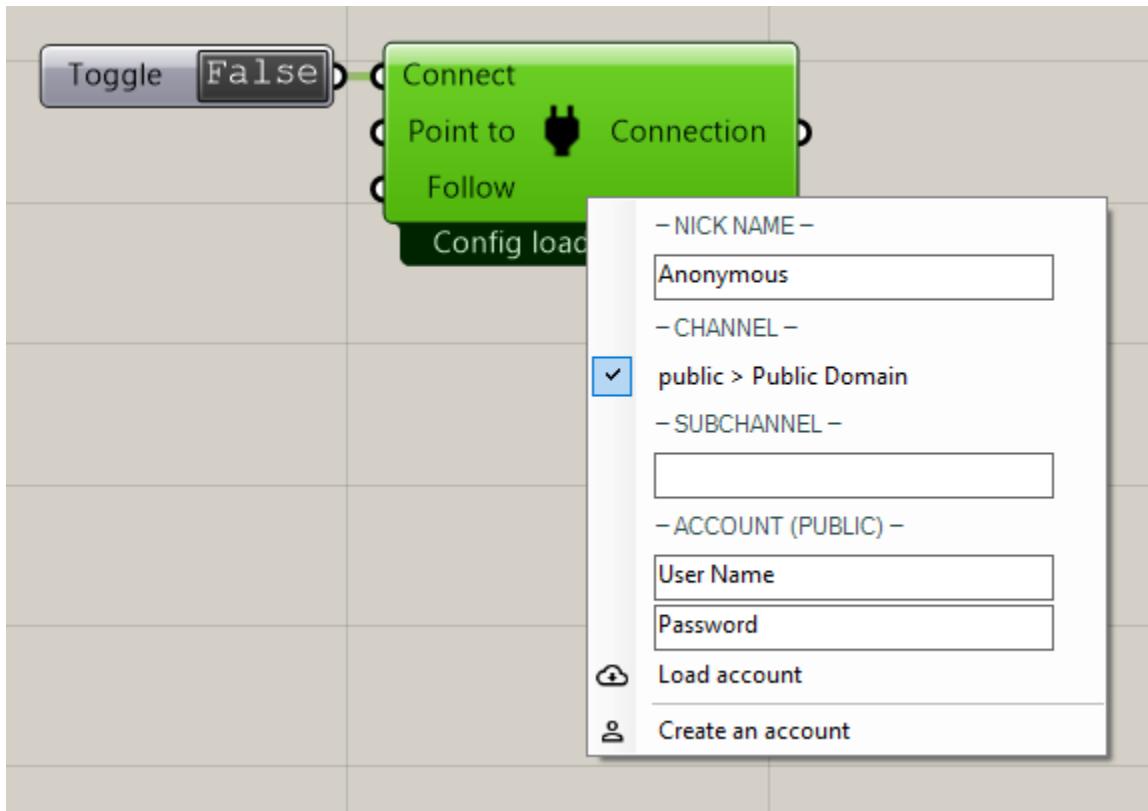
Name	Description	Type
Connect	Start the connection to the server	Boolean
Point to	The rhino view is sending a pointer	Boolean
Follow	Everyone follows the rhino view	Boolean

Output

Name	Description	Type
Connection	All further components have to be connected here	Radii components

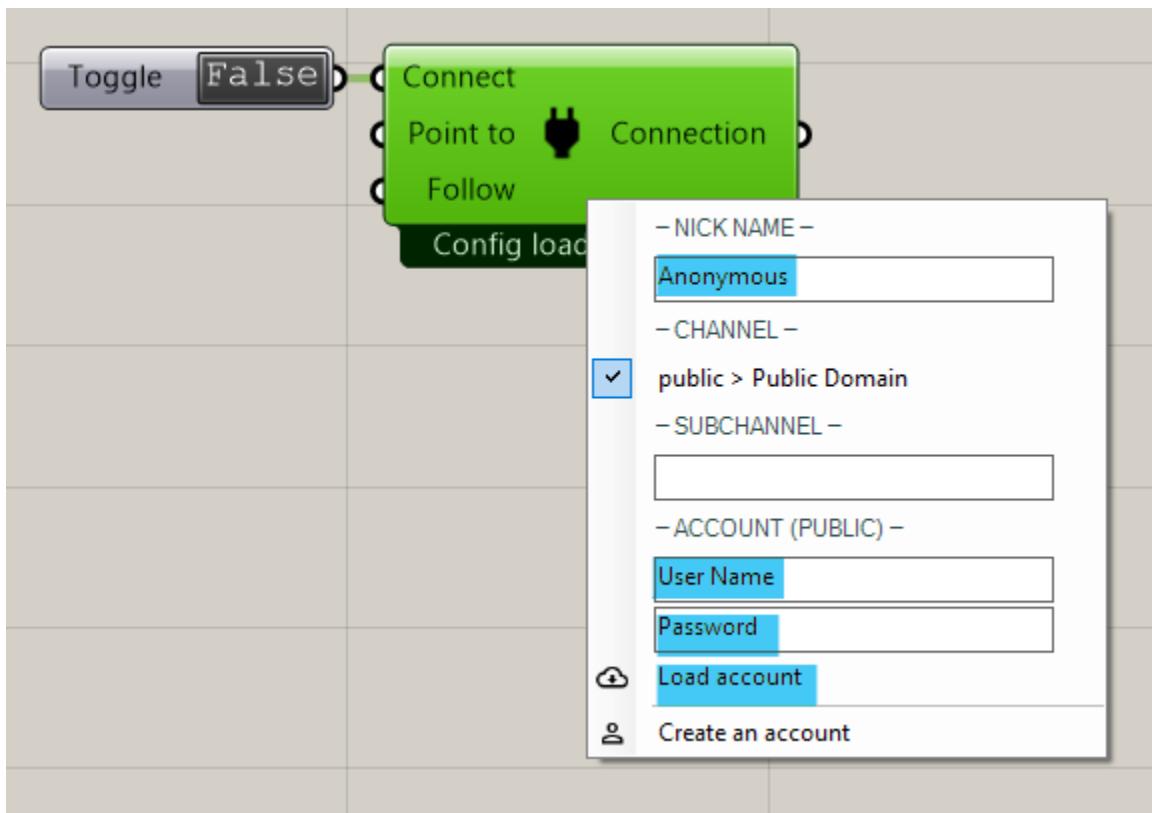


Right click menu:

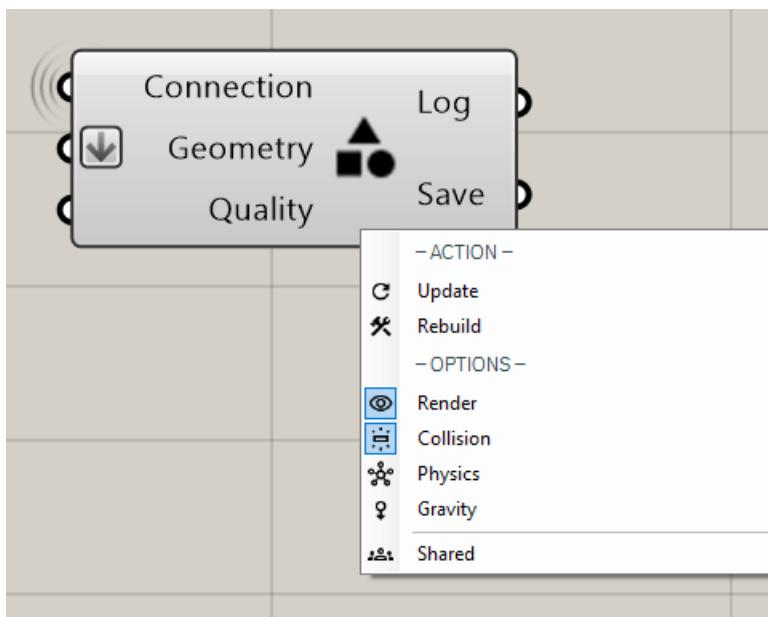


- Give yourself a nickname - this will be your visible name in the viewer
- **input your:**
 - User Name
 - Password
- click on load account
- if you do not have an account create one on radii.info

Note: please use your ETH-mail so we can connect you to the studio



PublishGeometry



Input

Name	Description	Type
Connection	Link with the Connect component	Connection
Geometry	Geometry you want to upload	Brep or Mesh
Quality	Mesh Quality for conversion	Settings

Quality: To control the quality of your geometry you can use the following components

- Setting (Speed)
- Setting (Quality)
- Setting (Custom)
 - use “Min Edge” to set the minimal edge length this will make your model low poly if you go to high

