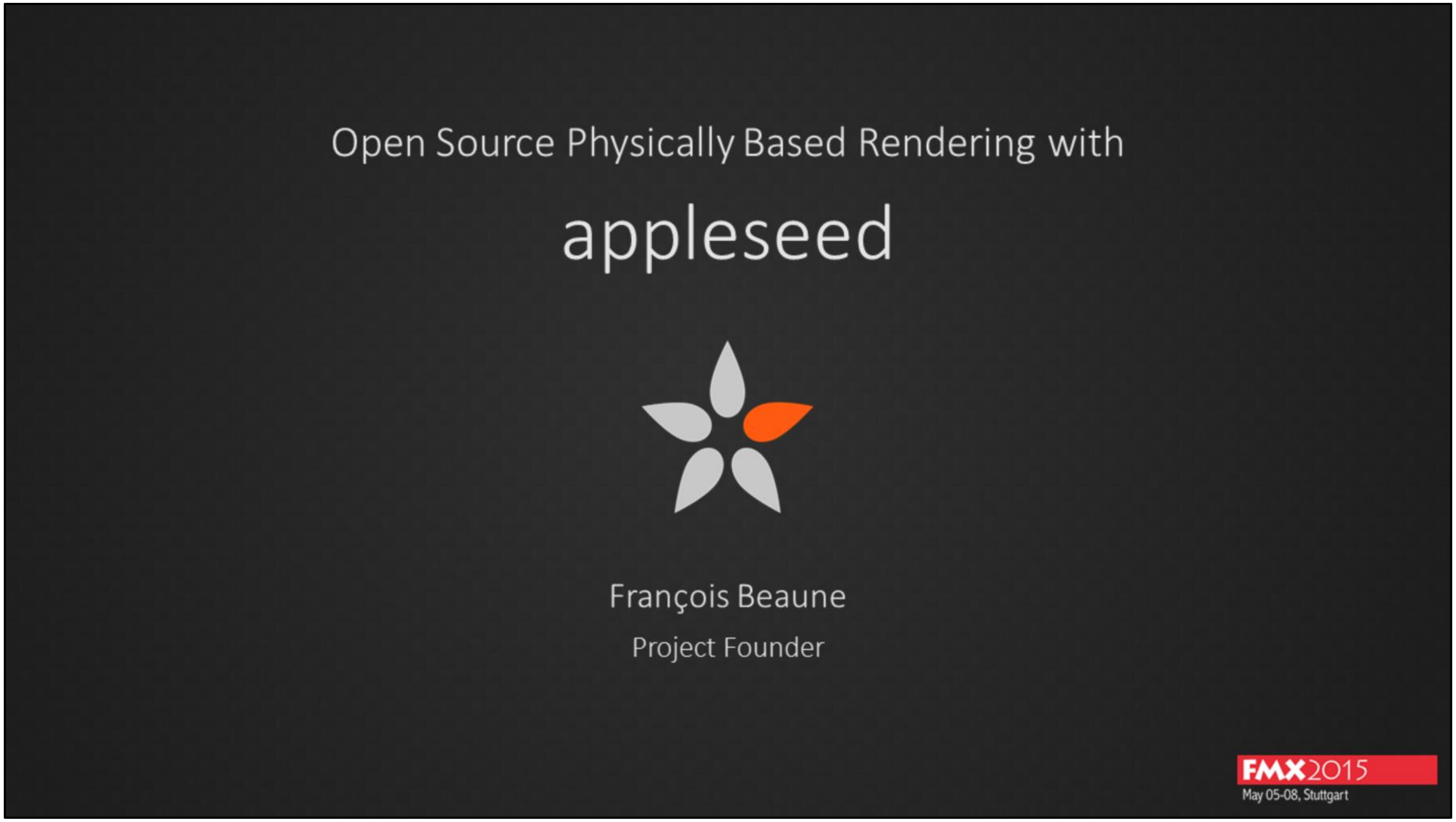
Foreword

- This was part of a talk I gave at the FMX conference in Stuttgart on May 6th, 2015.
- The part about Dropbox starts on page 25; slides 1-24 provide some context.
- Make sure to read the comments!
- "Fetch, a very short film" can be watched at https://vimeo.com/92172277
- The full slide deck for the talk can be found at http://appleseedhq.net/docs.html#fmx-2015
- Feel free to reach me at https://twitter.com/franzbeaune
- Finally, thanks for a great service (we're happy customers)!



Open Source Physically Based Rendering with

appleseed

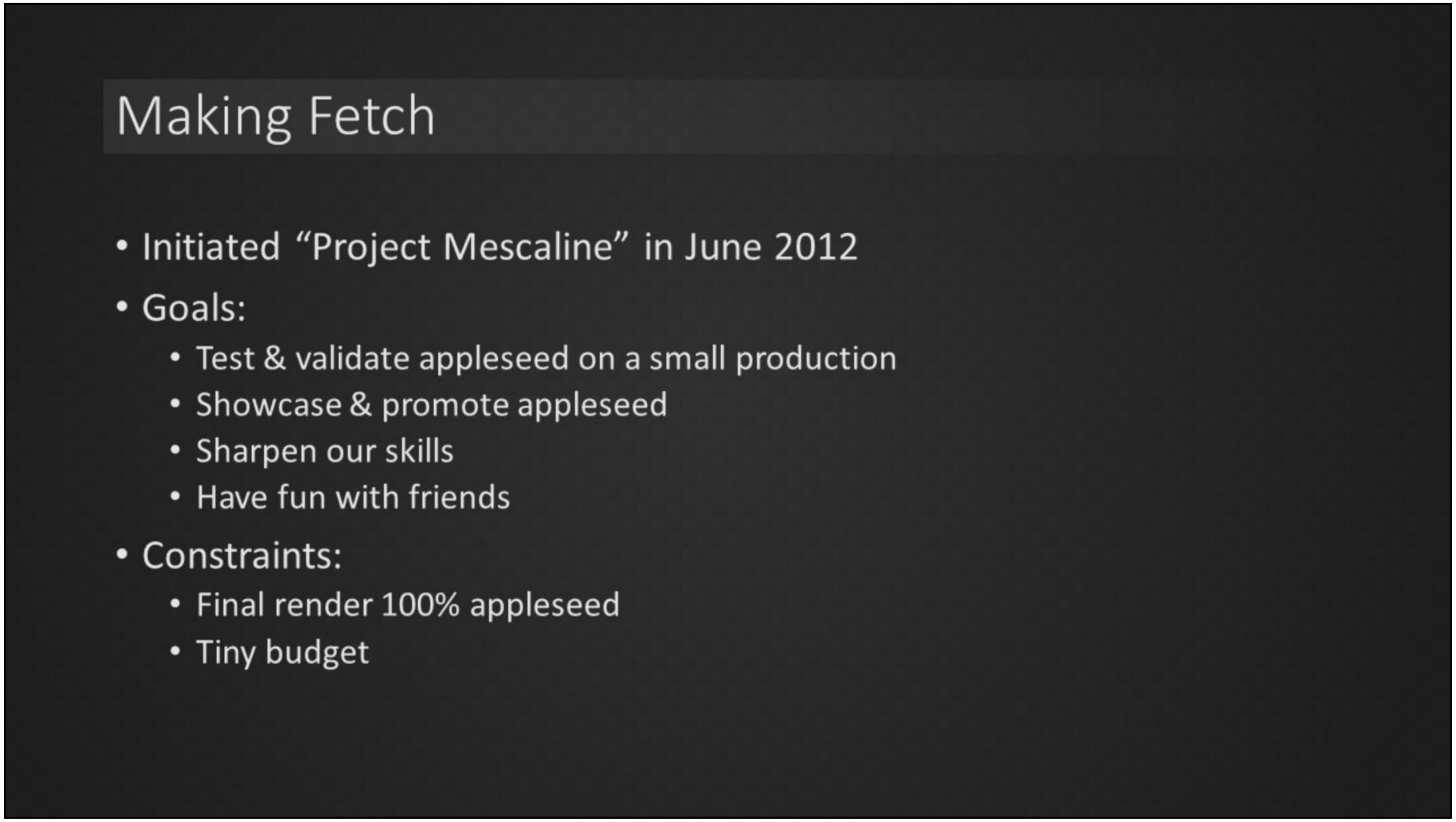
François Beaune

Project Founder

FMX2015

May 05-08, Stuttgart

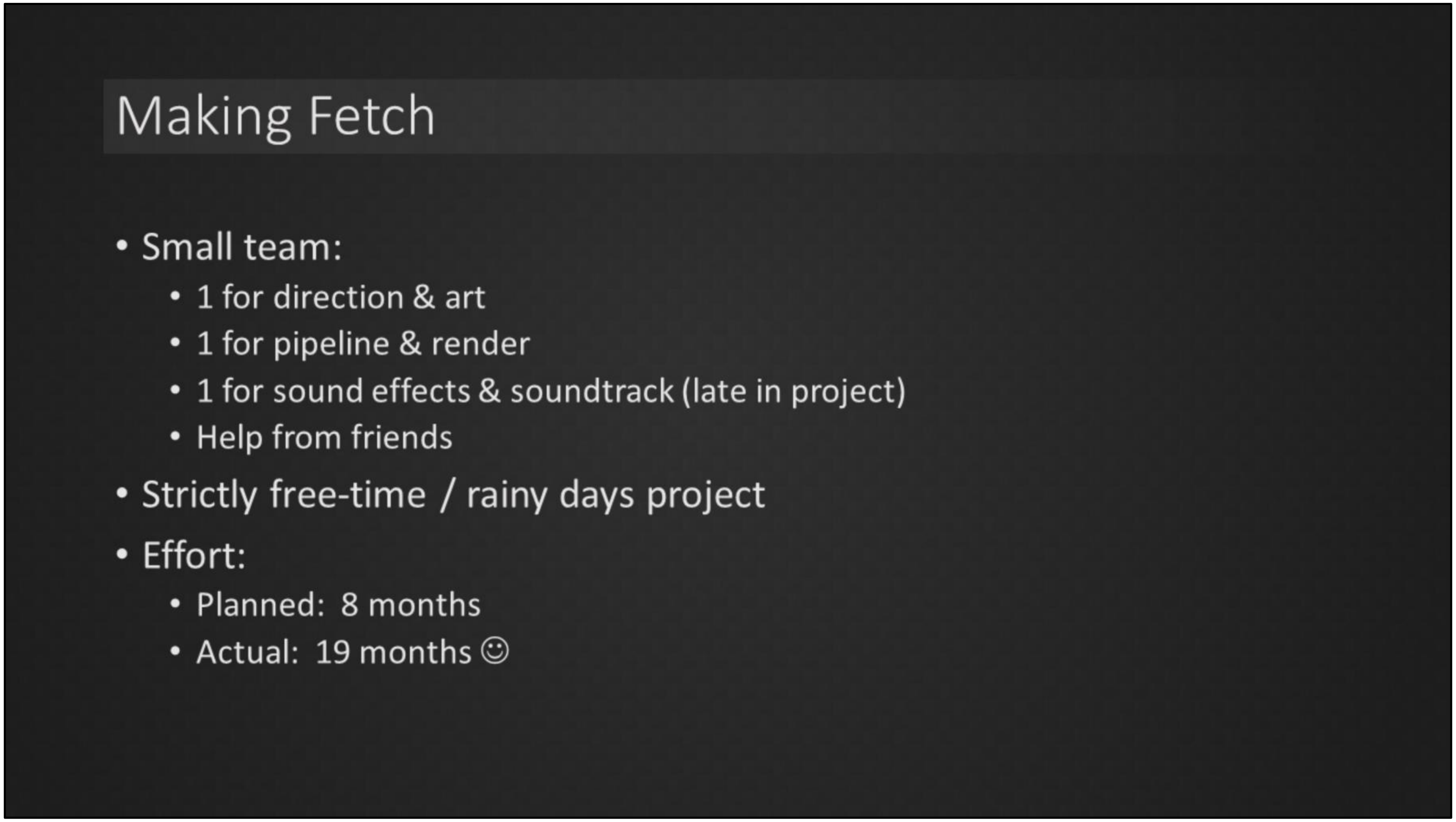
- Hi everyone!
- Thanks for attending my talk, appreciated! I hope you'll enjoy it.
- My name is François Beaune,
- I'm the founder of the appleseed project.



Making Fetch

- Initiated "Project Mescaline" in June 2012
- Goals:
  - Test & validate appleseed on a small production
  - Showcase & promote appleseed
  - Sharpen our skills
  - Have fun with friends
- Constraints:
  - Final render 100% appleseed
  - Tiny budget

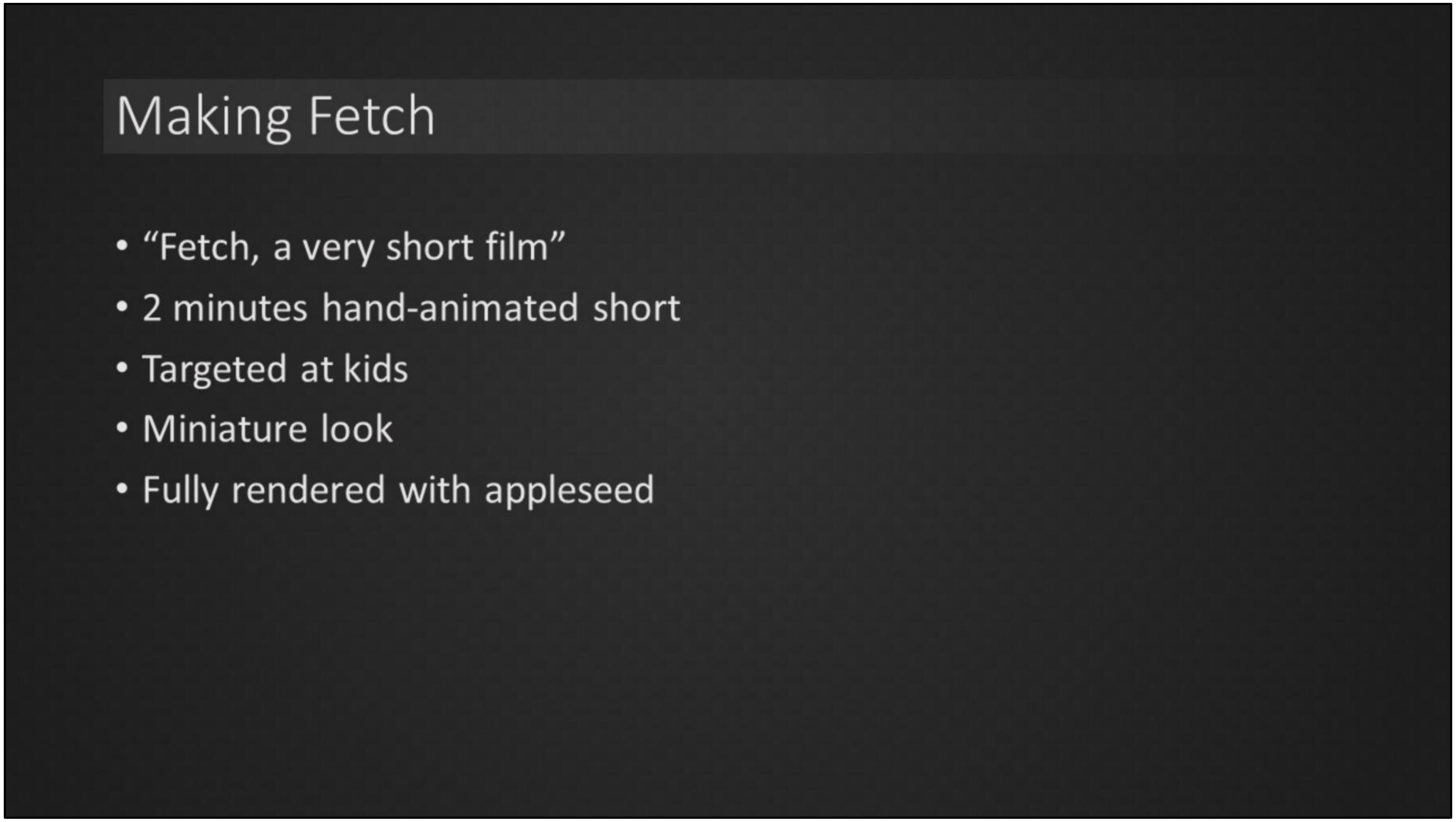
- We initiated what we called 'Project Mescaline' (I don't exactly remember why) in June of 2012.
- The main goal of this project was to test and validate appleseed on a small production
- We also wanted to have some cool material to showcase and promote appleseed
- It was also a good occasion to sharpen our skills, and have fun with friends (which we totally did)
- We had two main constraints though:
  - The final render had to be 100% done with appleseed
  - And we only had a tiny budget.



