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Release notes for Amira–Avizo 3D Software Version 2021.1

3D data visualization and analysis

This document informs you about the most important new features, improvements and changes in this version of Thermo Scientific™ Amira-Avizo™ software.

Please read these Release Notes carefully.

We would appreciate your feedback regarding this version. If you encounter any problems or have any suggestions for improvement, do not hesitate to contact us at FRBOR.3d_hotline@thermofisher.com.

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Amira-Avizo Software New Packages

Our product line continues to expand. With 2021.1, Our Amira-Avizo Software technology comes in brand new packages, bringing more clarity and consistency to our product line.

The main updates to our product packages for Amira-Avizo Software product lines include:

Products and editions:

- Avizo Lite becomes Avizo 3D
- Amira becomes Amira 3D
- Avizo becomes Avizo 3D Pro
- The combination of Amira + XImagePAQ becomes Amira 3D Pro, a brand new package
- Amira for Cell Biology becomes Amira 3D for Cell Biology and is now enhanced with our new Xplore5D extension to provide even more value.
- Avizo for Industrial Inspection becomes Avizo 3D for Industrial Inspection

Other changes to Amira-Avizo Software

XImagePAQ, XLVolume, Xpand, and XPublisher (to publish ToGo file format available with our free viewer) are now integrated in Amira-Avizo 3D Pro, in Amira 3D for Cell Biology and in Avizo 3D for Industrial Inspection. These are no longer available as separate extensions. This brings significant added value to our 3D Pro editions.

In addition to in-package features, Amira, Avizo, and Thermo Scientific PerGeos Software still benefit from an online, constantly enriched XTras library of add-ons (recipes and scripts) and how-tos (short videos on specific use cases) that can help you improve and simplify your day-to-day use of Amira-Avizo and PerGeos Software.

Subscriptions Update

With the release of Amira and Avizo Software 2021.1, we introduce a new structure and model for our Yearly Subscription (License) Program. These important updates bring more technology and rationalize the usage of the tokens to allow more users to work with the advanced features of Amira and Avizo Software.

Our updated Yearly Subscription (License) Program is still driven by bringing more benefits to the licensee by providing:

- Largest array of our technology available in one program to address multiple problems and workflows
- Significant cost savings compared to separate acquisition of licenses and extensions
    - As the number of users increases, the price per user decreases, facilitating the adoption of the software within an organization
- Flexibility over the usage of our technologies
- Predictable investment; easy to budget
- Scalable, easy to deploy, and easy to manage with centralized license management
- Ability to define groups and rules to fine tune the usage of the technology

Our Yearly Subscription (License) Program now comes with the following important structural changes:

- Tokens are replaced by two types of licenses:
    - Main User licenses—ensuring that there's always a pool of concurrent users.
    - Extension licenses—providing the entire breadth of our Amira and Avizo Software technology
    - New option to purchase additional Extension licenses separately

- Therefore, you will have a predefined number of Main User licenses, which can be used concurrently, and a predefined number of Extension licenses, which can be used concurrently.
- Addition of new technology previously unavailable under the subscription program. This now covers almost the entire breadth of the Amira and Avizo Software product portfolios, including our new Amira-Avizo 2D Software which will be available in the Subscription Program only a few days following the release (you will be notified by email when it is available to be added).
- More technology that previously required token usage is now embedded in existing Main User and Extension licenses.

New Xplore5D Extension

The 2021.1 release introduces a major new extension allowing to view and animate extremely large multichannel time series data (5D). You are also able to extract sub-volumes that fit in memory for enabling full image processing capabilities. This extension adds a new Smart Multichannel Series data type (or SMS data), and its corresponding new .sms file format.

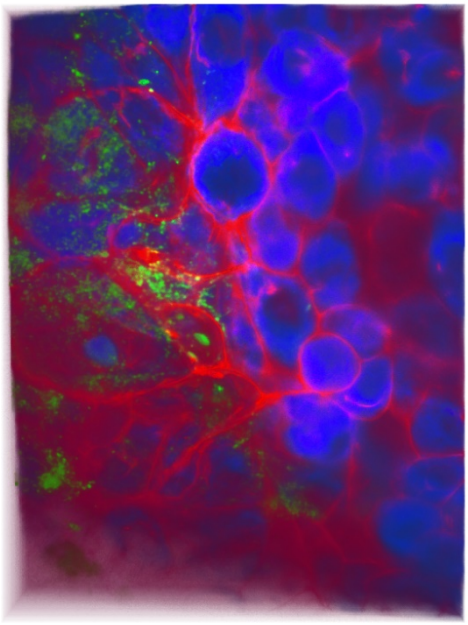


Figure 1: Three channel time series: subcellular dynamics of living cells, (courtesy of Srigokul Upadhyayula - Howard Hughes Medical Institute and Harvard Medical School).