Output

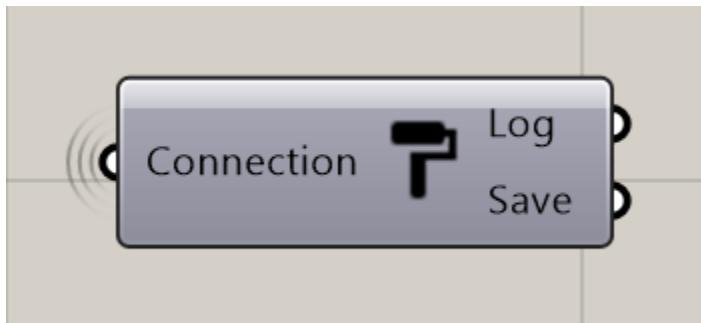
Name	Description	Type
Log	Documents changes & data send	Text
Save	Connect to Save component for saving Radii content	

- Log can help identify how much data and what kind of it is sent

Menu:

Update:	update only changed geometry
Rebuild:	republish everything in the component
Render:	visible/invisible
Collision:	permeable/impermeable
Physics:	objects push on each other
Gravity:	9.807 m/s ² pulling on each object
Shared:	collaborative editing of geometry in the viewer

PublishMaterial



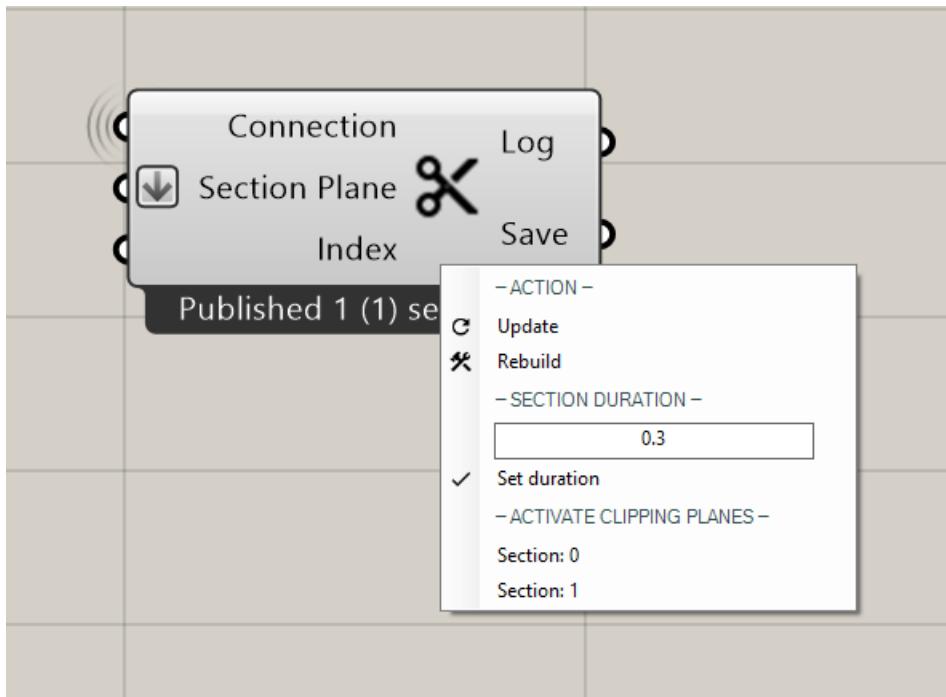
Input

Name	Description	Type
Connection	Link with the Connect component	Connection

Output

Name	Description	Type
Log	Documents changes & Data send	Text
Save	Connect to SaveContent for saving Radii content	Radii content

PublishSection



Input

Name	Description	Type
Connection	Link with the Connect component	Connection
Section	Plane A plane that will cut the model	Plane/surfaces
Index	Select a plane from a list	Number

- at the time of writing index only works for a list of surfaces in the input: section plane
- Rhino clipping planes have to be selected in the menu at -Activate clipping planes-

Output

Name	Description	Type
Log	Documents changes & Data send	Text
Save	Connect to SaveContent for saving Radii content	Radii content

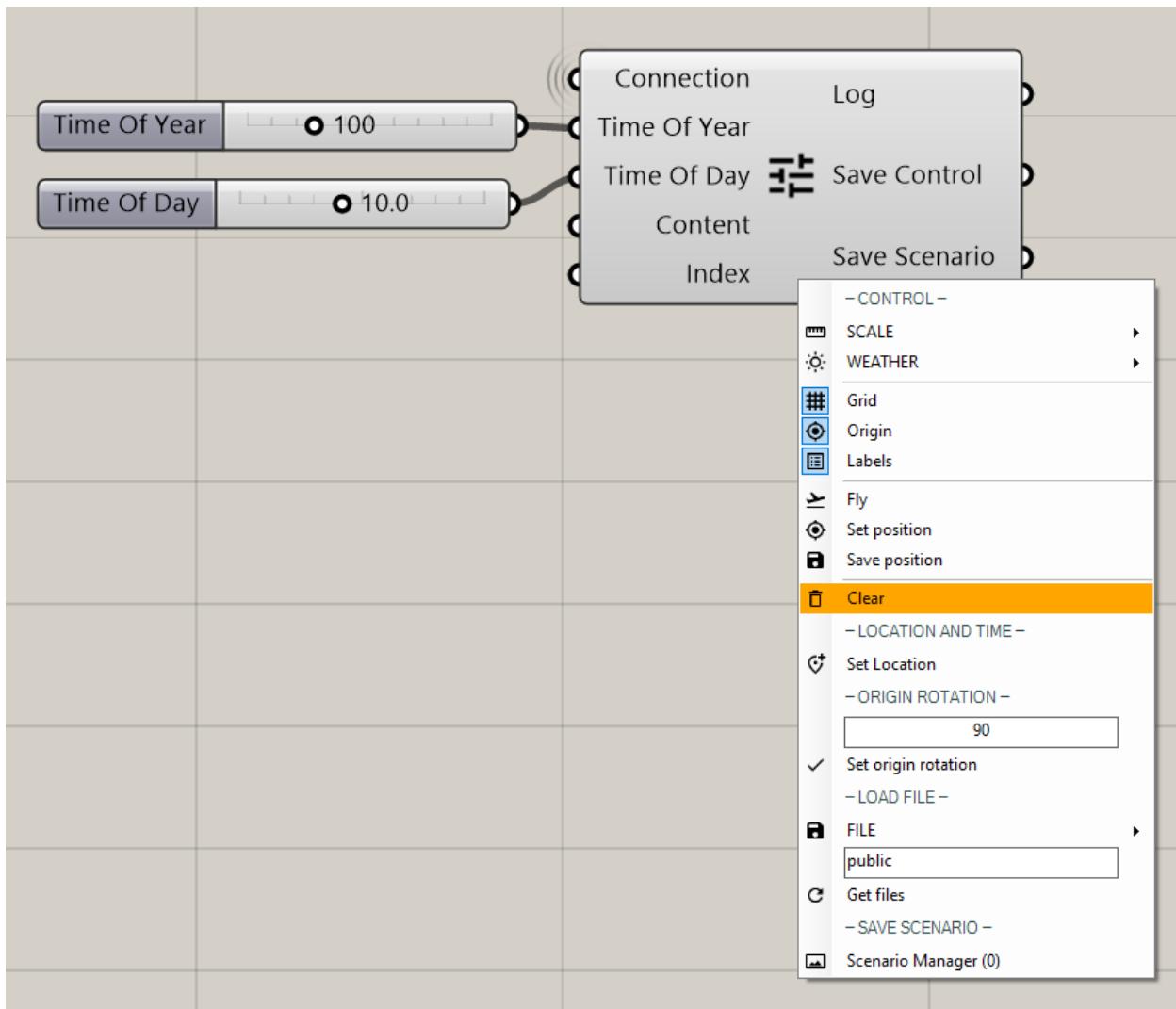
Menu

Section Duration:	how quickly the section is moving into place
Set duration:	toggle to have a moving clipping plane
Activate clipping planes:	clipping planes from rhino to be selected

Note:

- In Rhino flipping a clipping plane is not recognized by Radii, rotating the plane by 180° however archives the same
- Names of clipping planes are not carried over into the grasshopper plugin

PublishControl



Publish control lets you control the viewer settings from grasshopper

- Everything you set as input can be saved in this publish control component with the scenario manager. Be careful with geometry content, this can make your grasshopper file very heavy.