Making Fetch

- Small team:
  - 1 for direction & art
  - 1 for pipeline & render
  - 1 for sound effects & soundtrack (late in project)
  - Help from friends
- Strictly free-time / rainy days project
- Effort:
  - Planned: 8 months
  - Actual: 19 months ☺

- As I showed earlier, we were a very small team:
  - One person (François Gilliot) was responsible for the direction, and for all the graphics arts
  - One person (me) was responsible for pipeline setup and the final render
  - And one person (Ulric Santore) was responsible for sound effects and soundtrack
    - He was only involved at the end of the project, and he did a terrific job
  - We also got the occasional help from friends, in particular Jonathan Topf for the Maya-to-appleseed exporter
- Like appleseed, this was a strictly free-time / rainy days project.
- We kind of blew the schedule... But it's OK ☺



Making Fetch

- “Fetch, a very short film”
- 2 minutes hand-animated short
- Targeted at kids
- Miniature look
- Fully rendered with appleseed

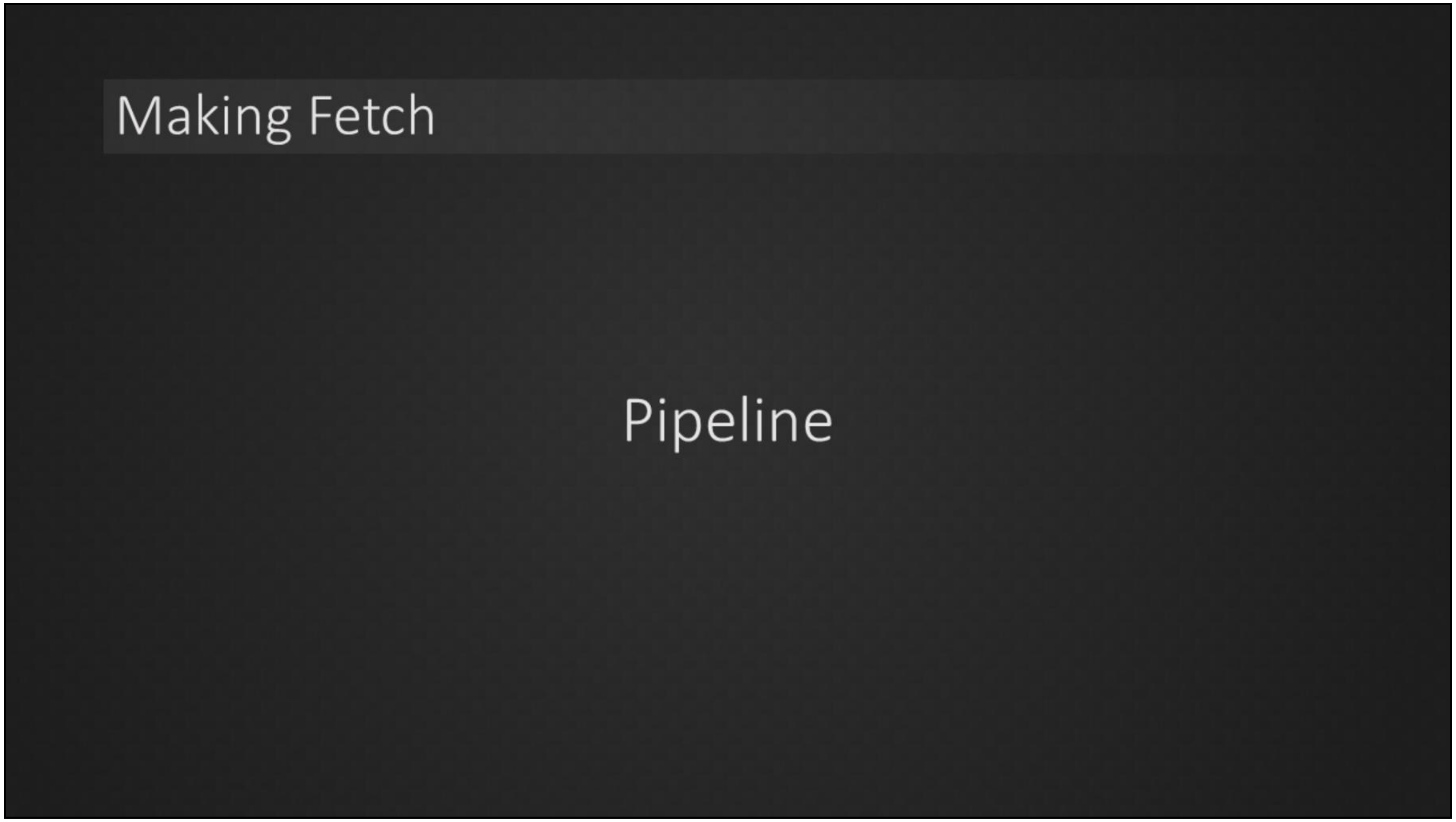
- So the film is appropriately called ‘Fetch, a very short film’
- It’s a 2-minute hand-animated short
- Targeted at kids
- We went for a miniature look
- Definitely inspired by the animated film Coraline, produced by Laika
- And of course, as this was the goal, every single pixel was rendered by appleseed

(Video)

Making Fetch

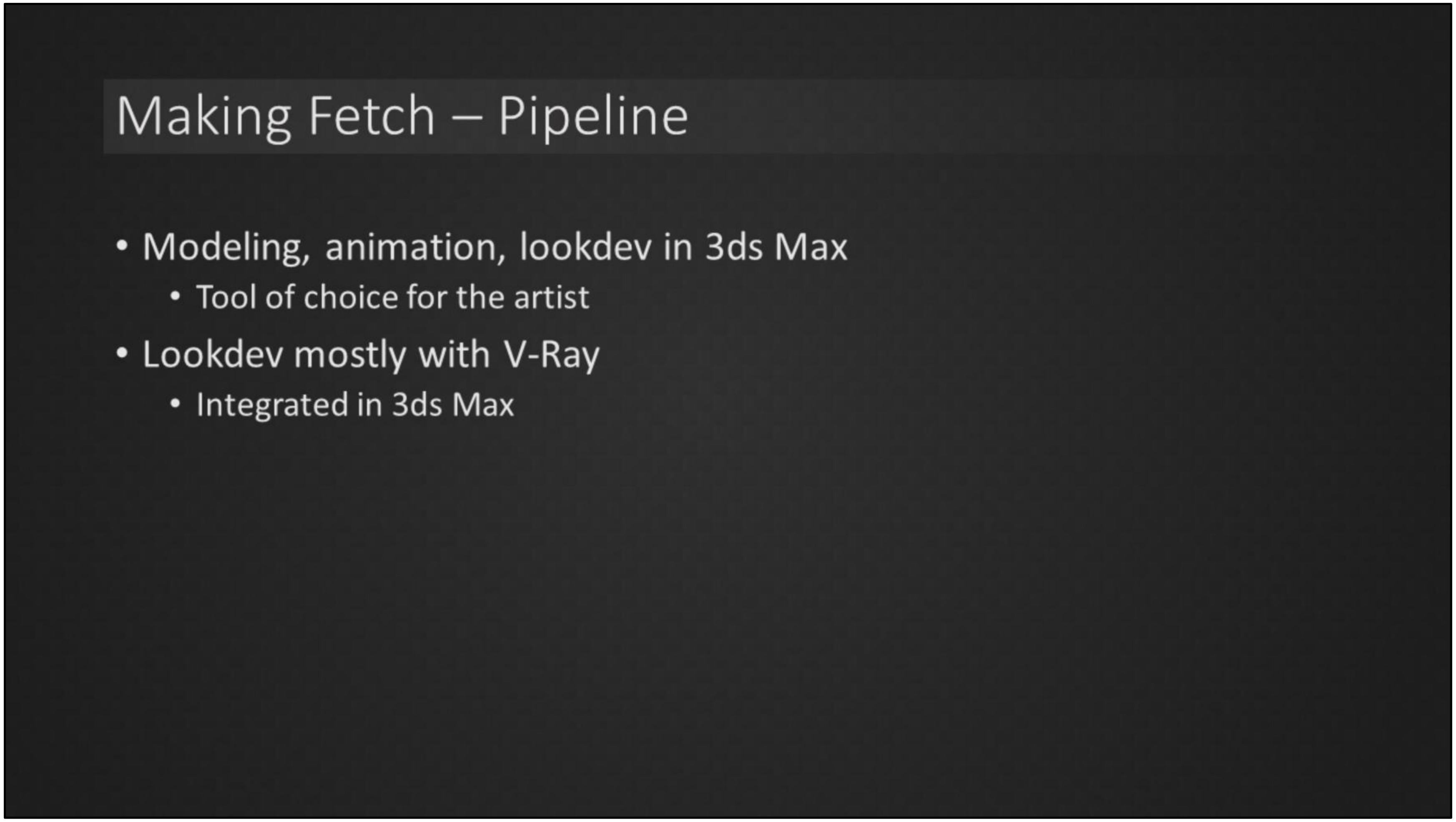
- Pipeline
- Render Setup
- Render Farm
- Conclusion

- So I'll be talking about three technical aspects of the making of Fetch
    - Our render pipeline
    - How we did the render setup
    - And our custom render farm



Making Fetch

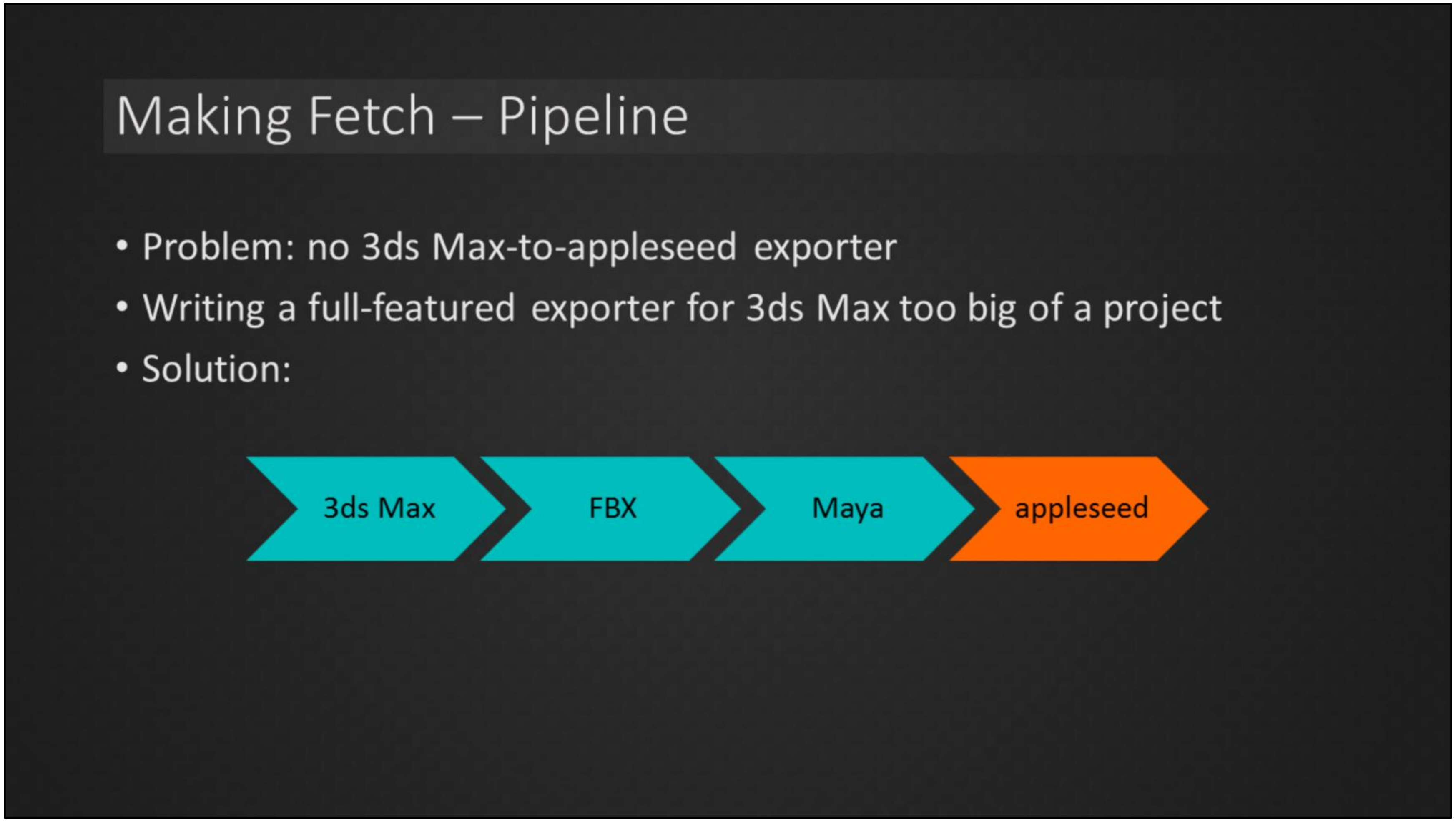
Pipeline



Making Fetch – Pipeline

- Modeling, animation, lookdev in 3ds Max
  - Tool of choice for the artist
- Lookdev mostly with V-Ray
  - Integrated in 3ds Max

- All modeling, animation and lookdev was done in 3ds Max
  - There wasn't much discussion about it, it was just the tool of choice of the artist.
- Lookdev was mostly done with V-Ray
  - Again because it's the tool of choice of the artist
  - Also because the integration of V-Ray in 3ds Max is solid