Converting a dataset to an SMS file

This version includes a new SMS Converter tool, which you can use to convert your large multichannel time series dataset, initially stored as a set of TIFF files, into a single .sms file that is optimized for fast visualization. This standalone application can be started from its shortcut or from the File menu in Amira or Avizo Software.

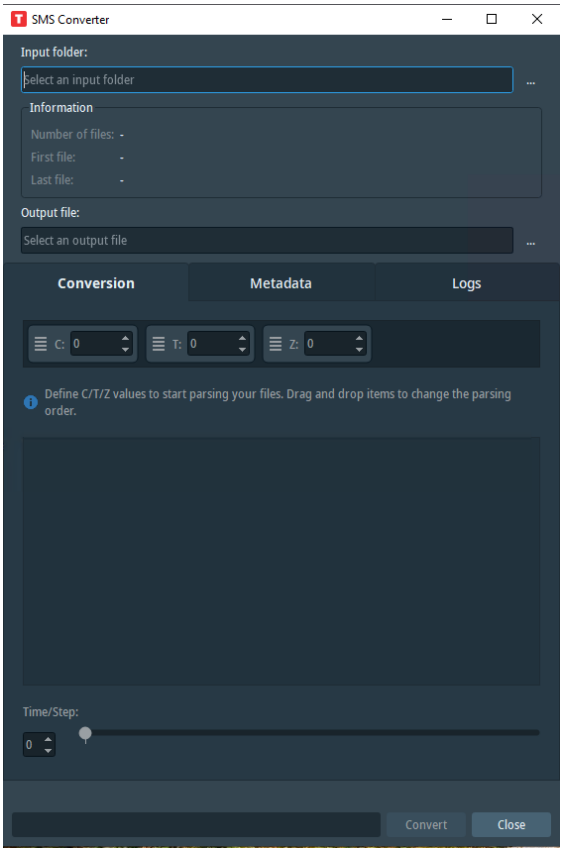


Figure 2: User Interface of the SMS Converter

Visualizing an animating a Multichannel time series

The new SMS data type can be connected to an SMS Ortho Slice or an SMS Volume Rendering. These display modules are specific to this data type. You can use them to display your data, navigate within or animate it.

Select the level of animation quality you want, from 'low' for a smooth animation to 'high' for loading as much data as your workstation can handle. Start the animation to render your data with this level of quality. Pause the animation to maximize the resolution for this time step.

If your data is extremely large or you do not have enough memory to display it with sufficient resolution, you can connect an ROI Box for a more precise visualization within the area of interest.

Subvolume extraction and workflow processing

You can also extract a subvolume of your SMS data that fits in memory using the new SMS Extract Subvolume module. The output can be connected to any computation modules, allowing advanced processing workflows and analysis including application of recipes with SMS data.

New Features

Deep Learning Training

The Deep Learning Training module has been substantially reworked, with the following new features:

- Support for multi-class segmentation.

- Different types of networks and U-Net backbones are proposed: a generic UNet model with configurable number of layers or feature map size, and different classical backbones such as VGG and RESNET.
- More Loss and Metric functions, such as Dice, Jaccard, and Intersection over Union.
- More controls for configuring the training batches.
- A new Plugin mechanism to enable custom network architectures, loss or metric functions, so they can be used within the module. This is described in a new documentation page, which is referenced in the documentation of the module as well as in the updated tutorial.