Note: Grasshopper has an autosave. If the Publish Control component becomes too heavy, it will make you wait a lot

Input

Name	Description	Type
Connection	Link with the Connect component	Connect
Time of Year	Day of the Year	Number
Time of Day	Time of the day	Number
Content Save	output from other radii components	save (Radii)
Index	For switching between scenarios	Number

Output

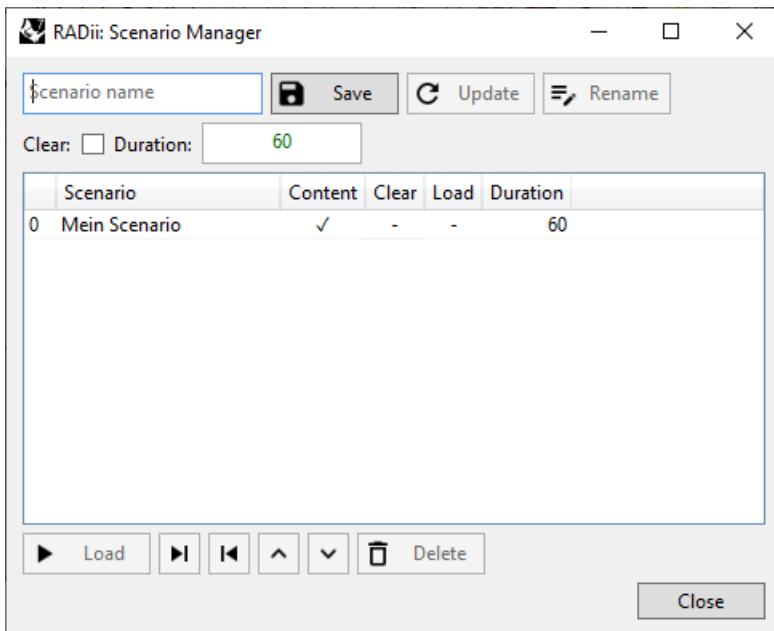
Name	Description	Type
Log	Documents changes & Data send	Text
Save Control	Saving the controls only	Radii
Save Scenario	Save control and geometry	Radii

Menu

Name	Description
Scale	Set the model scale
Weather	Weather options
Grid	Toggle base floor
Origin	Toggle origin sign
Labels	Toggle all labels
Fly	Forces viewers to fly
Set position	Set the camera of your active rhino viewport as position
Save position	Include the position in a scenario save
Clear	Clears all content from viewers
Set Location	Sets the world location for the sun
Origin rotation	Rotates the model by x-degrees
Set origin rotation	Confirm rotation
File	Displays the files from the channel that you can input below
Get files	Connects to the channel, now the saved files appear in files
Scenario Manager	Opens the scenario manager, you can save your scenario with all settings from above

- with files you can command the scenario manager to directly download a file from the server instead of uploading it and sending it to the viewers

Scenario Manager



The scenario manager lets you save the selected options of the publishControl component and content that is connected to it.

Clear	clears the scene between each scenario - this can mean that you are uploading your geometry every time you load a new one
Duration	length of the scenario

Column descriptions

Blank	Number of the scenario
Scenario	name of the scenario
Content	is content send (geometry, views, etc.) you could just send settings (time, position etc.)
Clear	Clears the channel before uploading new geometry
Load	loading from the channel
Duration	of the scenario

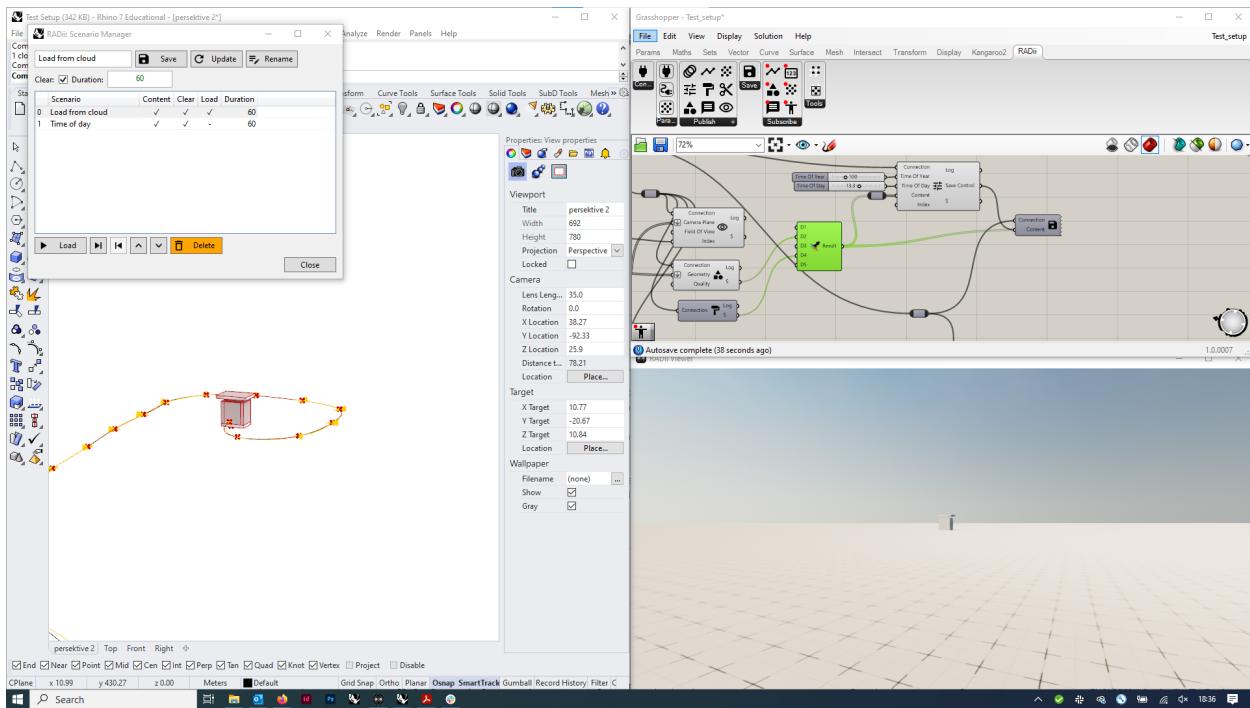
The saved content is stored in the component, be aware that huge amounts of geometry can make your .gh file very heavy and slow.

The current best practice for heavy geometry is to upload it to the server via the cloud manager in the save component and then command the download via the publishControl → File settings

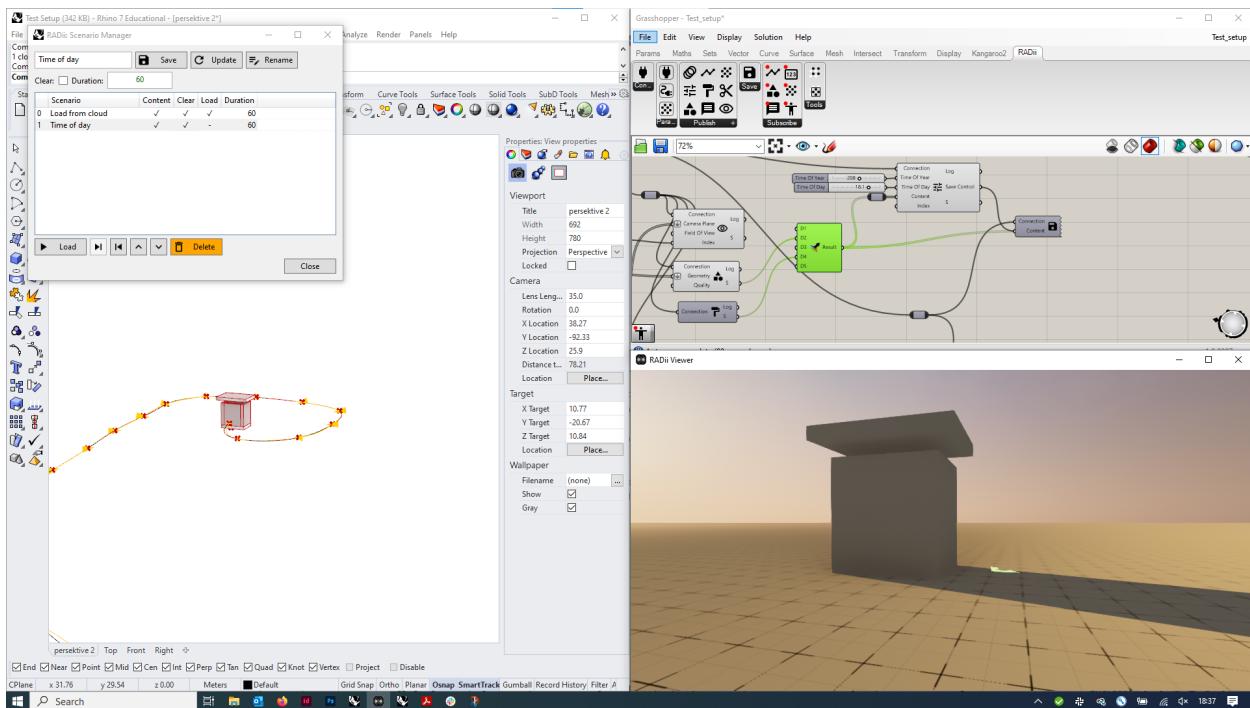
Examples

You have some geometry (a building) and want to publish or download from the server (1), then walk through it, change the time of the day (2) and continue your tour via a series of pre defined views (3-4). Instead of setting everything live during your presentation, you define one position after the other and save them as individual scenarios. You then can switch through them during your presentation more easily.

