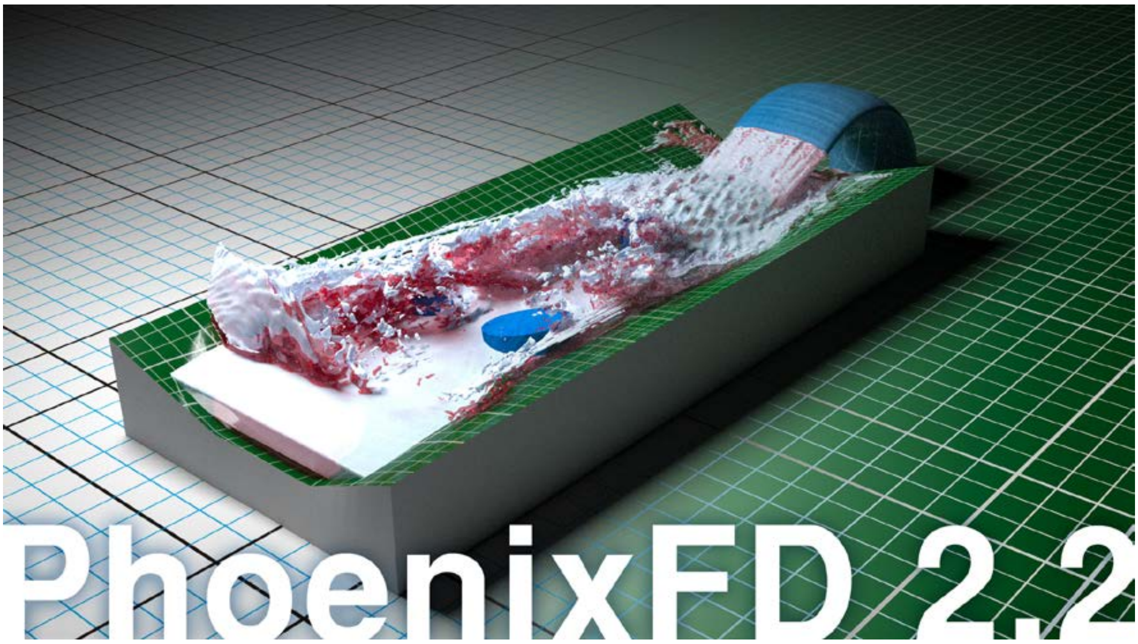

CONTENTS

ATMOSPHERIC EFFECTS AND FLUIDS

Atmospheric effects are still some of the most demanding effects in the CGI world. Whether they are clouds, rain, explosions or flowing water – what they all have in common is that the standard on-boards of many 3D tools deliver only rudimentary results.

Though explosions and smoke effects can be produced quickly and easily using plug-ins such as FumeFX by Sitni Sati in 3ds Max, fluid simulations are more intricate and time-consuming.

The simulation of fluidity requires more computing time, and the equations are more complex. Usually the most important parameters are set on the basis of an existing scene set-up. Parameters such as roughness, temperature, velocity, inflow conditions etc. are defined and subsequently calculated by means of highly simplified solvers. Here, physically simplified, usually Newtonian mathematical models of fluids and gases are taken as a basis.

Some tools, such as Houdini by Sideeffects, are already very well equipped to meet these requirements. Not only can Houdini calculate waves, but using FLIP (Fluid-Implicit Particle), it can also calculate spray and foam. The open source tool Blender, with its "Smoothed Particle Hydrodynamics", offers several options for calculating fluids, and Autodesk added the tool Bifröst (formerly Naiad) to Maya.

The user of 3ds Max still needs to employ external tools when these kinds of effects are required. Next Limit already sets high standards since 1998 with Realflow, and tools such as Krakatoa by Thinkbox enable much more than pure fluid calculations.

Since the architects of V-Ray presented Phoenix FD at the Sigraph in 2010, this simulation tool which has a strong focus on fluid simulation has continually been developed further. We took a closer look at the current version.

3DS MAX PLUG-IN PHOENIX FD 2.2

Producer: Chaosgroup Ltd.