Deep Learning Prediction

The Deep Learning Prediction module has been improved as follows:

- The default behavior of the module is now to generate a label map, instead of probability maps, when applied on a model trained with the Deep Learning Training module.
- An automatic algorithm estimates the GPU memory required to apply the Deep Learning Prediction module, depending on the architecture of the network. This allows the software to propose an Automatic Tiling mode. It remains possible to use the manual mode, which may be required for some custom architectures.
- The weights files and .py file are automatically selected when indicating the architecture file, provided they have the same file names. It is possible to manually select different files if relevant.
- The pre- and post-processing functions (.py file associated with the trained model) have been revisited. A new method has been proposed to allow custom post-processing at each tile, and to control the type of the output dataset.

The Deep Learning tutorial, and related Xtras have been updated to reflect these new features.

Refer to the Xtra Recipe Library and Compatibility Notes sections of this document.

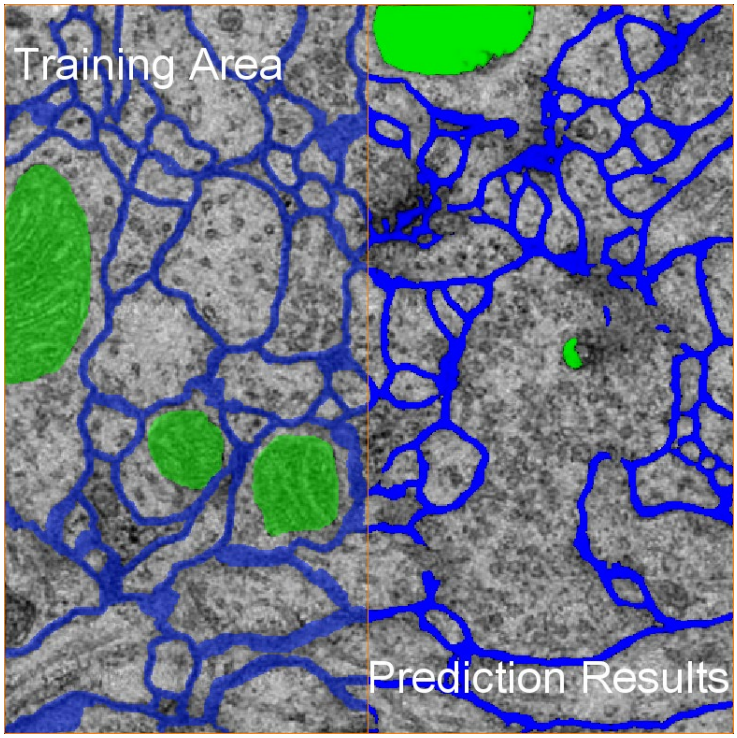


Figure 3: The Deep Learning Training module is now able to learn multi-class segmentation models, and Deep Learning Prediction can directly generate a label field as output.

Membrane Enhancement Filter (Amira 3D Pro and Avizo 3D Pro)

The Membrane Enhancement module has been upgraded by the addition of a new “Planeness Tensor Voting” option. This option allows you to significantly improve the detection quality of surface like structures (for example, cell membranes) present in a 3D uniform scalar field (available only for Windows operating system). The previously available “Planenss Tensor Voting” option has been renamed to “Partial Planeness Tensor Voting”.

This new module is a complete implementation of the TomoMemSegTV algorithm described by A. Martinez-Sanchez, I. Garcia, S. Asano, V. Lucic, and J.-J. Fernandez: Robust membrane detection based on tensor voting for electron tomography,
Journal of Structural Biology, vol.186, issue.1, pp.49-61, 2014.