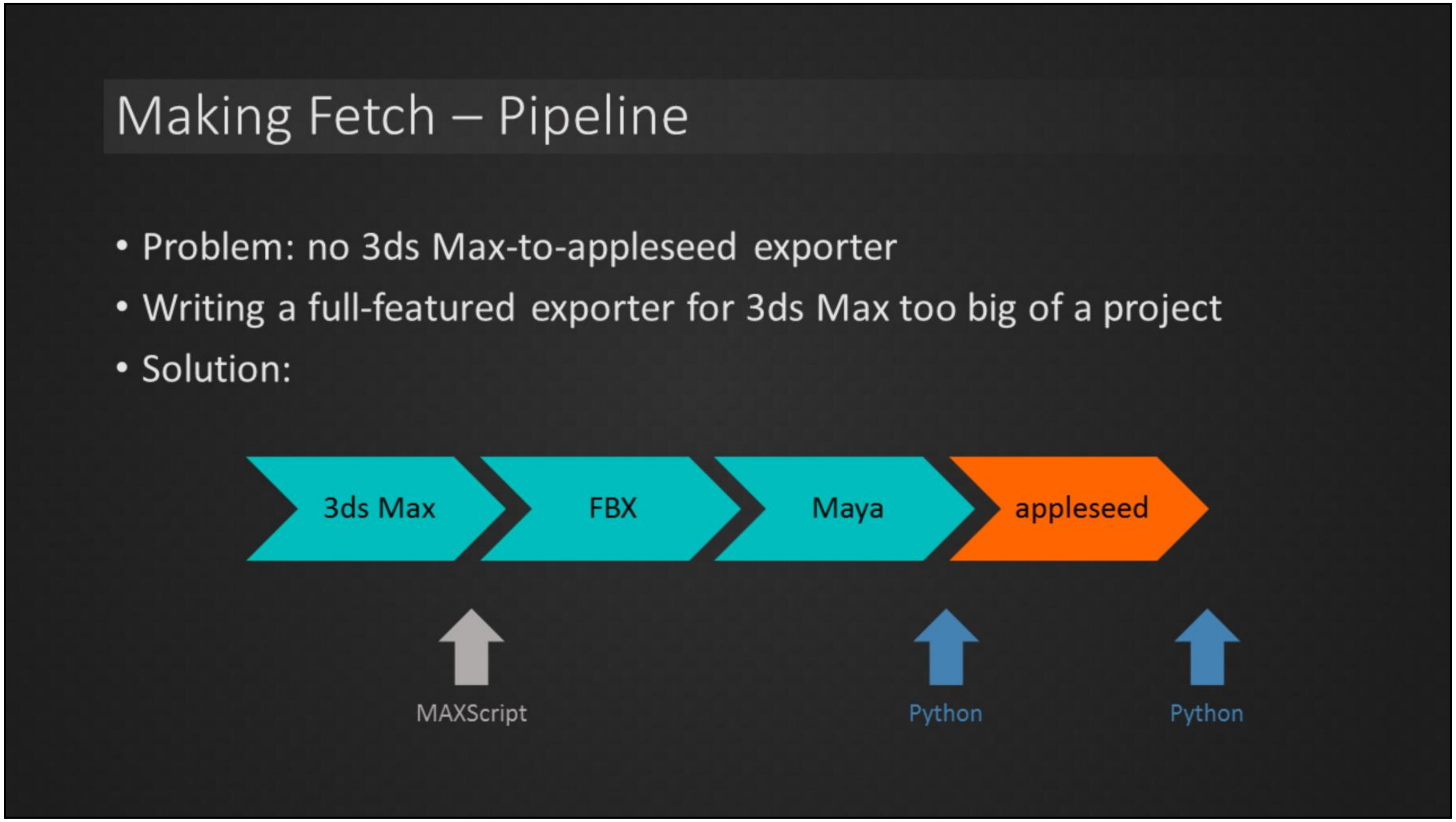


Making Fetch – Pipeline

- Problem: no 3ds Max-to-appleseed exporter
- Writing a full-featured exporter for 3ds Max too big of a project
- Solution:

3ds Max
FBX
Maya
appleseed

- The first problem was of course that, while we had an exporter for Maya (called mayaseed), we didn't have one for 3ds Max.
- We thought we wouldn't have time to write a full-featured exporter for 3ds Max
    - On a side note, it turned out we would have had time, and maybe that would have been a wise decision...
- Our 'brilliant' solution was to rely on Maya for the export, and on the FBX file format for scene data transport...



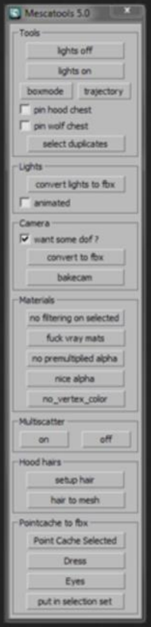
Making Fetch – Pipeline

- Problem: no 3ds Max-to-appleseed exporter
- Writing a full-featured exporter for 3ds Max too big of a project
- Solution:

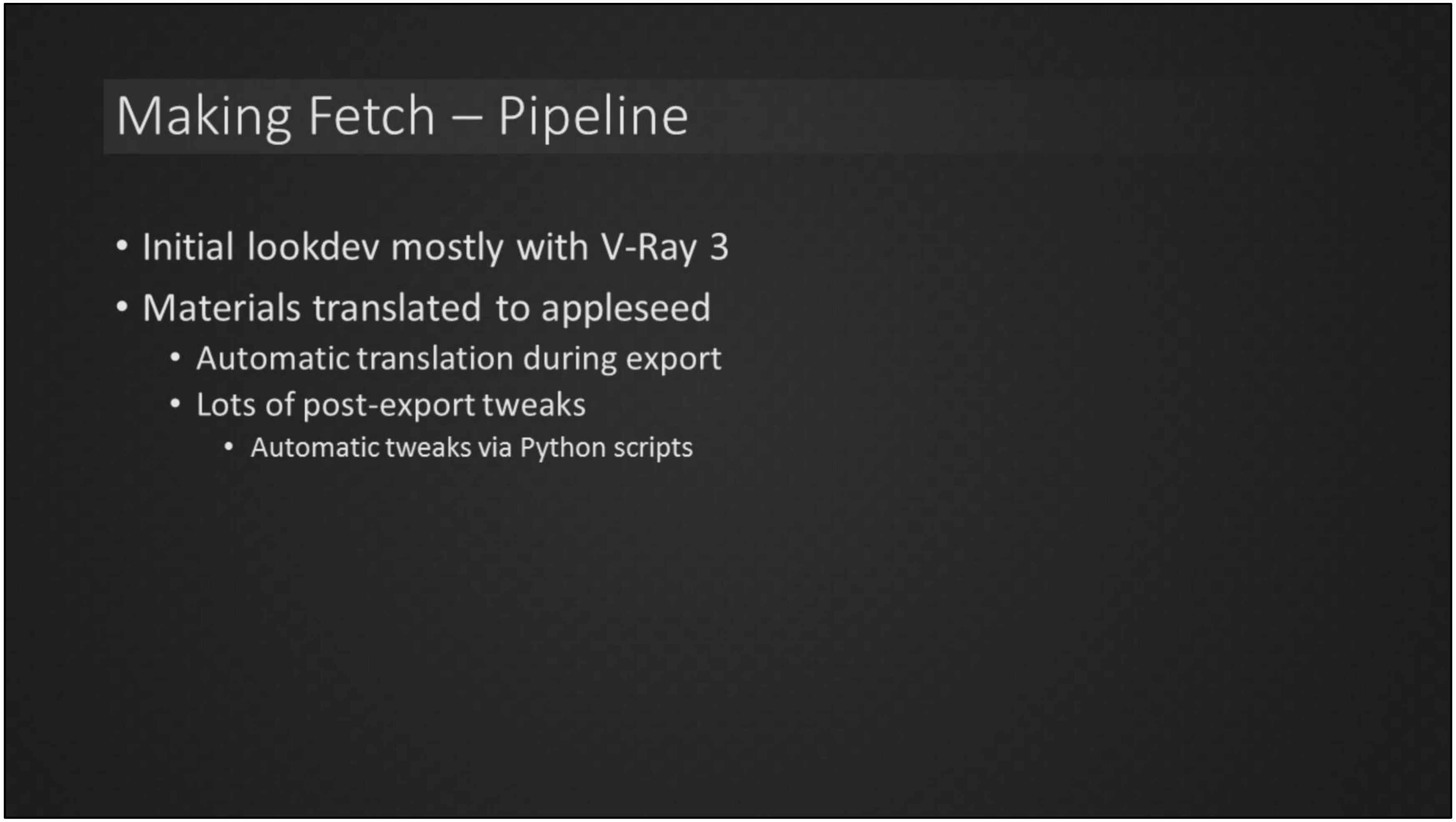
- Of course, we had to automate a bunch of intermediary tweaks to get it all to work:
    - In 3ds Max, before the FBX export
    - In Maya, right after the FBX import
    - And right after the export to appleseed scene files

Making Fetch – Pipeline

- FBX format would lose lots of information
  - Area lights
  - Gobos
  - DOF parameters…
- Several custom scripts to remedy this
  - 3ds Max side (MAXScript)
    - Store various info into custom attributes
    - Prepare the scene before FBX export
  - Maya side (Python)
    - Retrieve info from custom attributes
    - Adjust materials



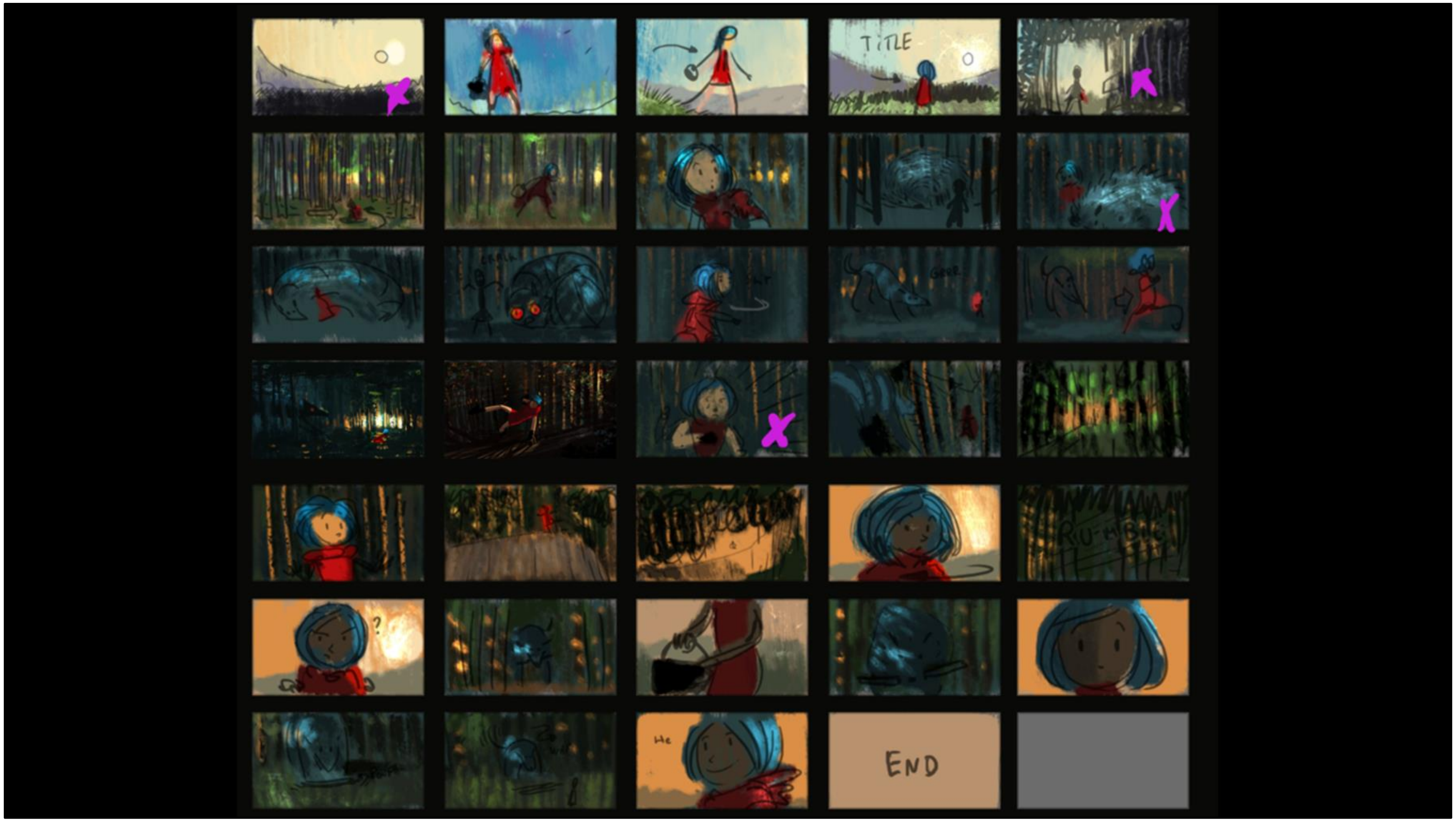
- One of the reason was that the FBX file format is totally not suited for transporting film scenes across DCC apps
  - It cannot adequately represent
    - Area lights
    - Gobos (projection textures on spot lights)
    - Depth of field parameters...
- So the first set of scripts were ran in 3ds Max, before FBX export
  - They would store as custom attributes everything that cannot be represented by FBX
  - And generally speaking, they would prepare the set before export
  - You can see here on the right the UI we built for these scripts
- The second set of scripts were ran in Maya, after FBX import
  - Retrieve the info from custom attributes and apply them to the scene
  - Adjust materials somewhat



Making Fetch – Pipeline

- Initial lookdev mostly with V-Ray 3
- Materials translated to appleseed
  - Automatic translation during export
  - Lots of post-export tweaks
    - Automatic tweaks via Python scripts

- As I explained earlier, the lookdev was done with V-Ray 3
- That meant we had to translate V-Ray materials to appleseed
  - That was mostly done automatically with our pre-FBX and post-FBX scripts
  - But some more tweaking was necessary after the export to appleseed
    - A Python script that would directly alter the appleseed scene files (looking for objects and materials by name)