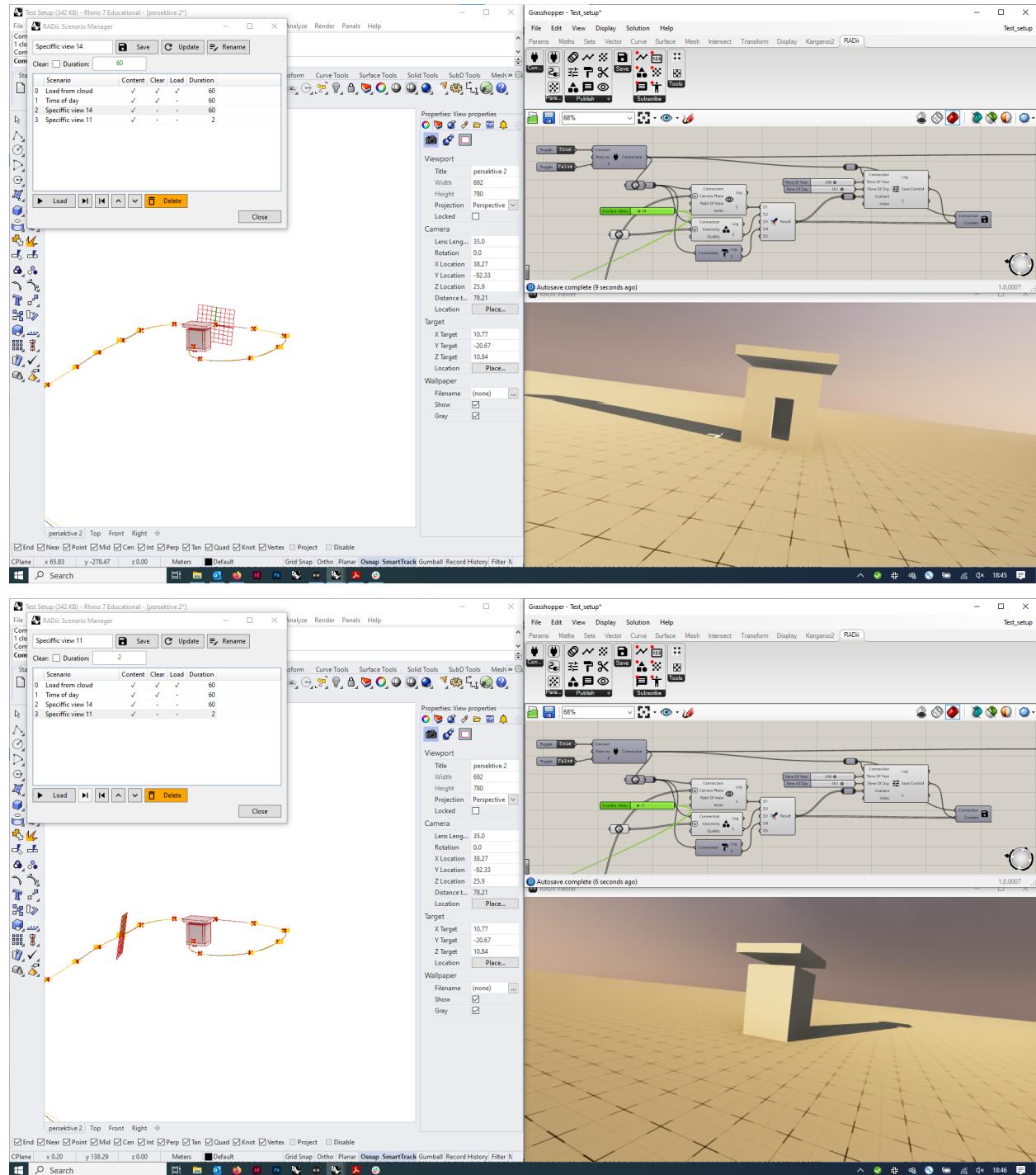
1)



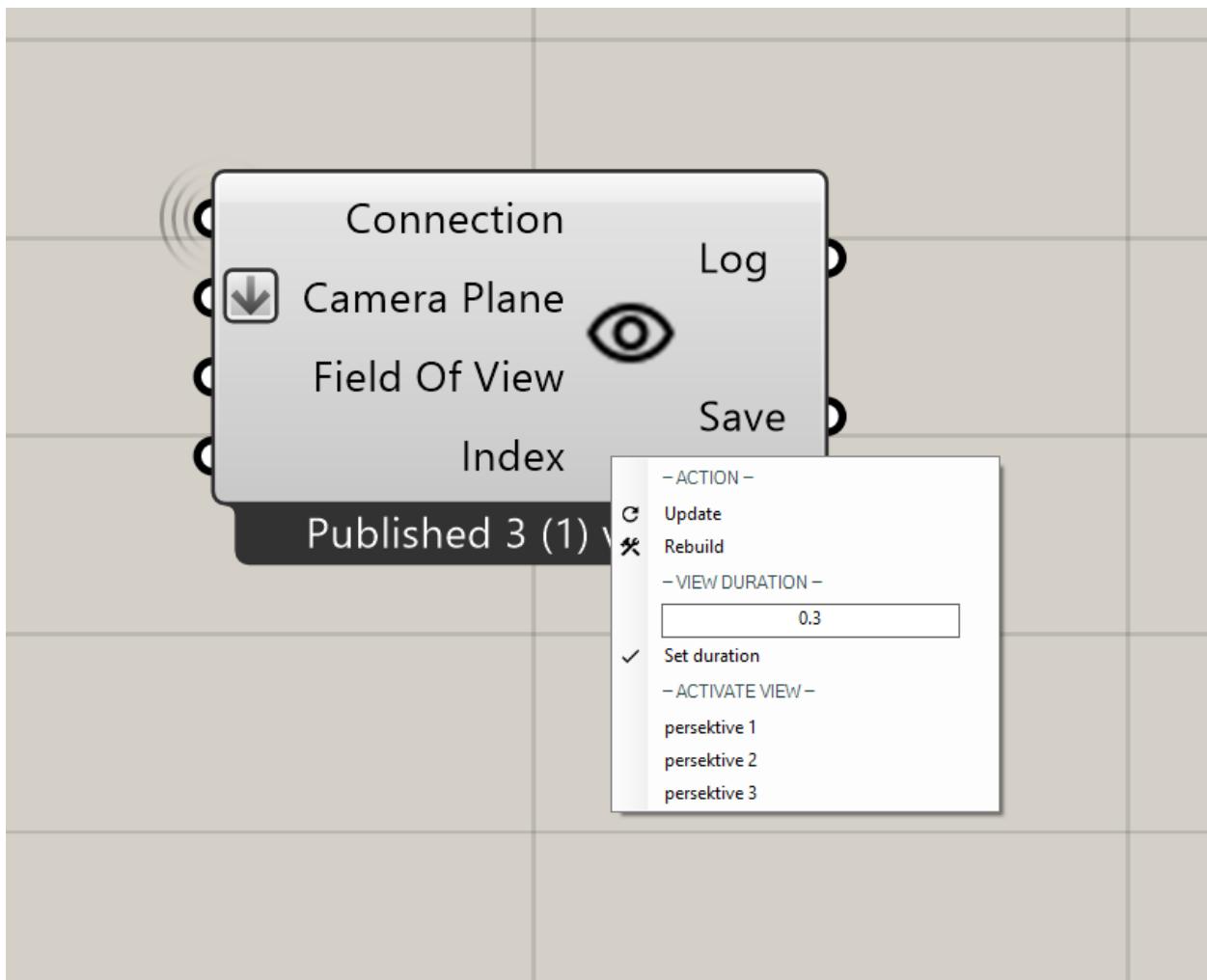
2)



3-4)



PublishView



- there are two ways to import views:
 - grasshopper via the component input
 - Saved Rhino views are accessible in the component menu

Input

Name	Description	Type
Connection	Link with the Connect component	Connect
Camera Planes	Planes to define viewpoints	Plane
Field of view	Size of view	Number
Index	To switch between views	Number