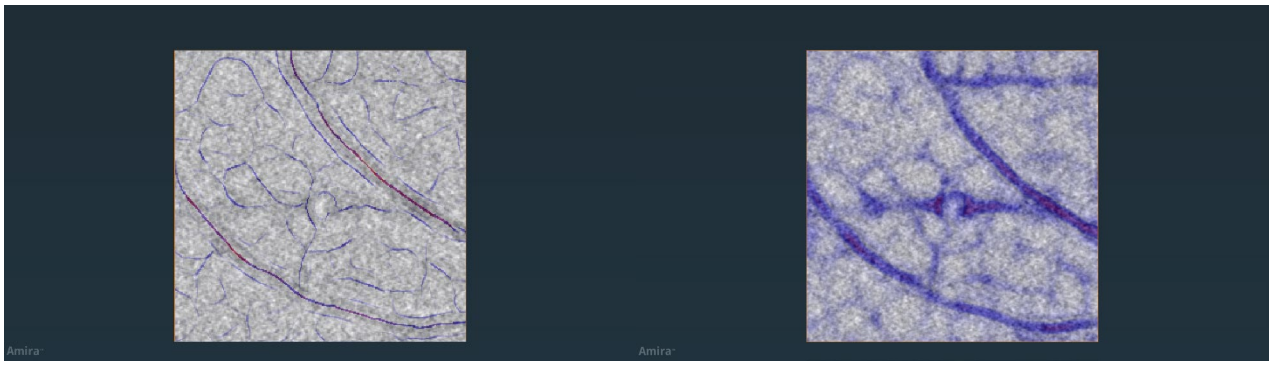


Figure 4: Comparing results of Planeness and Partial Planeness tensor voting (images courtesy of the Cell and Tissue Imaging (PICT-IBiSA), Institut Curie, member of the French National Research Infrastructure France-BioImaging (ANR10-INBS-04)). Module’s result image in ColorWash clearly shows improvements in structure enhancements along membranes’ ridges.

Enhancements

Python 3.6.12 and Python environments upgrade

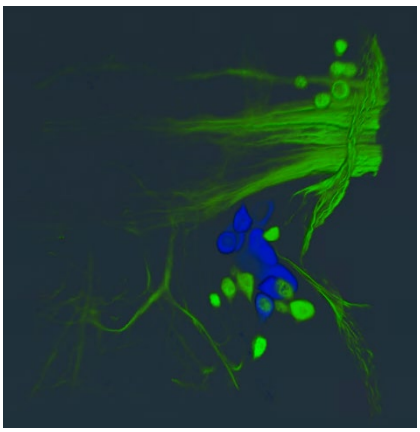
The Amira-Avizo Python interpreter has been updated to version 3.6.12. Python package distribution with both the embedded and the custom Deep Learning Python environments have been updated to the most recent versions available with this interpreter. In particular, TensorFlow version 2.2.2 and NumPy 1.17.4 are now available in Amira-Avizo.

Visualization enhancements

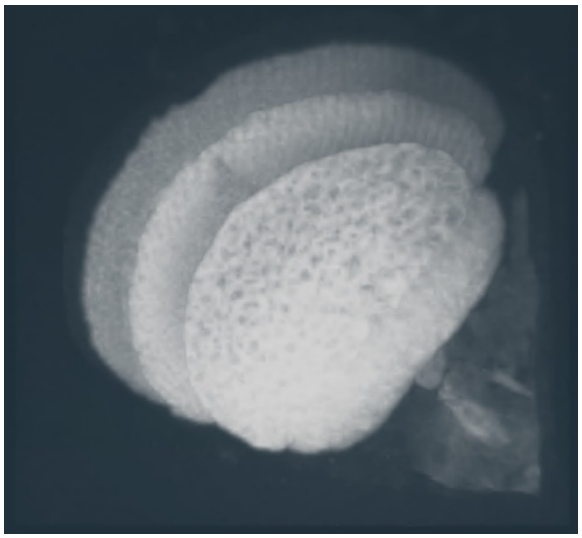
With the introduction of the new Xplore5D extension, we globally improved the visualization of existing large data and multiple channel data:

- Introducing a Colorwash module for the LDA Ortho Slice.

- The color blending of multichannel data has been improved and is now more accurate.



- The composition algorithm of volume data has been updated to a more realistic look and feel, especially the Maximum Intensity Project (“max” option of Composition port in Volume Rendering Settings module)



Normalize Grayscale (Amira 3D Pro and Avizo 3D Pro)

Normalize Grayscale now offers an option to allow manual selection of the pixel type of the output dataset.

This new option can save an unnecessary additional step, for instance when wanting to convert a 16-bit dataset to 8-bit. However, the default behavior is preserved, and the output dataset will have the same type as the input.

Optimization of Morphological Binary Operators (Amira 3D Pro and Avizo 3D Pro)

The Erosion, Dilation, Closing, Opening modules have been optimized when processing binary images with large square or cube structure element.

When the structure element size is larger than a threshold (which depends on the hardware configuration and XY or 3D interpretation), the module switches to a time-independent algorithm based on a distance map. The results remain identical to previous versions.