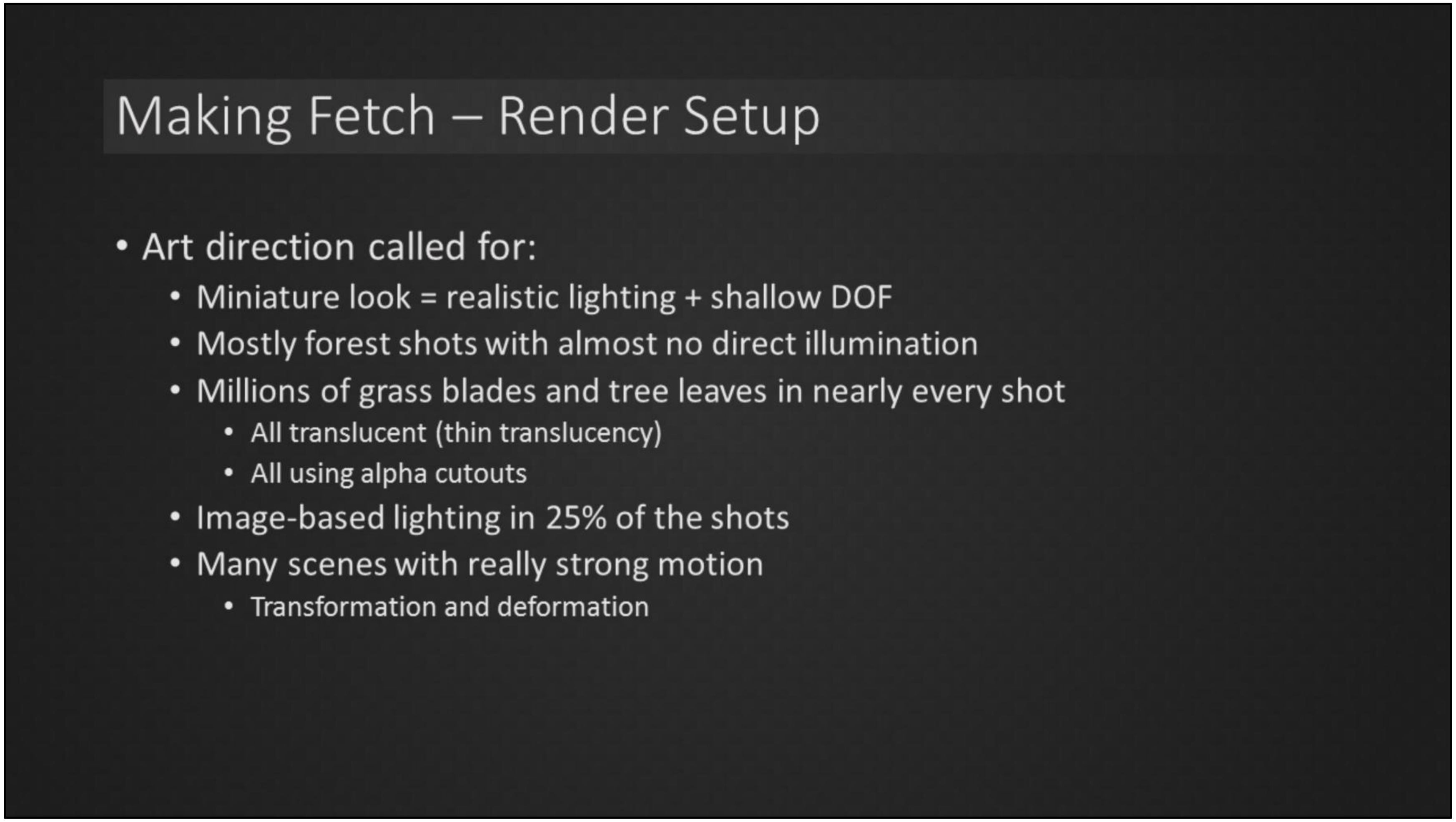


- Intermezzo: this is the color script of Fetch

Making Fetch

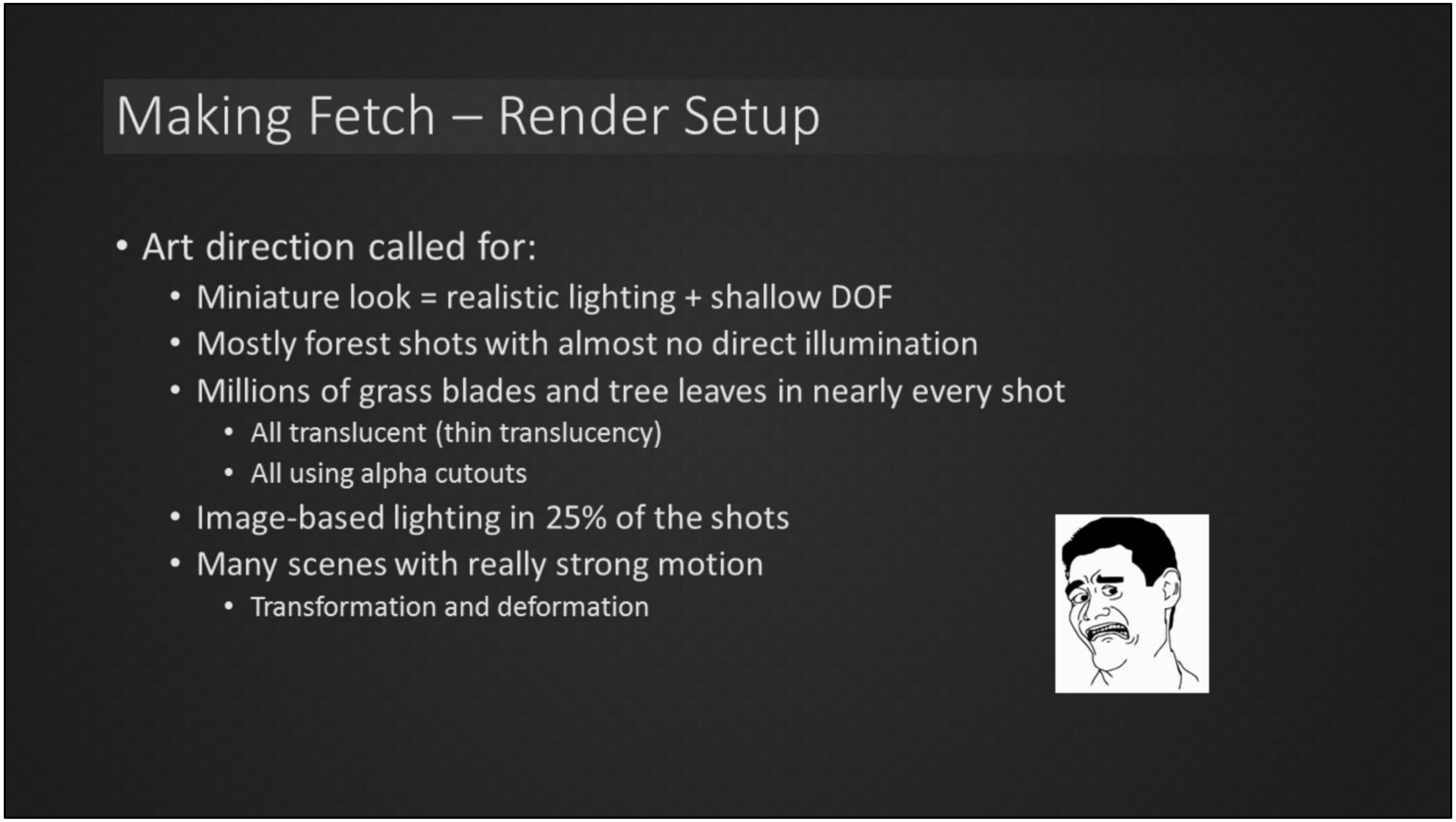
Render Setup

- Let's talk now about our render setup...


Making Fetch – Render Setup

- Art direction called for:
  - Miniature look = realistic lighting + shallow DOF
  - Mostly forest shots with almost no direct illumination
  - Millions of grass blades and tree leaves in nearly every shot
    - All translucent (thin translucency)
    - All using alpha cutouts
  - Image-based lighting in 25% of the shots
  - Many scenes with really strong motion
    - Transformation and deformation

- Usually, stop motion look means no motion blur
  - But we wanted to demonstrate appleseed’s motion blur capabilities so we decided to use it nevertheless



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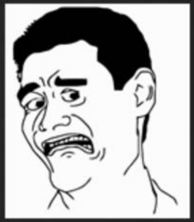
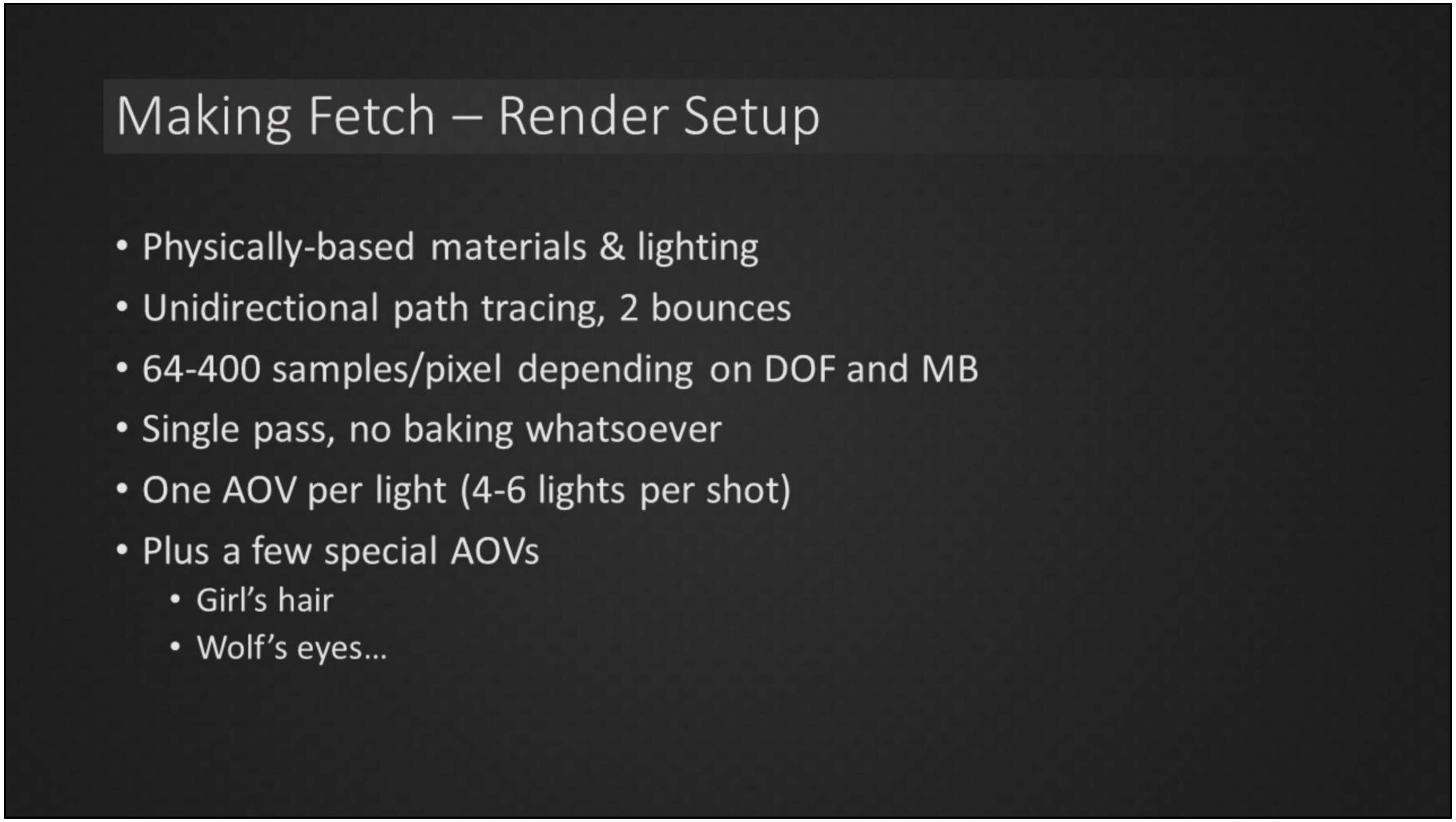
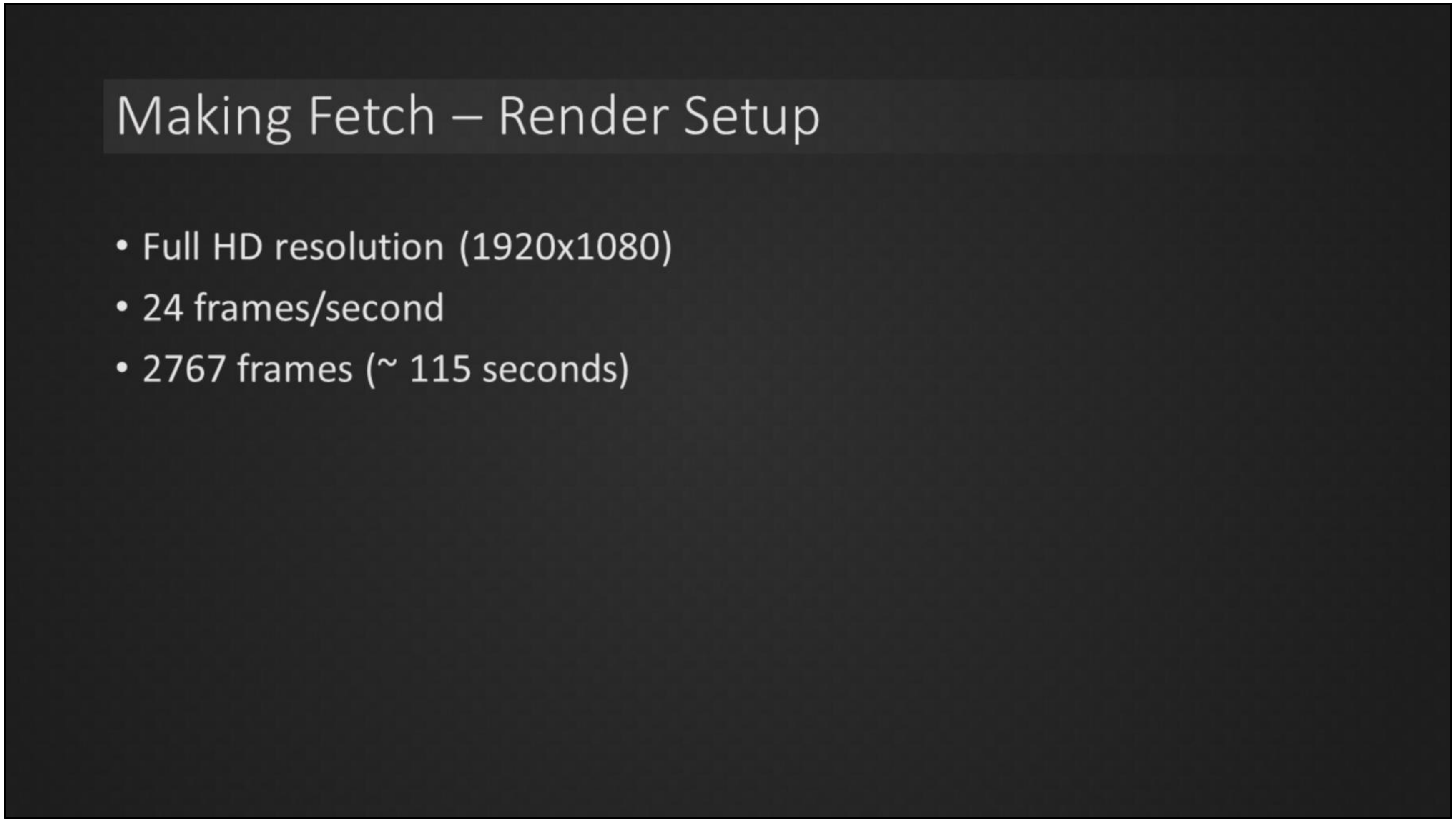




Making Fetch – Render Setup

- Physically-based materials & lighting
- Unidirectional path tracing, 2 bounces
- 64-400 samples/pixel depending on DOF and MB
- Single pass, no baking whatsoever
- One AOV per light (4-6 lights per shot)
- Plus a few special AOVs
  - Girl's hair
  - Wolf's eyes…