Platform: 3ds Max /Design Windows

Current version: 2.2, 2015

Further information: http://www.chaosgroup.com

Price: Phoenix FD 2.2 Workstation 700 €

Phoenix FD is a simulation tool for the creation of fire, explosions and smoke, and focusses especially on fluids. Physically "correct" simulations generally require extensive computing time, and whoever ventures into the realm of simulated physics should be armed with ample state-of-the-art hardware and patience.

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Our test computer: Windows 7 Pro 64 Bit, 3ds Max 2016, CPU Intel i7, 3770K, 32 GB RAM, GForce GTX Titan X.

Phoenix FD calculates simulations on the basis of the given scene set-up and generates its own binary data files, which are stored on the computer. These data files contain the requisite values for the fluid simulation. During rendering, the results of the pre-calculated simulation are loaded and incorporated into the image processing.

Phoenix FD employs diverse methods to process images. Specific properties are assigned to uniform volumetric cells with a pre-defined volume (Voxel – **Vo**lumetric Pi**xel**). The properties of the cells, including mass, friction, temperature and velocity are incorporated into the calculation according to the position of the cell, and they deliver the respective result for each cell at a specific time. This method is applied by Phoenix FD for the calculation of incompressible fluids. Simulations for processing spray and foam are calculated as free particles in accordance with the conservation of mass. Together, both procedures enable a convincing simulation of fluids.

Basically, many things are possible with Phoenix FD: explosions, the dispersal of user-defined gases, volumetric clouds, infinite oceans and illuminating particles – to name but a few.

We have confined our considerations to the topic of “flowing”.

Getting Started and Operating

Chaosgroup provides two versions of Phoenix FD for 3ds Max, one which runs with an installed V-Ray renderer, and one without. We tested the version with the V-Ray.

The installation is carried out in line with the usual standards, and tools for the initial establishment can be found under Create | Geometry | Standard Primitives | Phoenix FD.

A detailed documentation in English for a quick start, including many examples, can be found at http://docs.chaosgroup.com and with a little practice one can achieve first results quickly. For those who would like to go into more detail, several tutorials on the different aspects can be found on YouTube.

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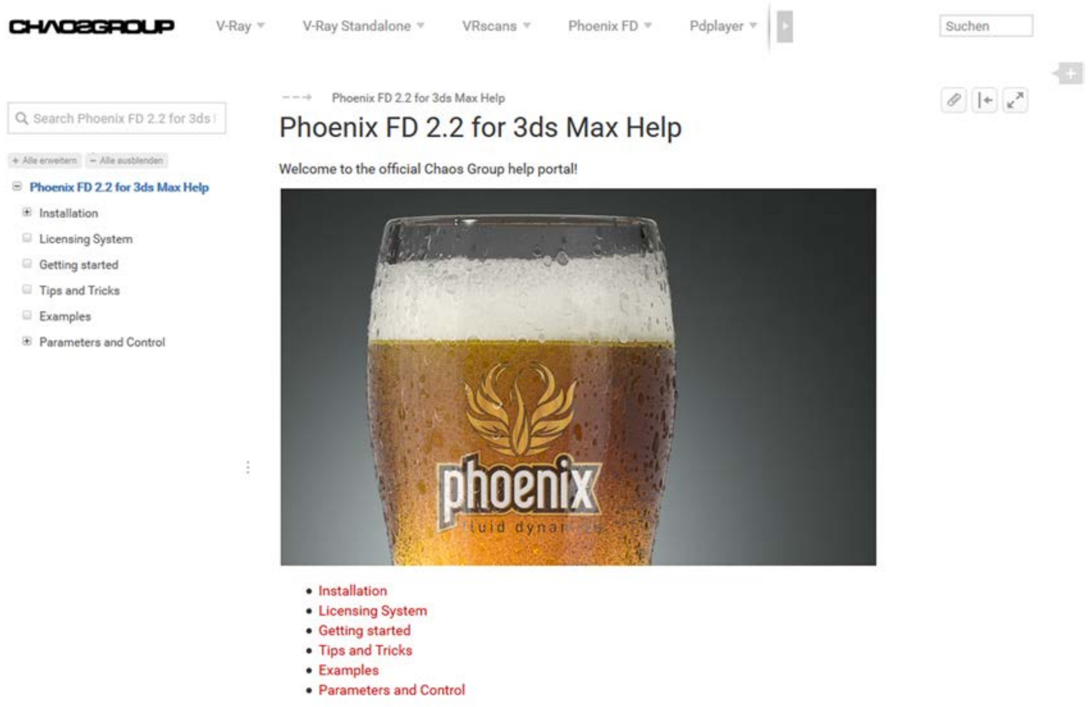