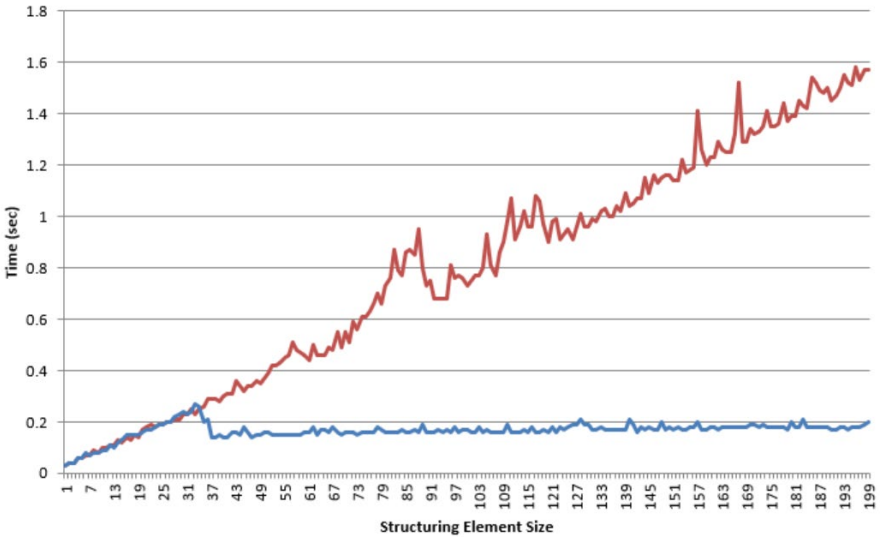
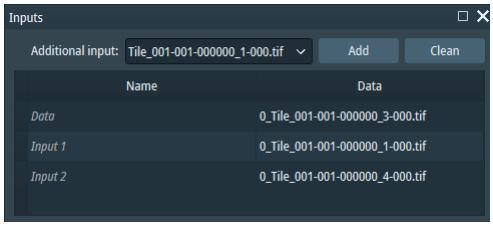


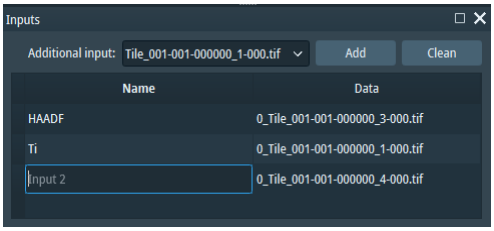
Figure 4: Comparison of computation time for a binary Opening of a 4096x4096 image with increasing size of a square structuring element. (red: with 2020.3, blue: with 2021.1)

Image Stack Processing and Image Volume Processing: enhancements (Amira 3D Pro and Avizo 3D Pro)

The way you add secondary inputs to an ISP/IVP recipe has been enhanced by adding a new Inputs panel in the workroom where you can select your additional inputs. You can now see how many inputs you have for your recipe directly from the workroom. You can use the Clean button to discard any data that is unused by the recipe.



You can now also rename each input of the recipe from this panel. Setting the name of the inputs of a recipe is very useful to understand what to expect from a recipe.



Preferences

With the introduction of the Xplore5D extension, the *LDA* tab of the Preferences panel has been renamed to *Large Data*, and its content has been updated.

Xtra Recipe Library

The following Xtras have been published or updated since the previous release notes. Pay particular attention to the product, license and OS requirements, as well as the installation instructions. Your feedback is welcome.

- Xplore5D Tutorial Data
- Getting Started with Deep Learning Training (Update)
- BSE SEM denoiser – Deep Learning Model (Update)
- Browse TensorBoard of old Deep Learning Training sessions
- Add Data To Point Cloud
- Extract Oriented Labels
- Fitting Molecule To Map
- Image Segmentation Evaluation Using Standard Metrics
- Getting Started with Flatten Experimental module
- Component Verification Using X-ray Computed Tomography and CAD Comparison
- Large Data Visualization
- Patch Extraction Tools for Deep Learning data preparation
- How to Set Up Two-Sided Clipping
- How to Use Camera Orbit and Animate a Rotation
- High Content Screening Plate Manager
- Efficient Graph-based 2D Image Segmentation

- How to Create a Movie File
- How to Compare Slices Side by Side
- Point Cloud to Spreadsheet
- How to install non-Standard Python Package
- FIBSEM Mitochondria Segmentation using Deep Learning
- Multi-Component Analysis of X-ray Computed Tomography Datasets
- Analysis of X-ray CT Calibration Spheres Using the Metrology Workroom
- Thresholding From Mean
- How to Create and Animate a Camera Path
- How to Animate the Appearance of Objects with the Animation Director
- How to Get Started with the Animation Director
- Export Measures

Compatibility notes

Deep Learning Training

The previous version of the Deep Learning Training model is now deprecated. You can still load projects created with earlier versions, but it is highly recommended to switch to the new module. All features from the previous module can be found in the new module.