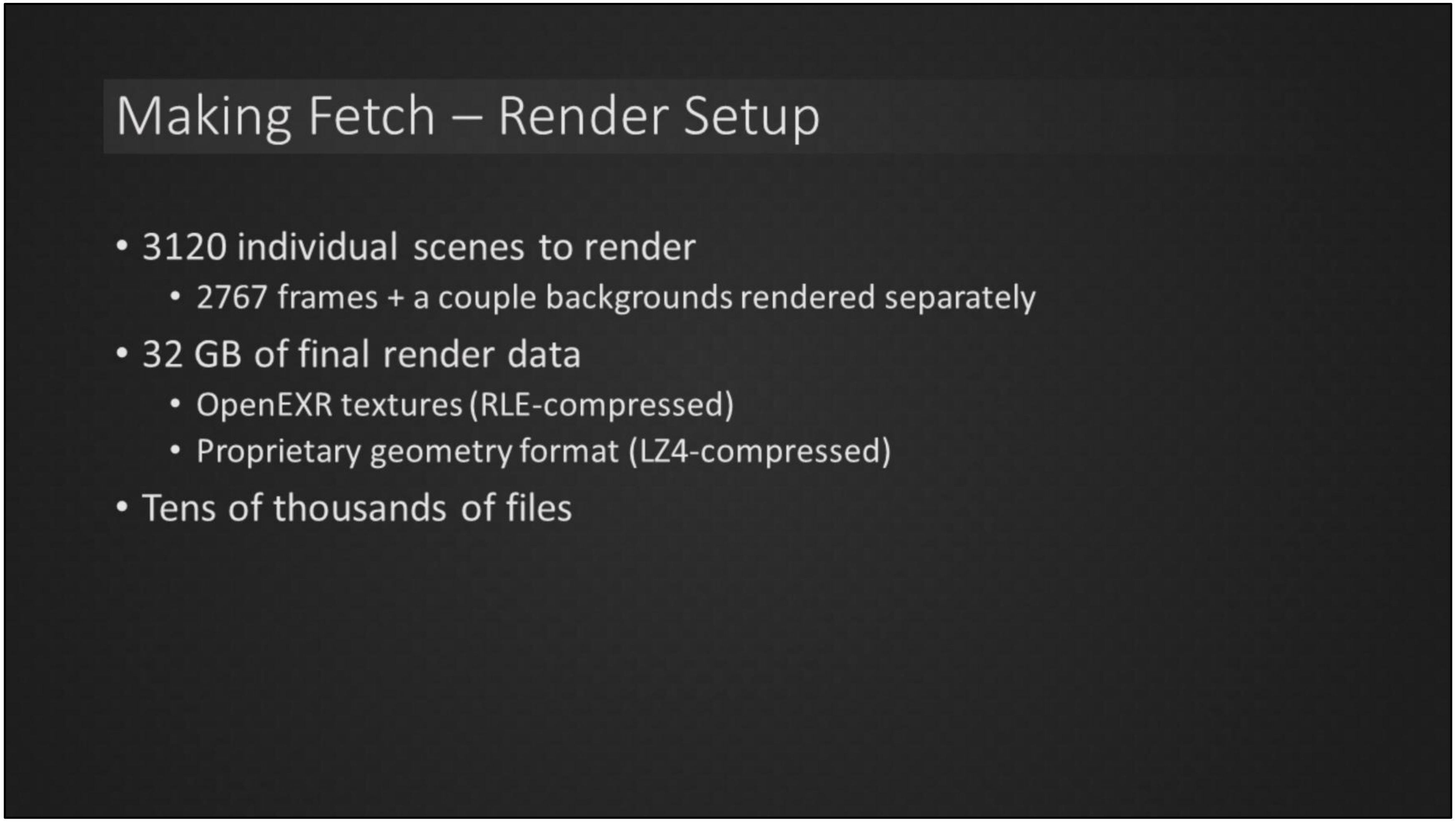
- So this is how we setup our rendering:
  - Of course we went for physically-based materials and lighting
    - Since that's what would allow us to achieve a miniature look
  - We limited path tracing to two bounces
    - Not sure more bounces would have been much slower since most surfaces are rather dark
  - We used anywhere from 64 to 400 samples/pixel depending on DOF and MB



Making Fetch – Render Setup

- Full HD resolution (1920x1080)
- 24 frames/second
- 2767 frames (~ 115 seconds)

- We chose to render at full HD resolution
- And we chose 24 frames/second
    - In hindsight, we could have chosen a lower frame rate, which would have made sense in the stop motion context



Making Fetch – Render Setup

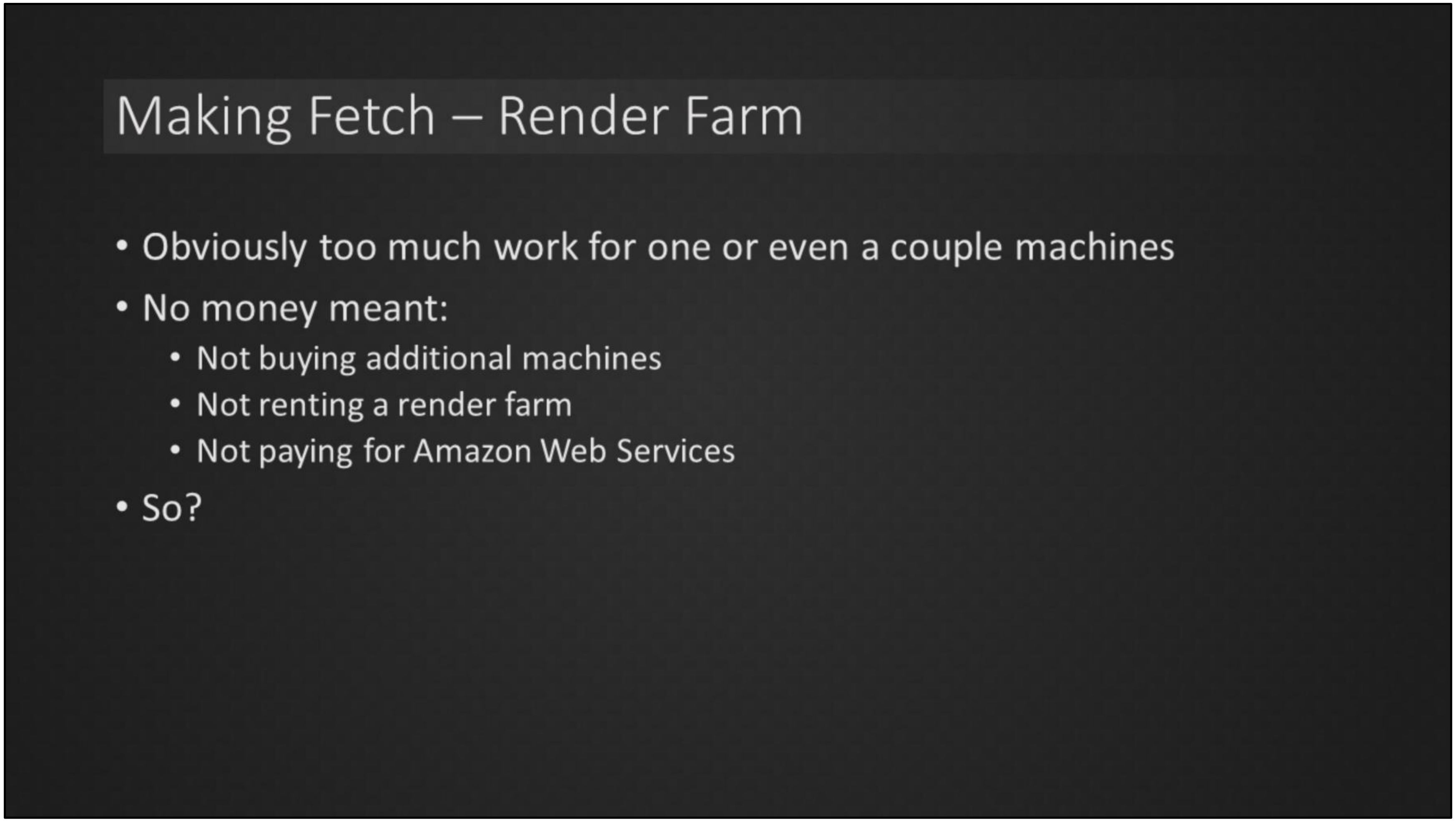
- 3120 individual scenes to render
  - 2767 frames + a couple backgrounds rendered separately
- 32 GB of final render data
  - OpenEXR textures (RLE-compressed)
  - Proprietary geometry format (LZ4-compressed)
- Tens of thousands of files

- Intermezzo: just a drawing

Making Fetch

Render Farm

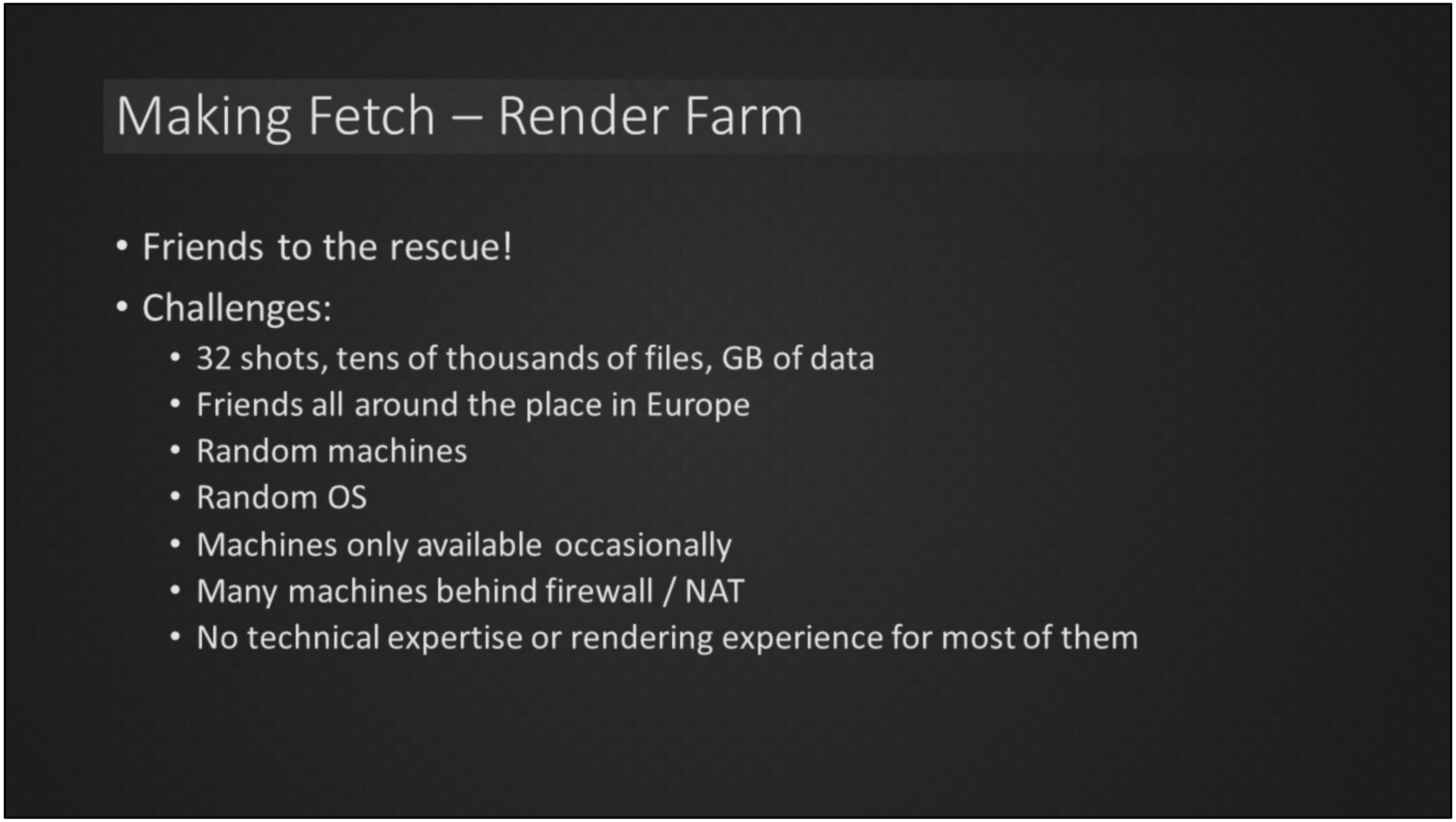
- Alright, so let’s talk now about how we actually managed to render that short film...



Making Fetch – Render Farm

- Obviously too much work for one or even a couple machines
- No money meant:
  - Not buying additional machines
  - Not renting a render farm
  - Not paying for Amazon Web Services
- So?

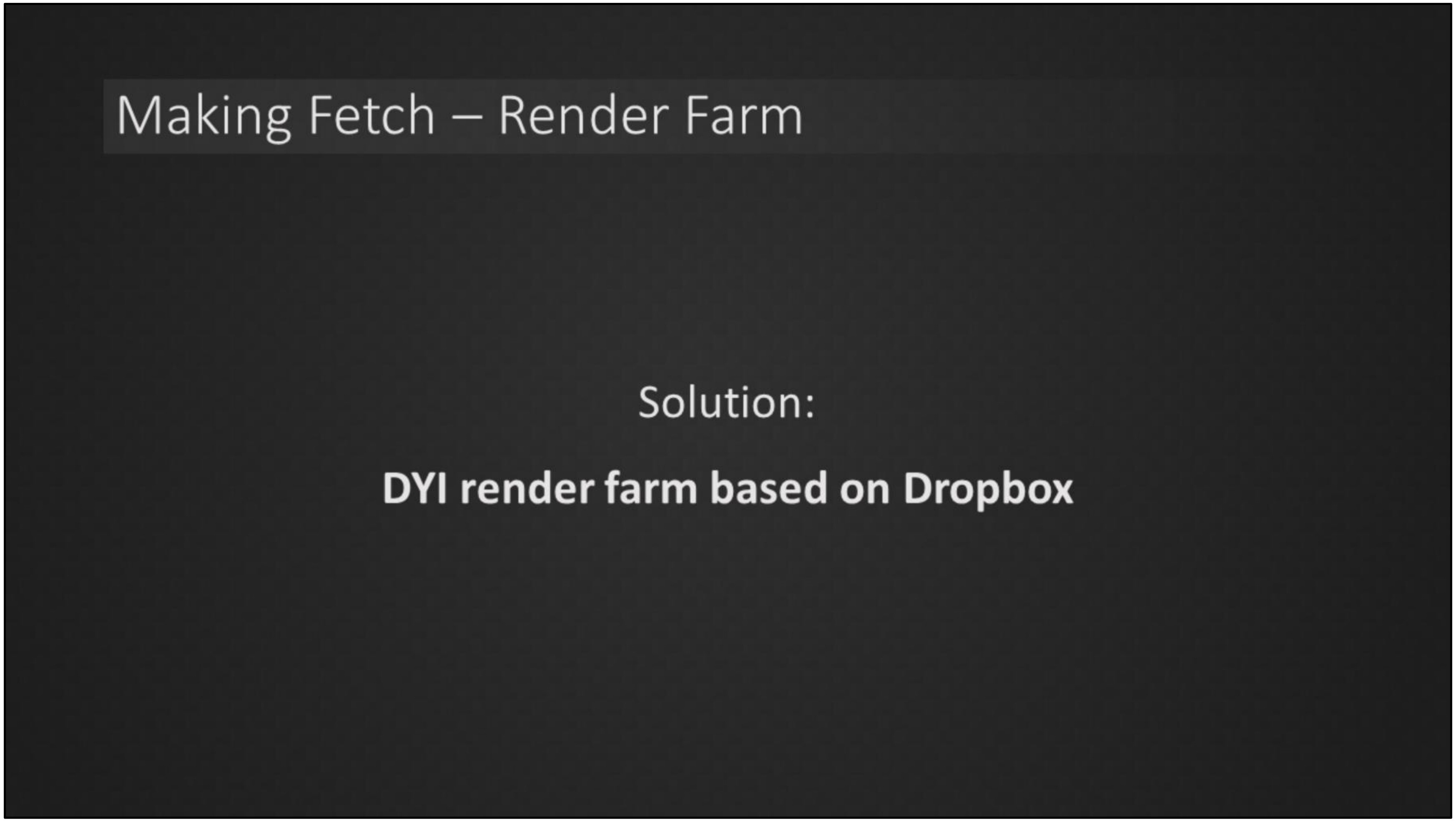
- Obviously we had way too many frames to render for a single machine, or even a couple of machines
- And since we had no money to spare, we couldn't
  - Buy additional machines to build our own render farm
  - Rent a render farm
  - Build a farm using AWS



Making Fetch – Render Farm

- Friends to the rescue!
- Challenges:
  - 32 shots, tens of thousands of files, GB of data
  - Friends all around the place in Europe
  - Random machines
  - Random OS
  - Machines only available occasionally
  - Many machines behind firewall / NAT
  - No technical expertise or rendering experience for most of them

- At this point we decided to involve our friends.
- But that brought its own set of challenges.