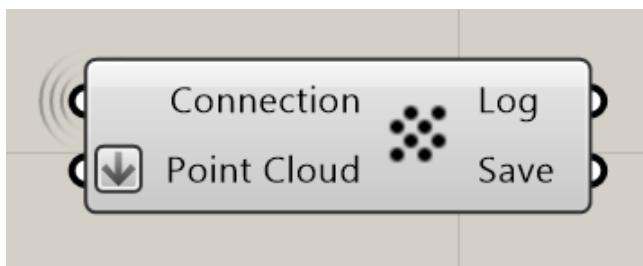
Output

Name	Description	Type
Log	Documents changes & Data send	Text
Save	Connect to SaveContent for saving	Radii content

Menu

View	Duration Speed to switch between views
Active view	Rhino Views

PublishPointcloud



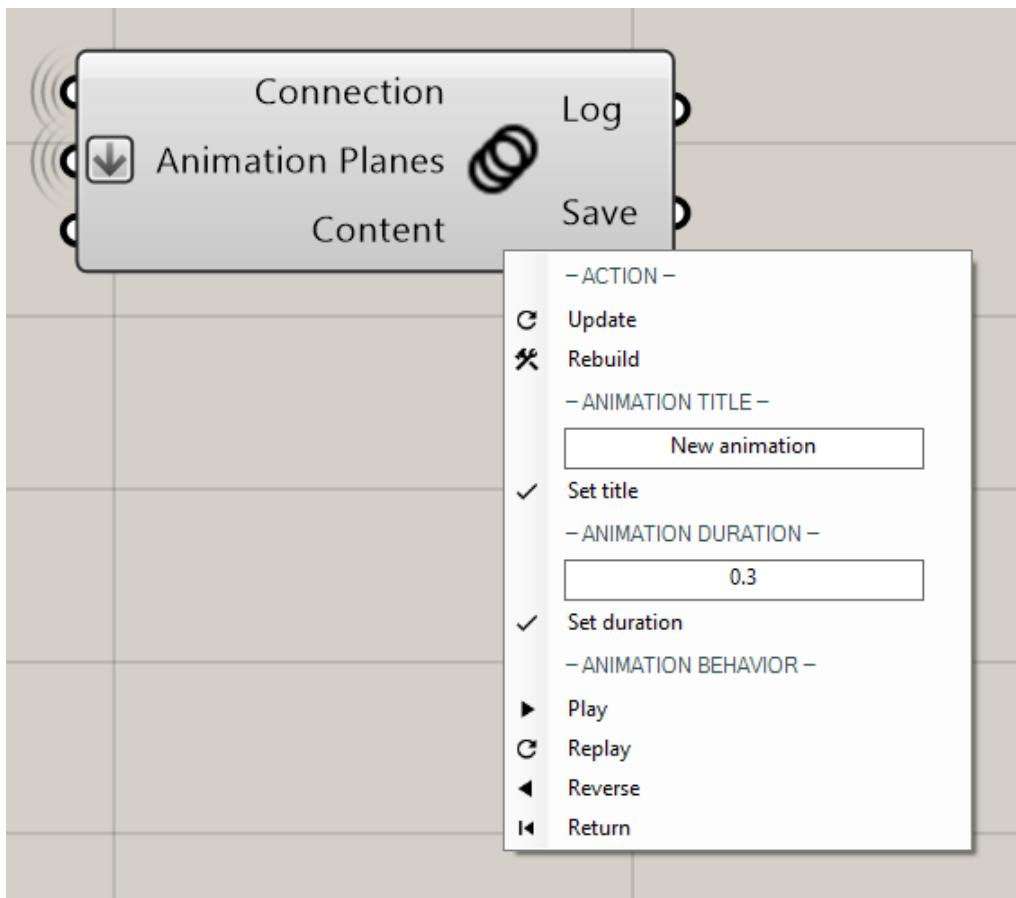
Input

Name	Description	Type
Connection	Link with the Connect component	Connect
Point Cloud	Input for a Point cloud	Point cloud

- Point clouds have a tendency to be strain on your pc, in those cases see more under the tool section of radii

Output

Name	Description	Type
Log	Documents changes & Data send	Text
Save	Connect to SaveContent for saving	Radii content

PublishAnimation**Input**

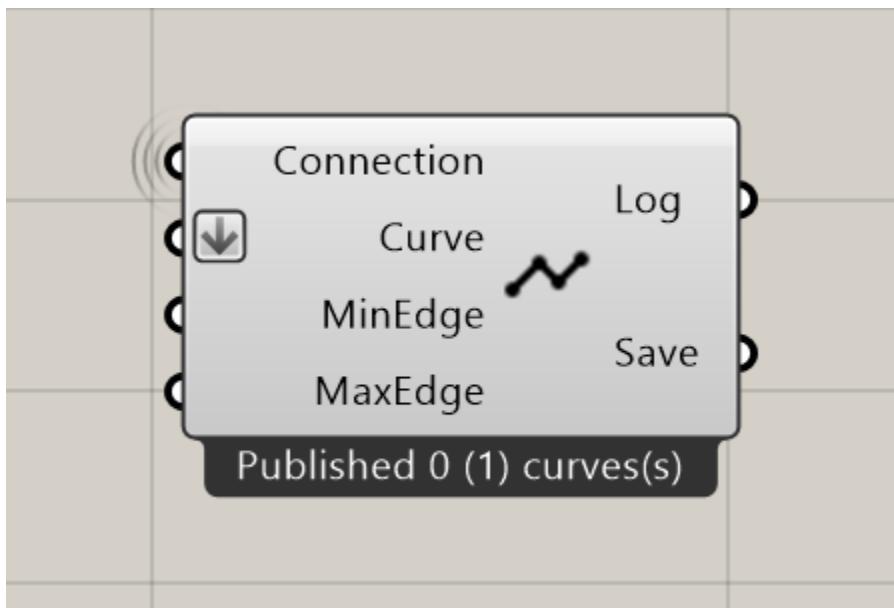
Name	Description	Type
Connection	Link with the Connect component	Connect
Animation Planes	Along the path you want to animate along	Planes
Content	Geometry you want to animate	Save of Publish Geometry component

Output

Name	Description	Type
Log	Documents changes & Data send	Text
Save	Connect to SaveContent for saving	Radii content

Menu

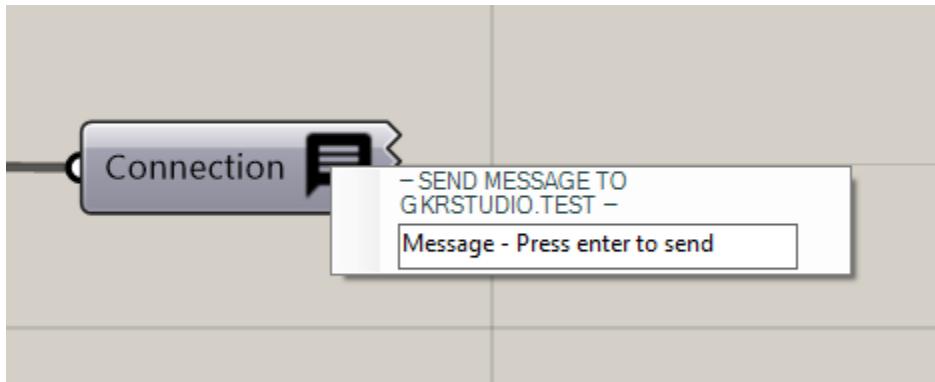
Animation	Title	Name of your Animation
Animation	Duration	Speed: higher number = quicker
Animation	Behavior	Play, Replay, Reverse, Return

PublishCurve**Input**

Name	Description	Type
Connection	Link with the Connect component	Connect
Curve	the curves to publish	Curve
MinEdge	Min length of segments	Number
MaxEdge	Max length of segments	Number

Output

Name	Description	Type
Log	Documents changes & Data send	Text
Save	Connect to SaveContent for saving	Radii content