Figure 1: Start page of the online help portal for PhoenixFD

Chaosgroup makes it easy for the creative user and facilitates the use within a short period of time. The operating concept is uncomplicated, and by observing certain factors – which play a role in creating atmospheric effects with just about all tools – one can achieve good results quickly. A typical example of this is the “correct” scaling. The units are IMPORTANT, because the underlying physics demand them. Therefore one should always make sure that the settings are suited to the geometry used.

Requirements for the simulation of fluidity

In order to start a fluid simulation with flowing matter, one needs a Phoenix FD object, which is a container describing the framework conditions of the simulation. The volume which is thereby fixed defines the amount of cells which determine the pure fluid simulation. It makes sense to take the time beforehand to consider the possible extensiveness and to limit the size of the area to what is absolutely necessary.

The larger the adjacent volume is, and the finer the resolution of the grid, the more time-consuming the rendering will be.

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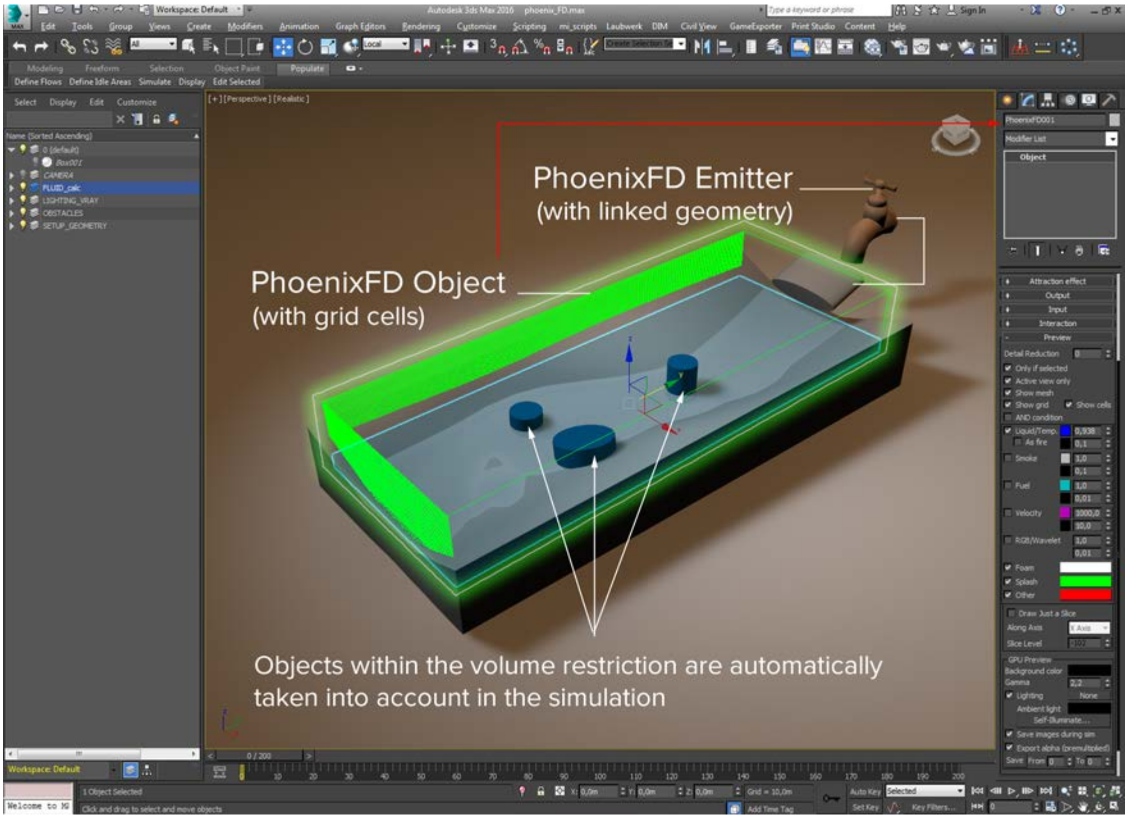

Figure 2: Minimum requirements for a simulation with an emitter and volume restriction

Furthermore, one needs an emitter which provides the inflow of the fluid. Such an emitter can take the form of any geometry. And, incidentally, one can specify the filling level at the start so that one does not have to fill an empty container.