The previous model architecture is not proposed, but a close equivalent is available with the GenericUnet Model Type and its default parameters. Consequently, models weights trained with previous versions of the software cannot be used to initialize a new training.

Deep Learning Prediction

The syntax for the .py file associated with a trained model has been modified. To maintain a full compatibility when using these models with the Prediction module, replace the original .py file associated with your models with the Compatibility_DL_Before_2021.1.py file provided in this Xtra: Getting Started with Deep Learning Training.

Otherwise, the intended post-processing would no longer apply. Instead of a probability map on 8-bits with values in [0,255], you would now obtain the raw prediction from Keras which is the same probability map but using the 32-bit float type and values in [0,1].

End of support

Mac OS discontinued since 2020.3

As previously announced, Avizo/Amira 2020.3 are the last official maintained release on MacOS platform. There has been no new product development or update on MacOS since this version.

You can still use the Mac OS versions of our software products and we will continue to provide bug fixes for 9 months. However, as new versions get released, we encourage you to transition to one of our supported platforms to benefit from our full support.

Reminder - XDigitalVolumeCorrelation

As already announced in the 2020.3 release, the Digital Volume Correlation module has been replaced by three new modules. Previously, both DVC approaches (local and global) and the generation of the mesh were nested in the

same interface. From now on, each approach is called from a separate module, which greatly simplifies the analysis. The mesh generation also has its own module. For each module, the options remain the same.
The previous version with a single interface is DEPRECATED. You will not be able to create it anymore. You can still load projects from version 2020.2 or earlier, but it is strongly recommend to update your workflow with the replacement modules.

Operating systems

Amira-Avizo Software version 2021.1 runs on:

- Microsoft® Windows 10™ (64-bit).
- Linux x86 64 (64-bit). Supported 64-bit architecture is Intel64/AMD64 architecture. The supported Linux distribution is CentOS 7.

Avizo 3D for Industrial Inspection version 2021.1 runs on:

- Microsoft Windows 10 (64-bit).

To add custom extensions with Amira-Avizo XPand extension, you will need:

- Microsoft Visual Studio 2013 (VC12) Update 4 on Windows
- gcc 4.8.x on Linux CentOS 7

Solved issues

3D registration	AA-24331	Metrics computations from SearchSlice script module are now fully available.
Auto Thresholding	AA-23112	Saving and reloading a project after Type port update now works as expected: result keeps its connection to the module.
Breadth3D	AA-23175	Breadth3D values are now available up to 65535 labels.
Label Analysis	AA-22328	The Mean and the Max values of the Width Orientation Theta are now in the appropriate range (-180;180).
Marker-based Watershed	AA-23273	The out-of-core data can now be processed by the marker-based watershed module.
ROI Box	AA-16870	It is now possible to associate a ROI Box to any LDA display module or Volume Rendering on a Multi-Channel-Field data. No artifact occurs when updating the ROI Box.
Propagation Distance	AA-21998	In the binary case, abnormal big numbers in some areas at the starting level have been corrected.
Remove small spots	AA-23995	Remove small spots is now working for large data.
Scan Spatial Graph to Surface	AA-13287	The port Sampling Options is now deprecated and should not be used anymore.
Non-Local Means Filter	AA-23845	GPU Standard in 3D interpretation is now deprecated. By adapting the filter's parameters, it can be replaced by Standard CPU 3D interpretation that is providing the same performance. Compatibility is maintained for old projects.

Object Naming	AA-22421	The rule for automatically renaming modules in case of name conflicts has been updated. The increment number is now added inside parenthesis at the end of the object name. This new rule only applies to new projects. Projects saved with earlier versions are not impacted.
Licensing	AA-25314	It is now possible to launch the product on Linux without error, even if no license has been activated.