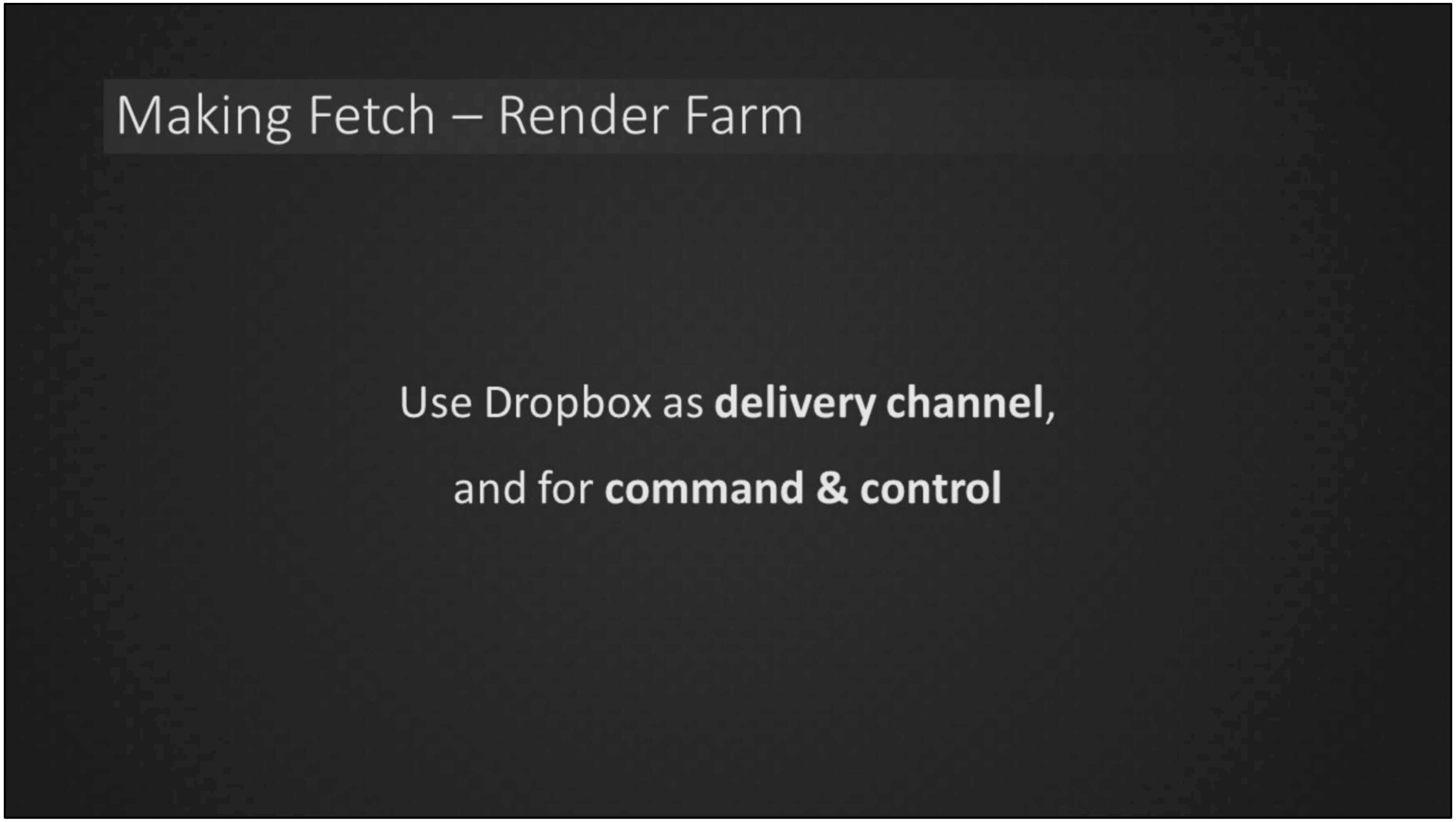


Making Fetch – Render Farm

Solution:

DYI render farm based on Dropbox

- The solution to this nightmare came in the form of a custom render farm system built around Dropbox
- The inspiration for this came from a tiny script that one of our team member, Jonathan Topf, who wrote to render the animations from the Light & Dark documentaries I talked about earlier.

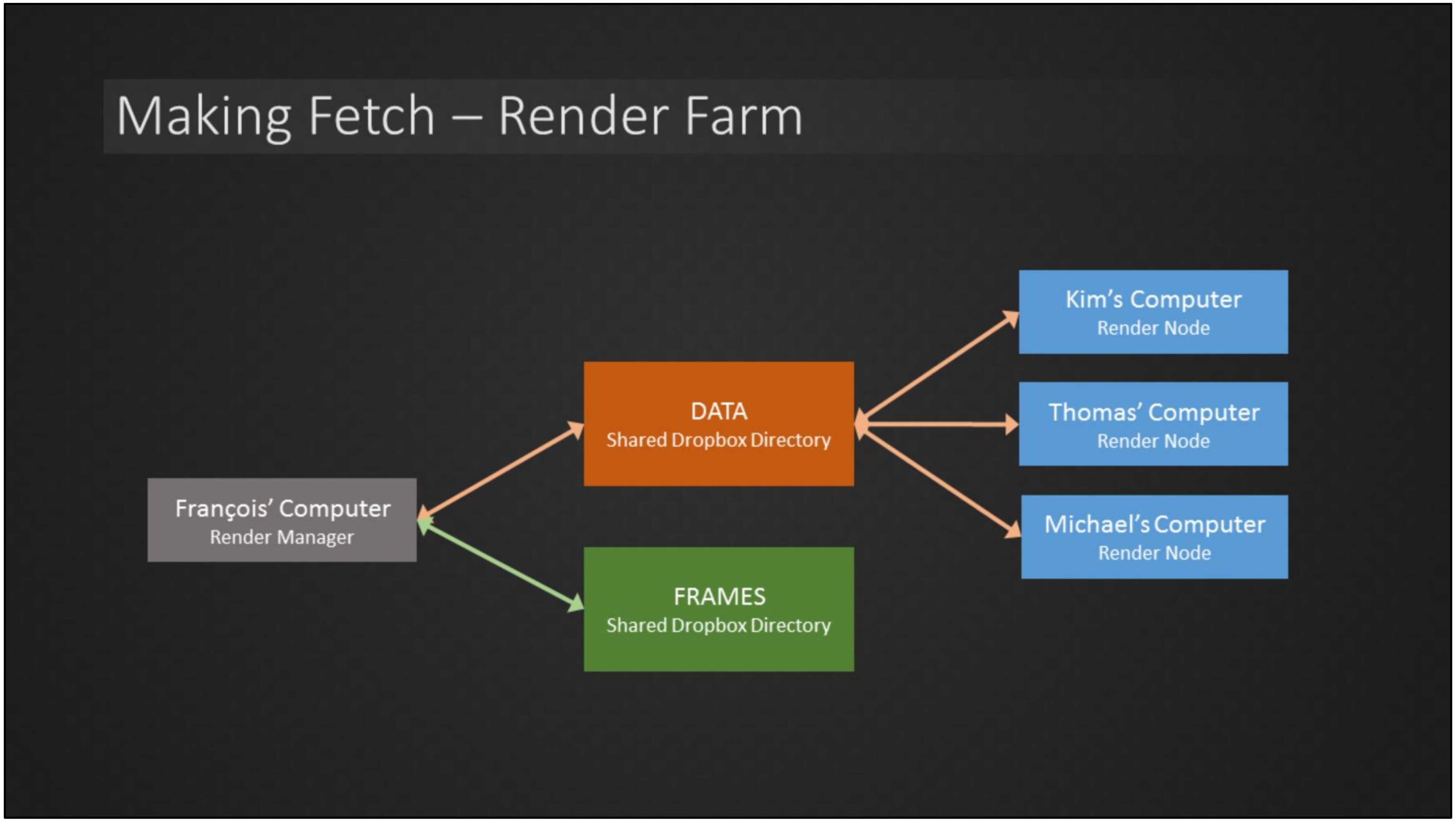


Making Fetch – Render Farm

Use Dropbox as **delivery channel,**

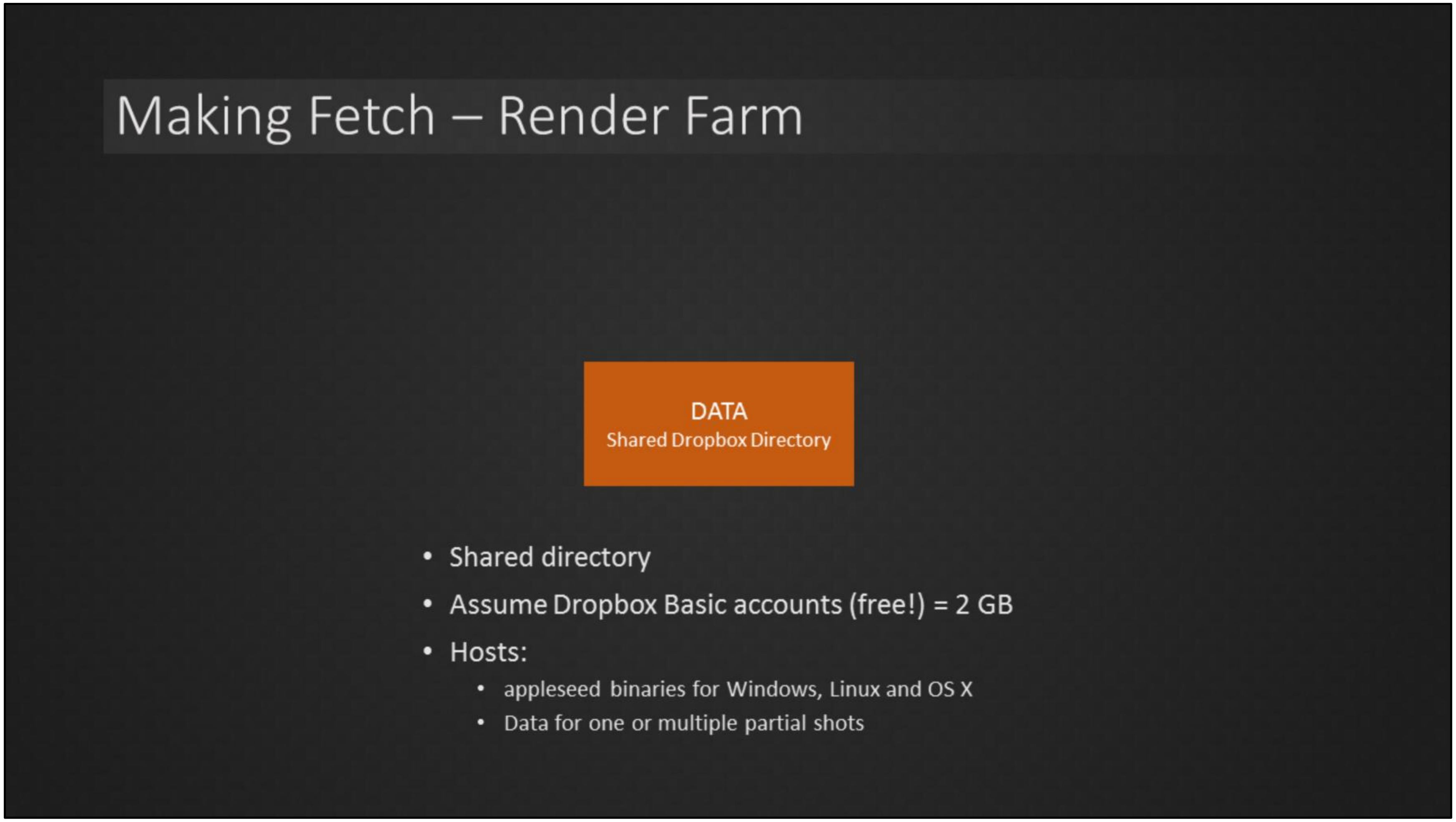
and for **command & control**

- The core idea is to use the Dropbox shared directory mechanism:
    - To deploy appleseed binaries to render node
    - Reliably send scene data to render nodes
    - Reliably send rendered frames back to some kind of ‘master’ node



Making Fetch – Render Farm

- So this is the overall architecture of our system.