AUTOMATISMS

It is interesting that all objects which are situated within the volume restriction are automatically taken into account in the simulation. It is not necessary to explicitly assign properties to them, although it is possible. This makes it possible to animate an obstacle within a channel, and Phoenix FD automatically includes these changes in the simulation. If one wants to remove objects again during the rendering, it is possible – similarly to light sources – to remove them via the exclude list.

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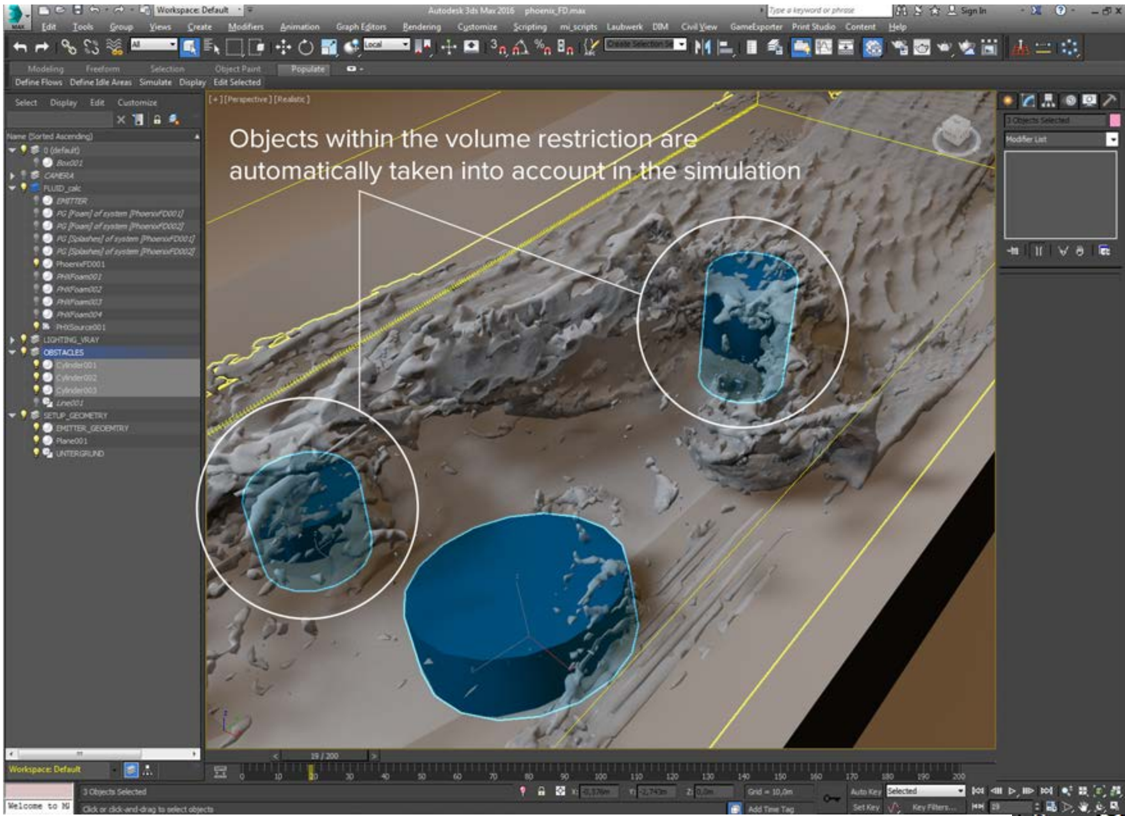