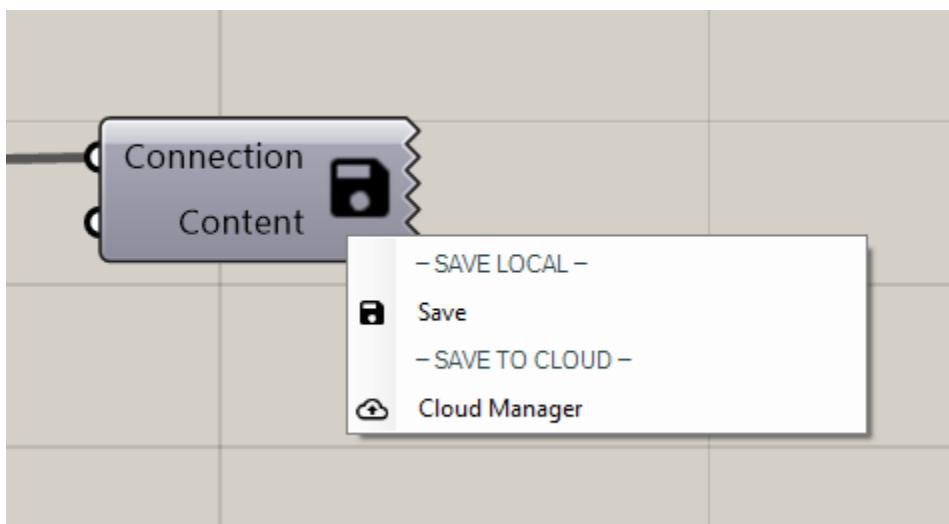
PublishMessage

Input

Name	Description	Type
Connection	Link with the Connect component	Connection

Menu

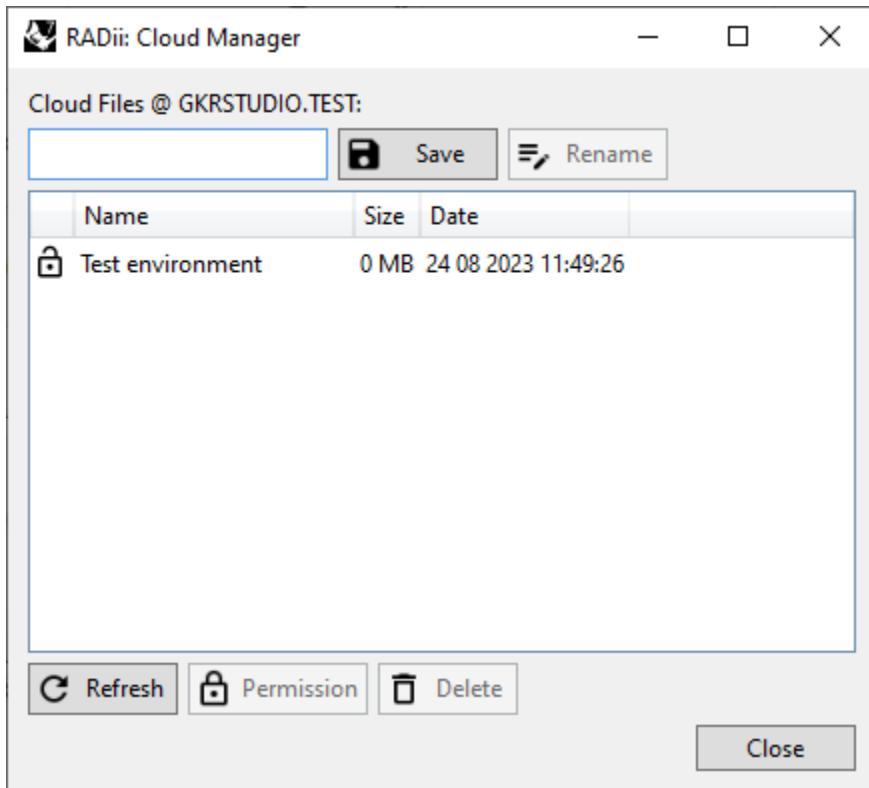
Send Message to channel	Type a message and press enter to send all viewers that are connected
-------------------------	---

Save Content**SaveContent****Input**

Name	Description	Type
Connection	Link with the Connect component	Connection
Content	To be included in the save	Radii content

Menu

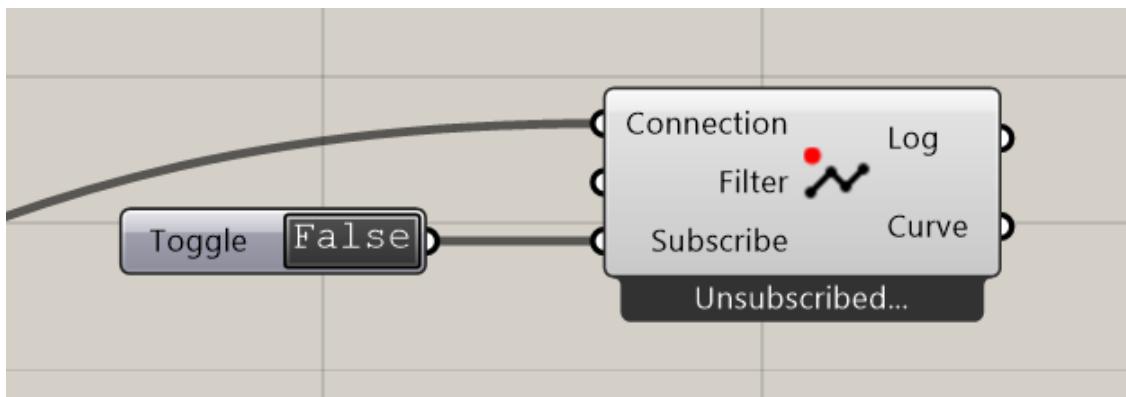
Save	Save a Radii file locally
Cloud Manager	Save to the connected channel



- Cloud content can also be loaded via the scenario manager

Subscribe Components

SubscribeCurve



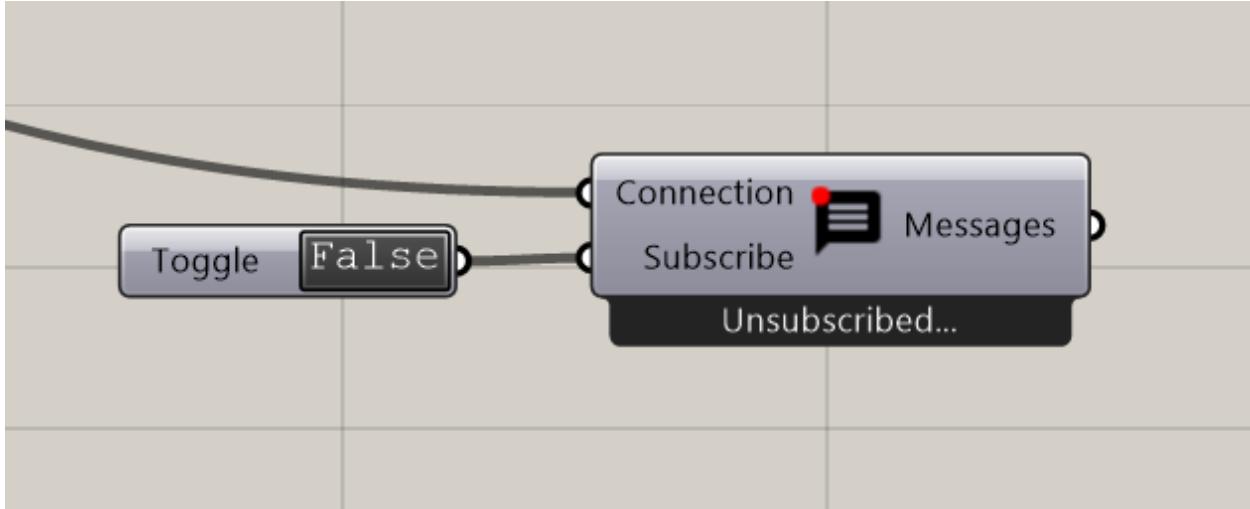
Input

Name	Description	Type
Connection	Link with the Connect component	Connection
Filter	Filter own publication/broadcast	Boolean
Subscribe	Toggle the subscription	Boolean

Output

Name	Description	Type
Log	Documents changes & Data send	Text
Curve	Element to work with	Curve

SubscribeMessages

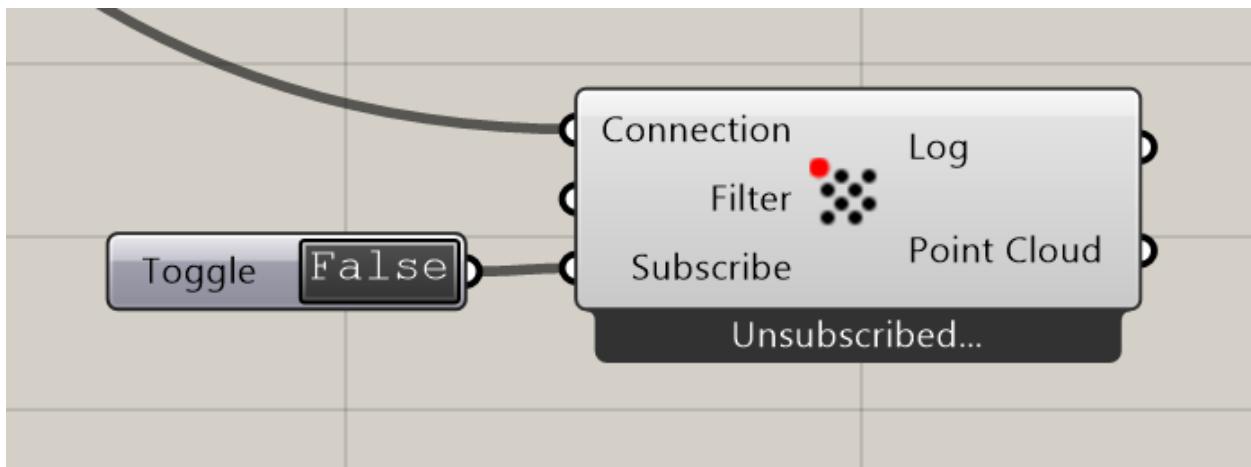


Input

Name	Description	Type
Connection	Link with the Connect component	Connection
Subscribe	Toggle the subscription	Boolean