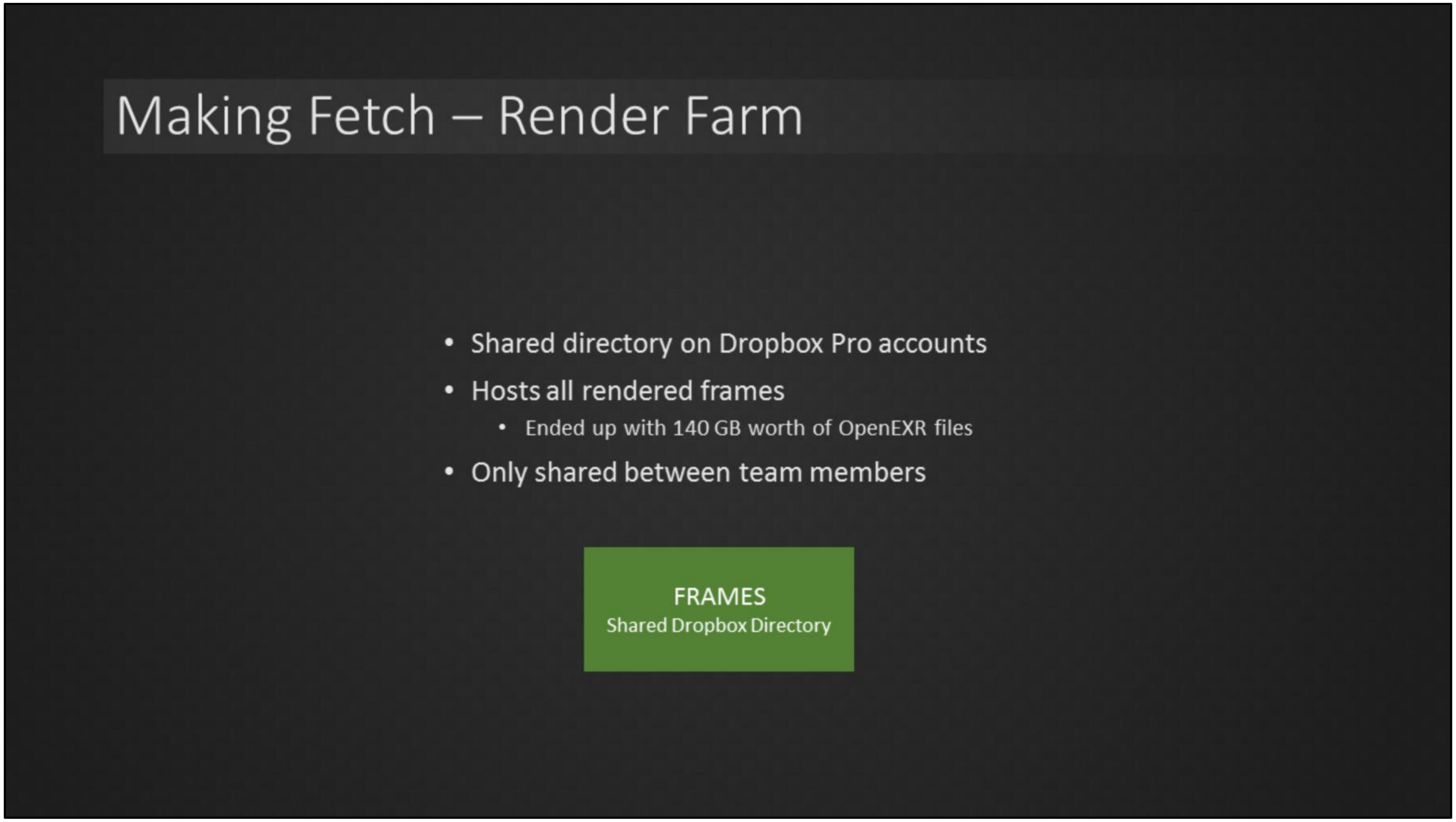


Making Fetch – Render Farm

DATA
Shared Dropbox Directory

- Shared directory
- Assume Dropbox Basic accounts (free!) = 2 GB
- Hosts:
  - appleseed binaries for Windows, Linux and OS X
  - Data for one or multiple partial shots

- The central piece is a shared directory we call DATA
  - Free Dropbox Basic accounts are limited to 2 GB, so that's the upper limit for the content of this directory.
  - In this directory we'll store three things:
    - appleseed binaries for Windows, Linux and OS X
    - Shot data (scene files, textures, geometry, etc.)
    - A few rendered frames
  - This directory *is* the central delivery and command & control mechanism.
- It's important to note that, regarding shot data, we may have:
  - multiple different shots at the same time
  - partial shots (only parts of the frames)

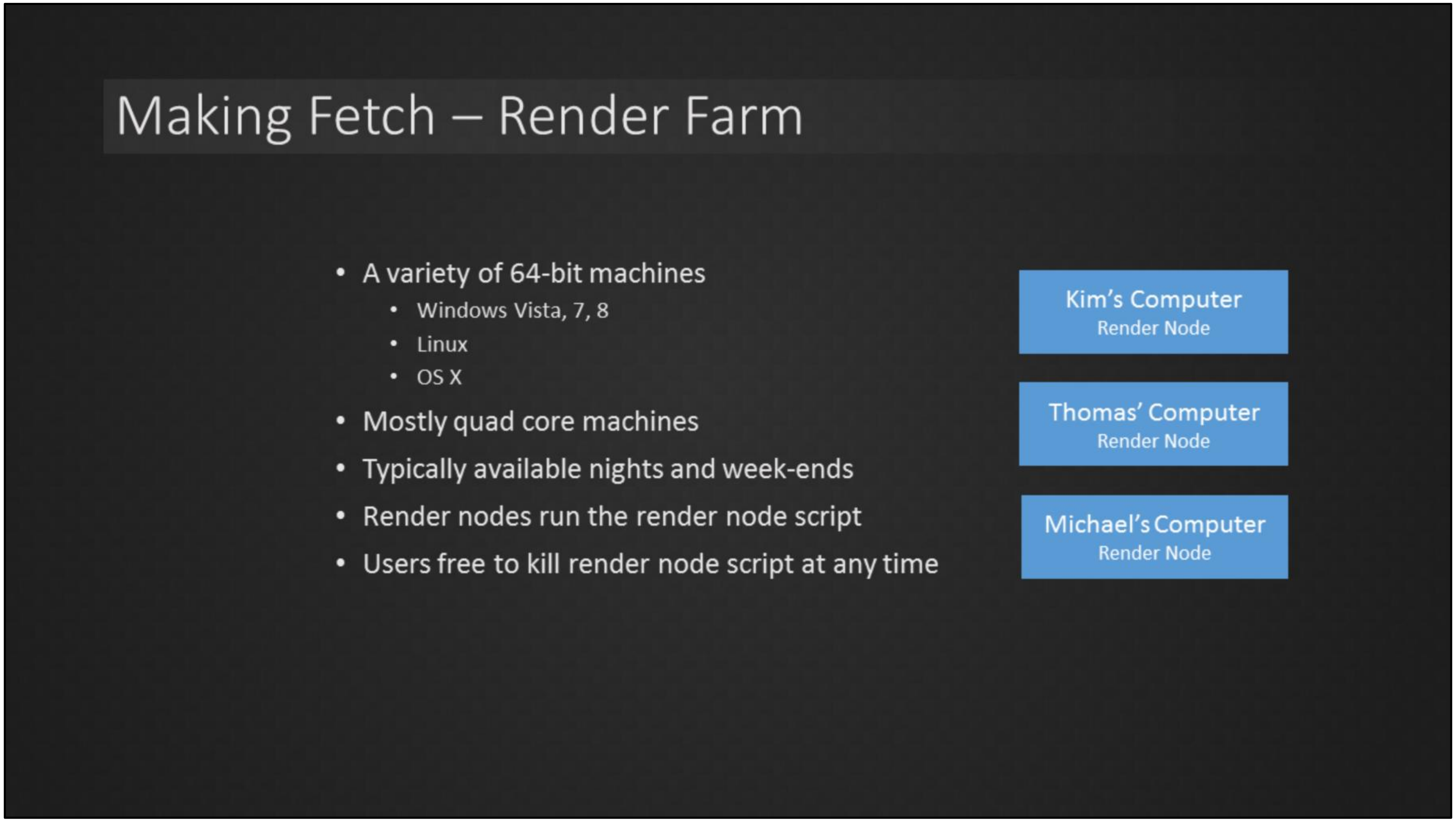


Making Fetch – Render Farm

- Shared directory on Dropbox Pro accounts
- Hosts all rendered frames
  - Ended up with 140 GB worth of OpenEXR files
- Only shared between team members

FRAMES
Shared Dropbox Directory

- We also have a second directory we call FRAMES
  - For this one we assume Dropbox Pro accounts, so limited to 1 TB of data
  - This directory hosts all the frames renderer so far
    - We ended up with about 140 GB worth of OpenEXR files
  - This directory is only shared with team members, not with the render farmers

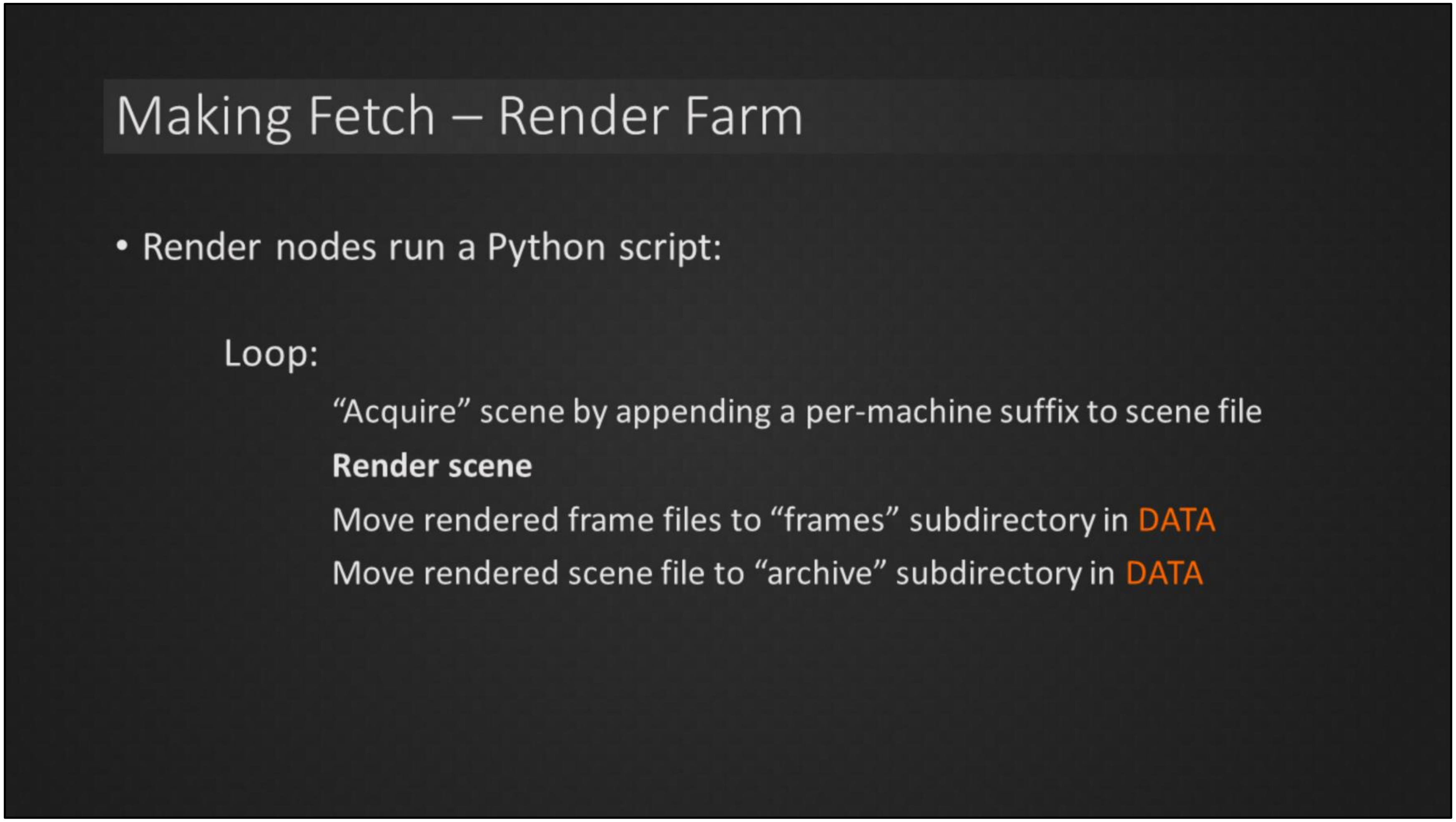


Making Fetch – Render Farm

- A variety of 64-bit machines
  - Windows Vista, 7, 8
  - Linux
  - OS X
- Mostly quad core machines
- Typically available nights and week-ends
- Render nodes run the render node script
- Users free to kill render node script at any time

Kim's Computer
Render Node
Thomas' Computer
Render Node
Michael's Computer
Render Node

- Then we have the Render Nodes themselves
  - These are just random 64-bit machines running a variety of operating systems
    - Windows Vista, Windows 7, Windows 8
    - Linux
    - OS X
  - We had mostly quad core machines, but not only
  - These machines were typically available on nights and week-ends only
  - Render nodes run a Python script we call the render node script
    - Acquires render jobs and executes them
  - Machine owners were free to kill the render node script at any time to reclaim their machine



Making Fetch – Render Farm

- Render nodes run a Python script:

  Loop:

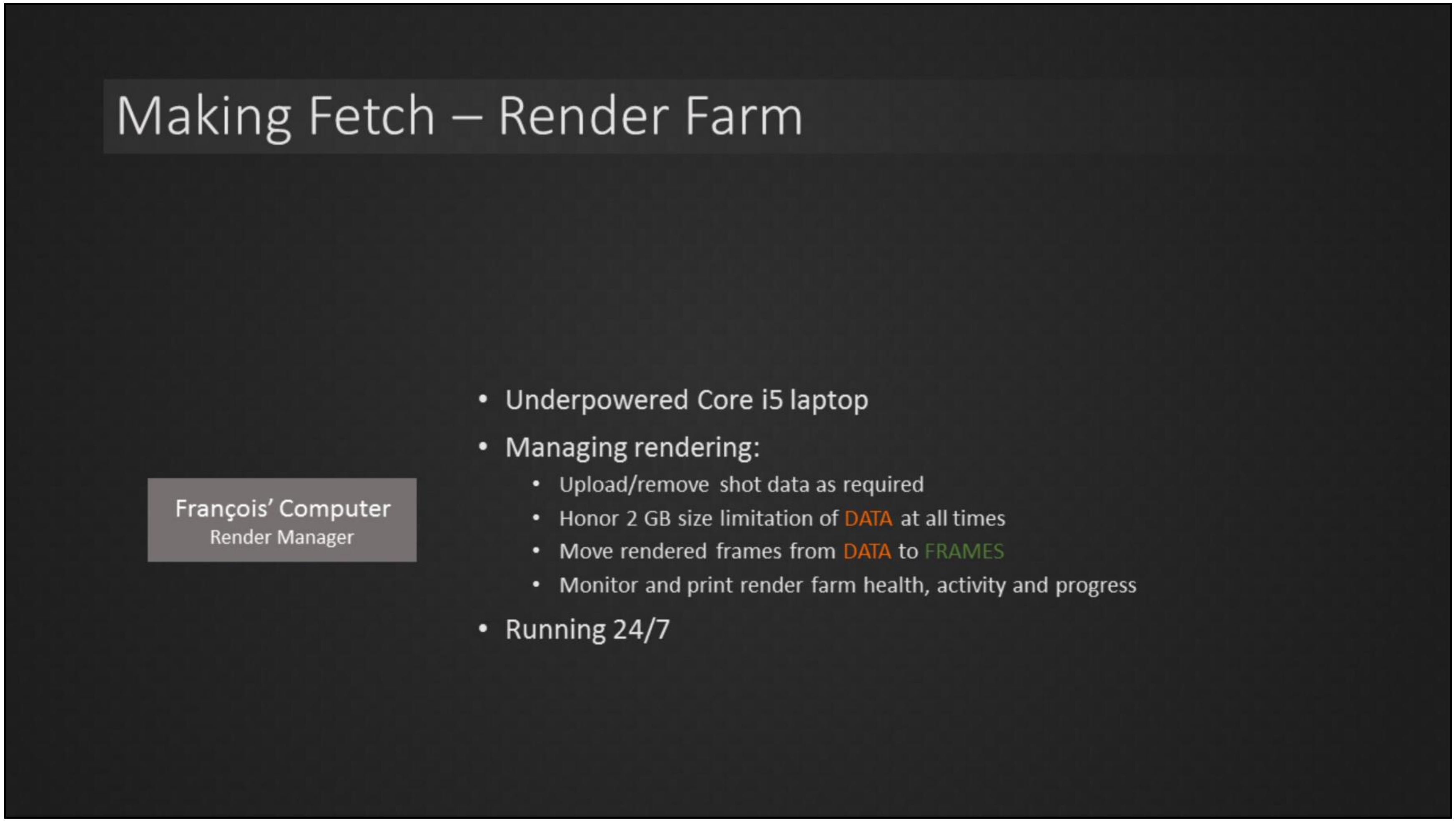
  “Acquire” scene by appending a per-machine suffix to scene file