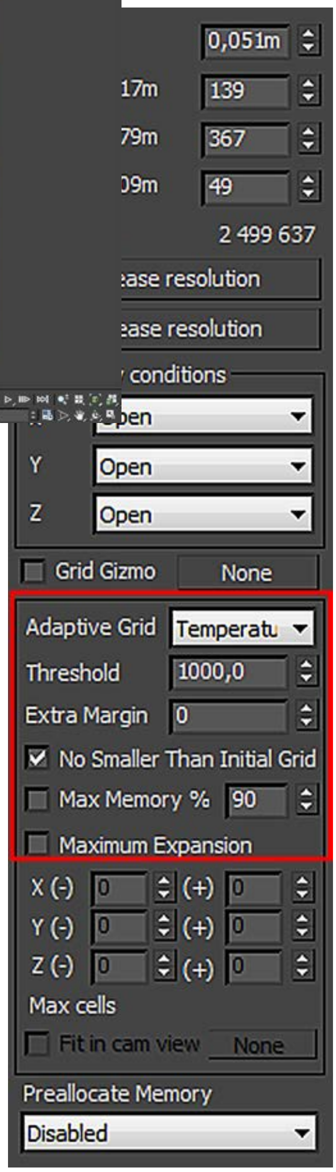

Figure 3: Every object within the volume restriction is automatically taken into account in the simulation.

As a very special feature Phoenix FD provides the option “adaptive grid” for the establishment of the confining volume gratings. This means that the required size of the calculation grid can be adapted as needed. It is easier to imagine this function in the diffusion of smoke clouds after an explosion than in fluids. However, one should proceed with caution here, because the rendering can become very protracted depending on what kind of diffusion is required.

INTERACTION

Although a rendering can take several days, depending on the complexity of a scene, once started, the processing can continue in 3ds Max. From test rendering to modelling, it is possible to interact with Max. Only changing the parameters which have a direct influence on the simulation requires a restart of the simulation.

If, however, a certain level of complexity and resolution of the volume gratings is reached, interaction with Max is only possible theoretically. In this case, all resources are occupied, and waiting for the next click on the mouse can take time.

It seems to make sense, after initial tests, to render fluids first, and then the splashes and foam, as the simultaneous processing of all parameters can be very time-consuming.

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VIEWPORT

All results calculated are displayed on-the-fly in the viewport. As soon as a new value of the active simulation is available it can be displayed interactively in the viewport. There are several view modes at one's disposal. The fastest performance is achieved with the option "show grid". The "mesh" mode is recommended for a more three-dimensional representation. Details can be hidden as required, depending on the complexity.

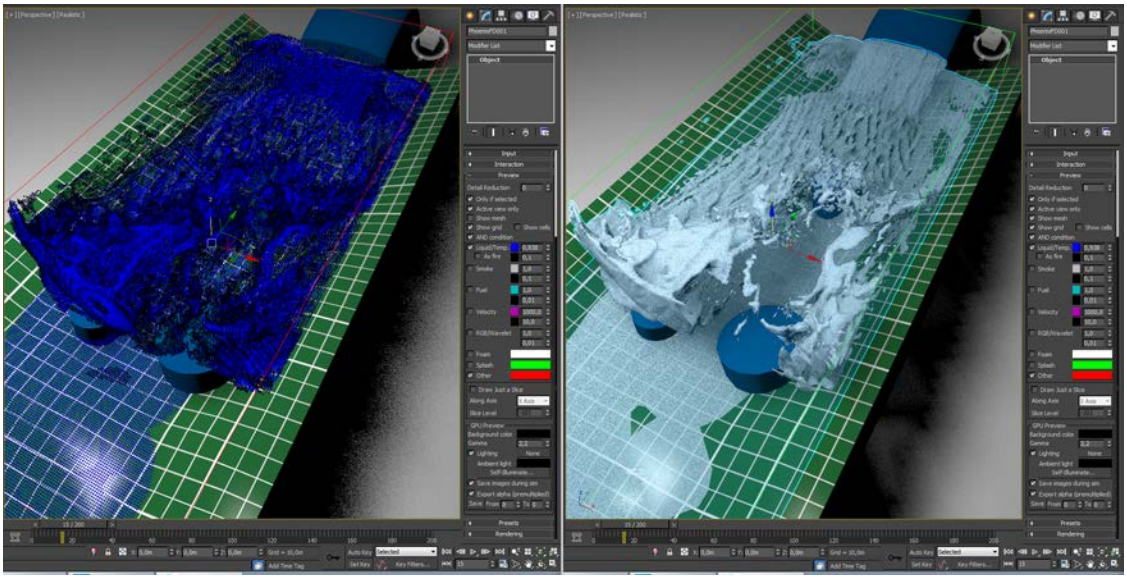

Figure 4: On the left, the representation in the grid mode, on the right in the mesh mode.