Output

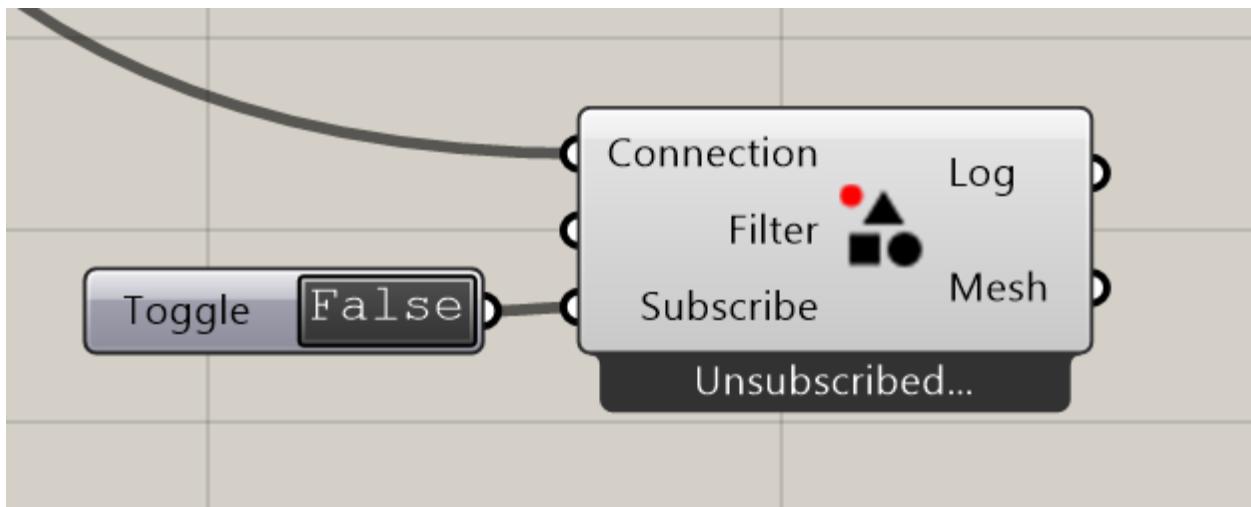
Name	Description	Type
Messages	Connect to a Notepad to observe	Text

SubscribePointCloud**Input**

Name	Description	Type
Connection	Link with the Connect component	Connection
Filter	Filter own publication/broadcast	Boolean
Subscribe	Toggle the subscription	Boolean

Output

Name	Description	Type
Point Cloud	Element to work with	Point Cloud

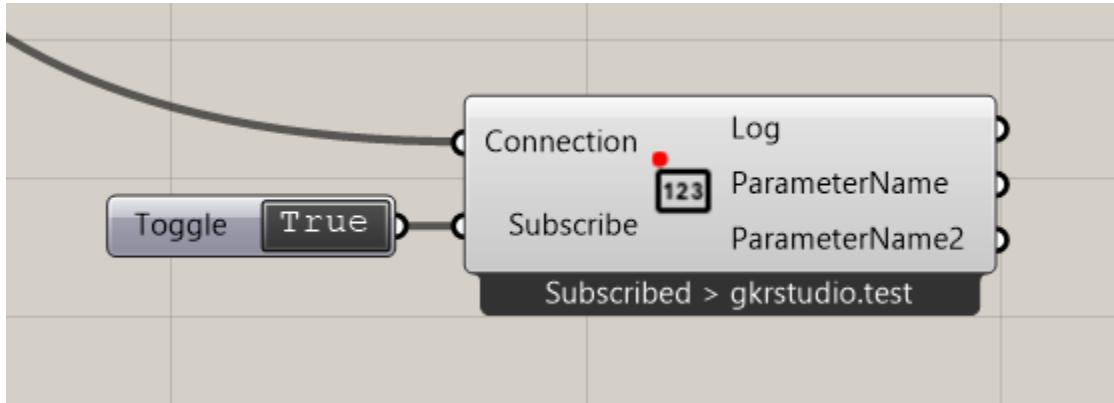
SubscribeGeometry**Input**

Name	Description	Type
Connection	Link with the Connect component	Connection
Filter	Filter own publication/broadcast	Boolean
Subscribe	Toggle the subscription	Boolean

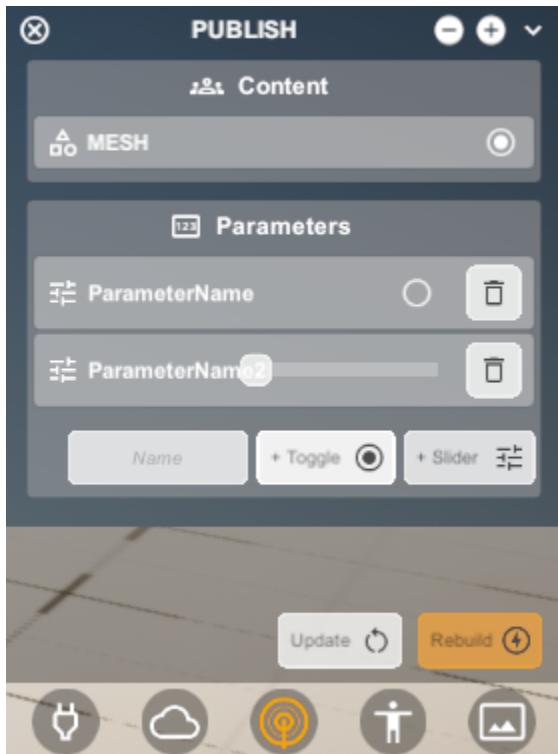
Output

Name	Description	Type
Log	Documents changes & Data send	Text
Geometry	Element to work with	Geometry

SubscribeParameter



Grashopper component



Radii viewer counterpart

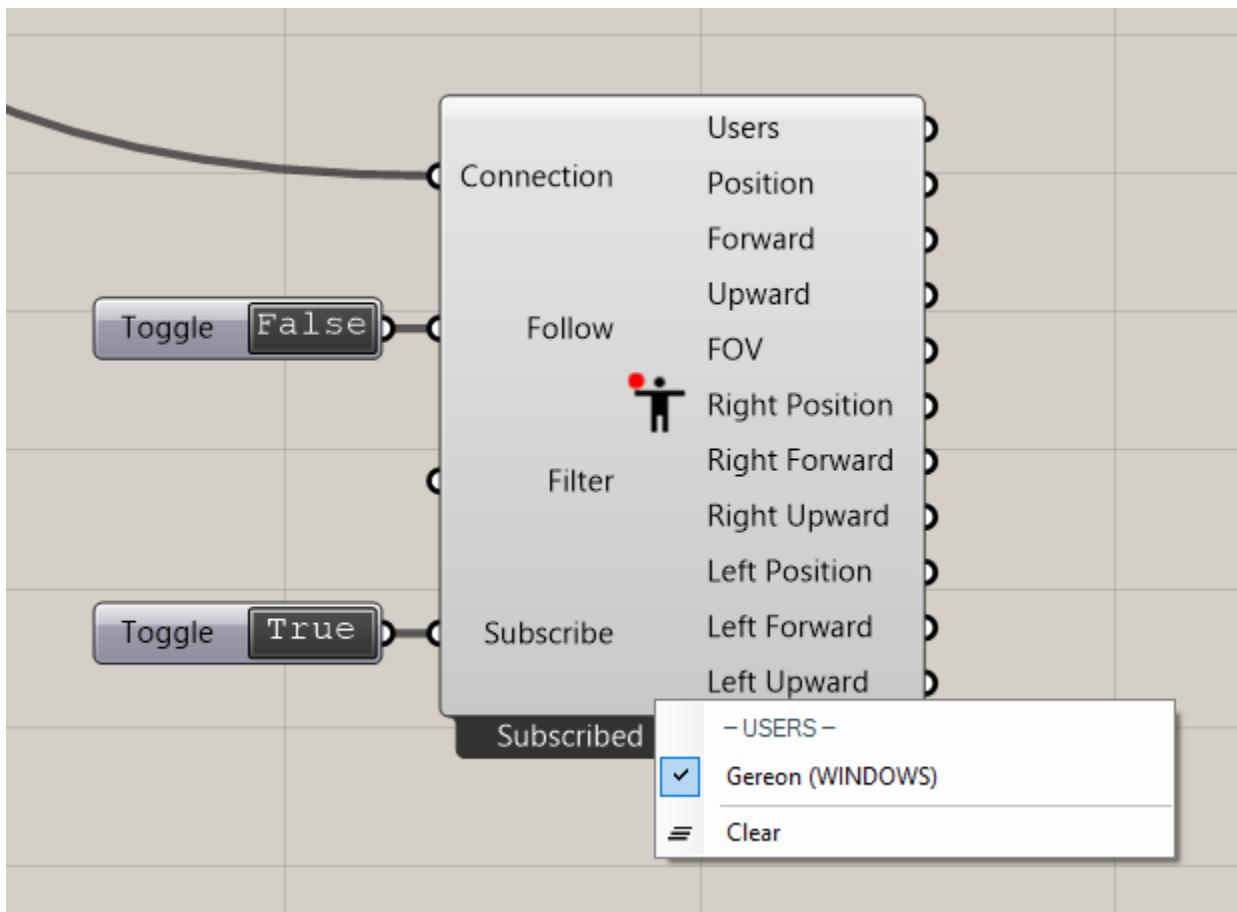
Input

Name	Description	Type
Connection	Link with the Connect component	Connection
Subscribe	Toggle the subscription	Boolean

Output

Name	Description	Type
Log	Documents changes & Data send	Text
Parameter/Boolean	Parameter/Boolean from Radii Viewer	Boolean/Number

- The more parameters you define in the viewer the more will be on this component
- the number will be between 0 to 1, you can remap this to any other range

SubscribeUser**Input**

Name	Description	Type
Connection	Link with the Connect component	Connection
Follow	Follow a user (select in the menu)	Boolean
Filter	Filter own publication/broadcast	Boolean
Subscribe	Toggle the subscription	Boolean

Output

Name	Description	Type
User	User List	Text
Position	Coordinates	Point
Forward	Direction of View	Vector
Upward	Direction upwards	Vector
FOV	Field of View	Number
Right Position	Right VR Position	Point
Right Forward	Direction forward	Vector
Right Upward	Direction upwards	Vector
Left Position	Left VR Position	Point
Left Forward	Direction forward	Vector
Left Upward	Direction upwards	Vector

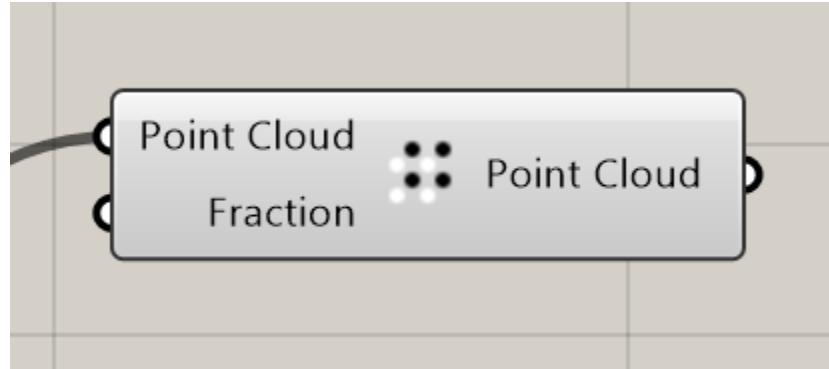
Menu

Users List of users to select

Tool Components & Tips

PointCloudReduce & SubsetPointCloud

ReducePointCloud



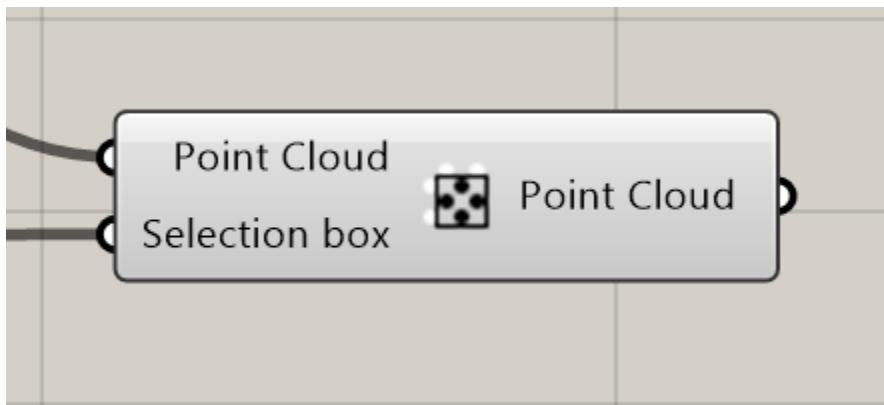
Input

Name	Description	Type
Point Cloud	Point Cloud to Reduce	Point Cloud
Fraction	Fraction of Points to remain	Number

Output

Name	Description	Type
Point Cloud	Reduced Point Cloud	Point Cloud

SubsetPointCloud



Input

Name	Description	Type
Point Cloud	Point Cloud to Reduce	Point Cloud
Selection box	Volume you want to keep	Box

Output

Name	Description	Type
Point Cloud	Selection of Point Cloud	Point Cloud

10 Rules for working with geometry

Following these rules should prevent you from running into errors and performance issues. This becomes more important in the later phases of a project.

1	You shall use mesh count wisely	Do not use thousands of vertices on a small door handle Manual: Chapter 4.3 PublishGeometry
2	You shall not use hidden or duplicate objects and materials	Purge objects that are never going to be seen by anybody or used by anything
3	You shall apply level of detail relative to object size, importance and distance	Do not spend time and performance doing high level of detail on objects you will never get close to
4	You shall keep texture resolutions low and relative object sizes	Do not use large texture resolution on small objects
5	You shall trim and subsample point clouds relative to distance and visibility	Do not use millions on points on something that is seen from far away or obscured by other objects
6	You shall only apply collision to objects that is required to collide with	Do not put collision on screws, nails, fixtures etc. Manual: Chapter 4.3 PublishGeometry
7	You shall target content to specific viewer platforms	Do not expect to run a heavy scene on and underpowered platform like a mobile phone or Oculus Standalone
8	You shall watch the scene for places of performance degradation	Always test the scene for places where the performance drops (no lower than 25-30 fps) and react accordingly with any of the above
9	You shall only publish when needed	Do not spam with content. Use a data dam to control when to send. Use a component for volatile content and another for large static content like context.
10	You shall report bugs	Always report a bug to the radii slack channel

2.4 Tutorials

Welcome to the guide page, the following resources should give a quick entry into Radii. The text files will be updated more frequently than the videos, should you come across discrepancies between the videos and what you encounter in Radii.

Text Guides

2.4.1 LV Exploration tutorial

This tutorial will introduce the basics of the Radii Grasshopper plugin and the Radii Viewer, on the basis of the introduction given at the Immersive Design Studio at ETH D-Arch.

2.4.2 LV The simple review tutorial

This tutorial explains what you need for a simple review/discussion with Radii. It details the usage of views and sections with the PublishViews and PublishSection components.

- how to save views in rhino
- import them in grasshopper
- set them through publish view
- setting a list of planes -> importing them -> cycle through
- Viewer how to click on views -> how to toggle them

2.4.3 Lv Presentation & Story tutorial

A presentation in Radii is different from showing plans with strictly defined views and perspectives, the participants can explore for themselves and you can guide them through your model. This explorative approach is more akin to a museum tour, the visit to an existing building or a performance where you are free to explore for yourself and change perspective.

Thus a presentation in Radii can have specific shared elements, this can be done through the usage of the PublishAnimation component and the Scenario Manager of the PublishControl component. With PublishAnimation it is possible to send viewers on defined paths and save a series of controlled moments and interactions with PublishControl.

- walkthrough of how to do an animation
- walkthrough on how to work with publishcontrol

2.4.4 Lv Collaborative tutorial

Usually Radii works in one direction one or many send content to one or a number of viewers, without any feedback. The collaborative components under the Subscribe section in Rhino can change this and feed back into the Rhino session. This tutorial will explain possible uses and examples for using them.

Content could be:

- easier animation with subscribe to user
- users play with geometry collectively and this is then saved as a rhino session
-

2.4.5 Design project documentation

How a Radii project can be documented for future use:

- save everything connected as a radii file to be used locally
- save everything to the cloud
- save the controls in a grasshopper component
- make a recording of a presentation

Video Guides

Thomas Lee - Radii tutorials playlist

- Basics Publish
- Basics Save
- Basics Subscribe
- Basics Viewer

**CHAPTER
THREE**

INDICES AND TABLES

- genindex
- search