GPU PREVIEW

Phoenix FD provides a very convincing GPU preview, which however only makes sense for active smoke and explosions. The GPU preview is unsuitable for the representation of simple fluids.

CROSS SECTION OF THE FLUID

A further point to consider is the option to create cross sections of fluids. These cross sections can be taken along the x, y, or z axis, as required.

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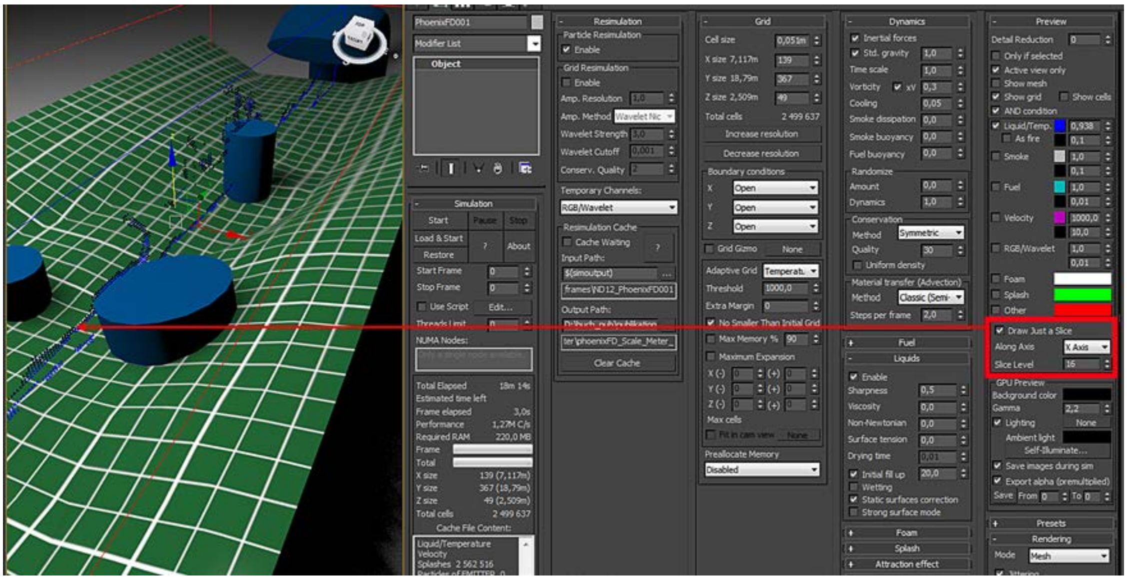

Figure 5: Rendering of the fluid in the grid mode with active presentation of the cross section

Concluding remarks

In Phoenix FD, Chaosgroup holds a convincing tool for fluid simulation. Operating it is simple; the workflow is uncomplicated and easy to learn. The integration into 3ds Max is good and the quality is impressive.

Phoenix FD can be integrated without any difficulty into the different 3ds Max renderers. Scanline and Mental Ray deliver very good results, and Corona also renders simulated fluids without any difficulties. The best results are achieved by Phoenix FD with V-Ray, however.

Rendering „real" and physically correct fluid simulations demands much more than Phoenix FD can manage, but with the means available this small tool creates convincing results that definitely do not need to hide. The interaction with objects and forces within 3ds Max is successfully achieved and offers several options.

Phoenix FD is capable of more than "just" fluids, and the capacity to generate volumetric clouds, for example, by means of the turbulence aids is at least as impressive as being able to use existing particle flow interfaces for the further processing of generated particles. Thereby, it beats many tools the field of atmospheric effects.

The calculation of 50 million voxels in the example simulation was impressive. Here, Phoenix FD remained incredibly stable.

Licensing by means of a USB dongle is not everyone's cup of tea. And a GPU preview that works for fluids would be desirable.

All in all, Phoenix FD is impressive. The results are convincing and can be achieved within a reasonable period of time.

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