  Render scene

  Move rendered frame files to “frames” subdirectory in DATA

  Move rendered scene file to “archive” subdirectory in DATA

- The render node script runs a main loop:
  - It first ‘acquire’ a **random** available scene file by appending a per-machine suffix (a short id) to the file
  - It then render the scene locally
  - Once done, it moves the rendered frame (up to a dozen OpenEXR files) to a ‘frames’ subdirectory
  - And finally it moves the scene file to an ‘archive’ subdirectory

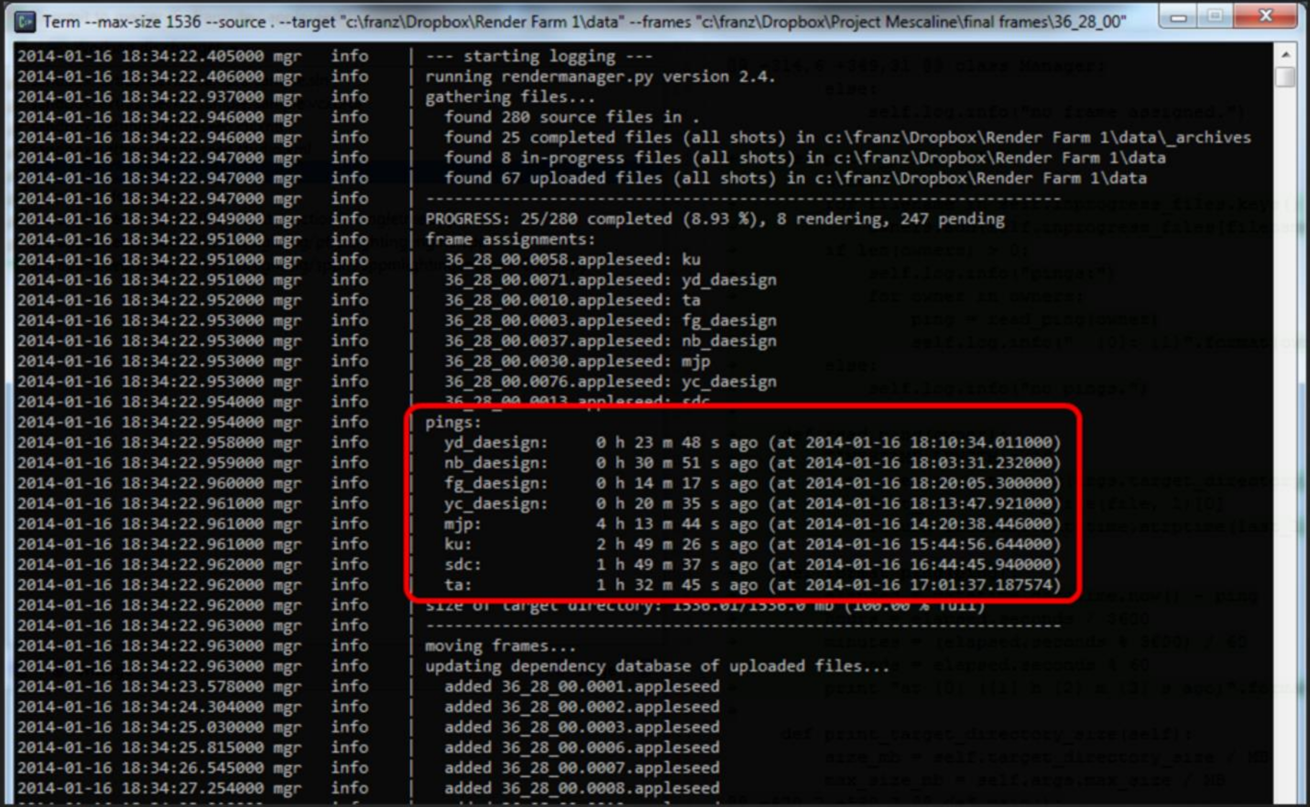


Making Fetch – Render Farm

François' Computer
Render Manager

- Underpowered Core i5 laptop
- Managing rendering:
  - Upload/remove shot data as required
  - Honor 2 GB size limitation of DATA at all times
  - Move rendered frames from DATA to FRAMES
  - Monitor and print render farm health, activity and progress
- Running 24/7

- Finally we have the Render Manager, which was just my laptop (my main machine at the time)
  - Definitely a low-spec machine, certainly too weak for any serious compute task
  - But enough to manage rendering (and to develop appleseed)
  - So the tasks of the Render Manager are:
    - Upload shot data as required
    - Remove unused shot data to honor the 2 GB size limitation at all times
    - Move rendered frames from DATA to FRAMES
    - Monitor and print the render farm health, activity and progress
  - My machine was running nearly 24/7 at the time
    - I actually surprised it didn't kill it



```
Term --max-size 1536 --source . --target "c:\franz\Dropbox\Render Farm 1\data" --frames "c:\franz\Dropbox\Project Mescaline\final frames\36_28_00"
2014-01-16 18:34:22.405000 mgr   info    | --- starting logging ---
2014-01-16 18:34:22.406000 mgr   info    | running rendermanager.py version 2.4.
2014-01-16 18:34:22.937000 mgr   info    | gathering files...
2014-01-16 18:34:22.946000 mgr   info    |   found 280 source files in .
2014-01-16 18:34:22.946000 mgr   info    |   found 25 completed files (all shots) in c:\franz\Dropbox\Render Farm 1\data\_archives
2014-01-16 18:34:22.947000 mgr   info    |   found 8 in-progress files (all shots) in c:\franz\Dropbox\Render Farm 1\data
2014-01-16 18:34:22.947000 mgr   info    |   found 67 uploaded files (all shots) in c:\franz\Dropbox\Render Farm 1\data
2014-01-16 18:34:22.947000 mgr   info    | ----------------------------------------------------------------------------
2014-01-16 18:34:22.949000 mgr   info    | PROGRESS: 25/280 completed (8.93 %), 8 rendering, 247 pending
2014-01-16 18:34:22.951000 mgr   info    | frame assignments:
2014-01-16 18:34:22.951000 mgr   info    |   36_28_00.0058.appleseed: ku
2014-01-16 18:34:22.951000 mgr   info    |   36_28_00.0071.appleseed: yd_daesign
2014-01-16 18:34:22.952000 mgr   info    |   36_28_00.0010.appleseed: ta
2014-01-16 18:34:22.953000 mgr   info    |   36_28_00.0003.appleseed: fg_daesign
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2014-01-16 18:34:22.954000 mgr   info    | pings:
2014-01-16 18:34:22.958000 mgr   info    |   yd_daesign:     0 h 23 m 48 s ago (at 2014-01-16 18:10:34.011000)
2014-01-16 18:34:22.959000 mgr   info    |   nb_daesign:     0 h 30 m 51 s ago (at 2014-01-16 18:03:31.232000)
2014-01-16 18:34:22.960000 mgr   info    |   fg_daesign:     0 h 14 m 17 s ago (at 2014-01-16 18:20:05.300000)
2014-01-16 18:34:22.961000 mgr   info    |   yc_daesign:     0 h 20 m 35 s ago (at 2014-01-16 18:13:47.921000)
2014-01-16 18:34:22.961000 mgr   info    |   mjp:            4 h 13 m 44 s ago (at 2014-01-16 14:20:38.446000)
2014-01-16 18:34:22.961000 mgr   info    |   ku:             2 h 49 m 26 s ago (at 2014-01-16 15:44:56.644000)
2014-01-16 18:34:22.962000 mgr   info    |   sdc:            1 h 49 m 37 s ago (at 2014-01-16 16:44:45.940000)
2014-01-16 18:34:22.962000 mgr   info    |   ta:             1 h 32 m 45 s ago (at 2014-01-16 17:01:37.187574)
2014-01-16 18:34:22.962000 mgr   info    | size of target directory: 1536.01/1536.0 mb (100.00 % full)
2014-01-16 18:34:22.963000 mgr   info    | ----------------------------------------------------------------------------
2014-01-16 18:34:22.963000 mgr   info    | moving frames...
2014-01-16 18:34:22.963000 mgr   info    | updating dependency database of uploaded files...
2014-01-16 18:34:23.578000 mgr   info    |   added 36_28_00.0001.appleseed
2014-01-16 18:34:24.304000 mgr   info    |   added 36_28_00.0002.appleseed
2014-01-16 18:34:25.030000 mgr   info    |   added 36_28_00.0003.appleseed
2014-01-16 18:34:25.815000 mgr   info    |   added 36_28_00.0006.appleseed
2014-01-16 18:34:26.545000 mgr   info    |   added 36_28_00.0007.appleseed
2014-01-16 18:34:27.254000 mgr   info    |   added 36_28_00.0008.appleseed
```
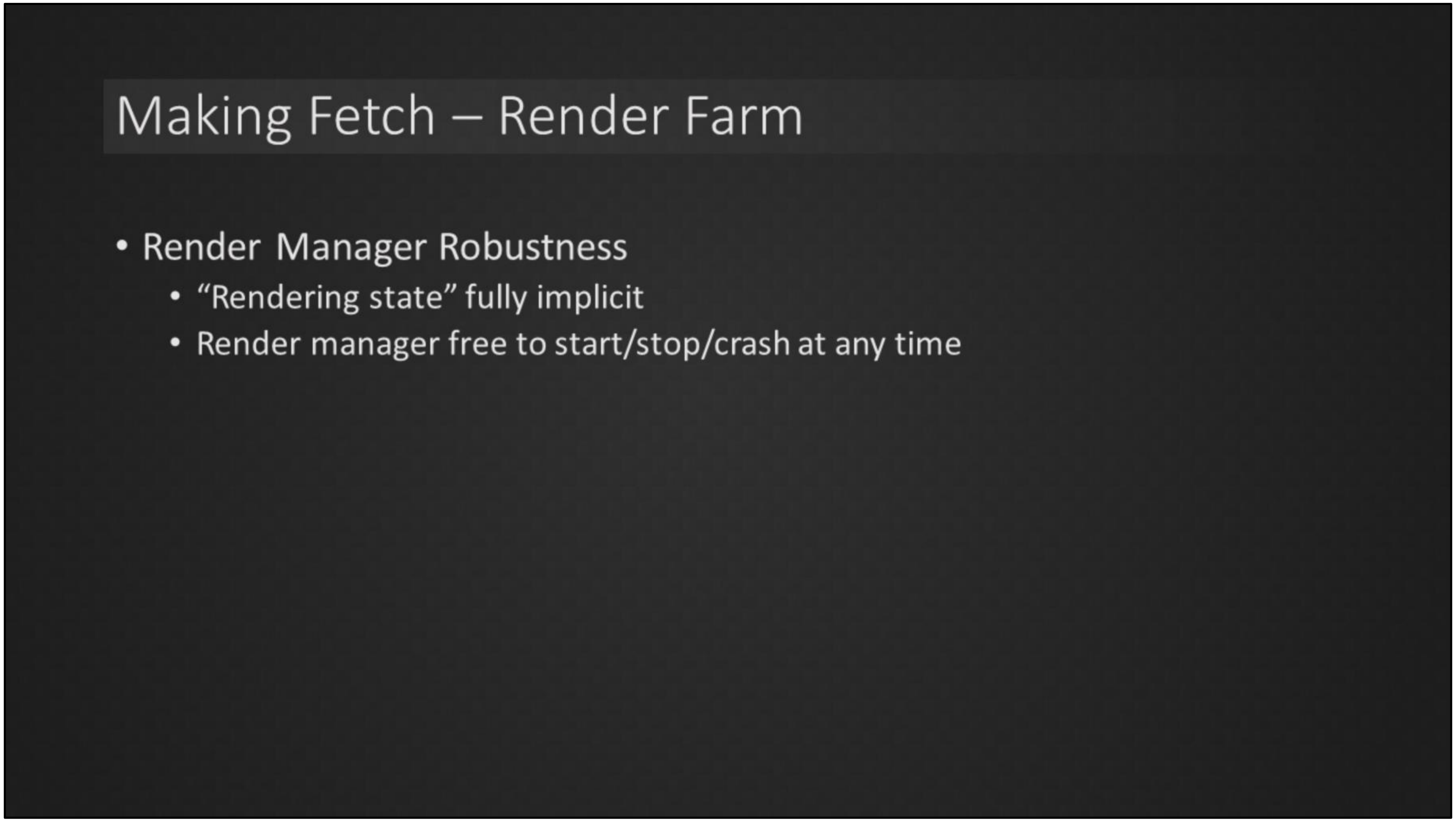

- Here is a random screenshot I found while making this presentation
- Nevermind the red rectangle highlighting the machine pings
    - I was probably just excited to show this new feature to someone at the time this screenshot was made
- So in this picture you can see:
    - A summary of what the DATA directory contains
    - Frame files being rendered by machines
    - Machines are identified by a short id, typically the initials of its owner
    - Pings, to check when we last got news from a machine
        - If you're curious, pings were derived from the 'Last Modified' date on the scene files
    - And then what actions the render manager is taking



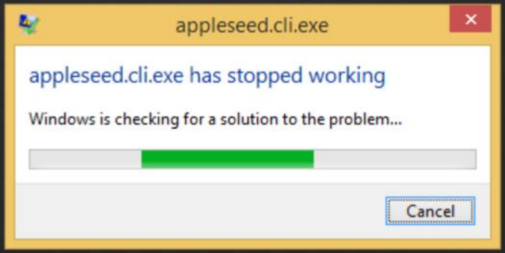
Making Fetch – Render Farm

- Render Manager Robustness
  - “Rendering state” fully implicit
  - Render manager free to start/stop/crash at any time

- The key to making the render managed robust was to make it state-free
  - The ‘rendering state’ was entirely determined by the files in DATA
- That meant that I could start or stop the render manager without impacting rendering
  - For instance to fix a bug in the script
- If the render manager crashes or stops:
  - Render nodes simply run out of work
  - Or the DATA shared directory fills up and nodes no longer gets Dropbox updates

Making Fetch – Render Farm

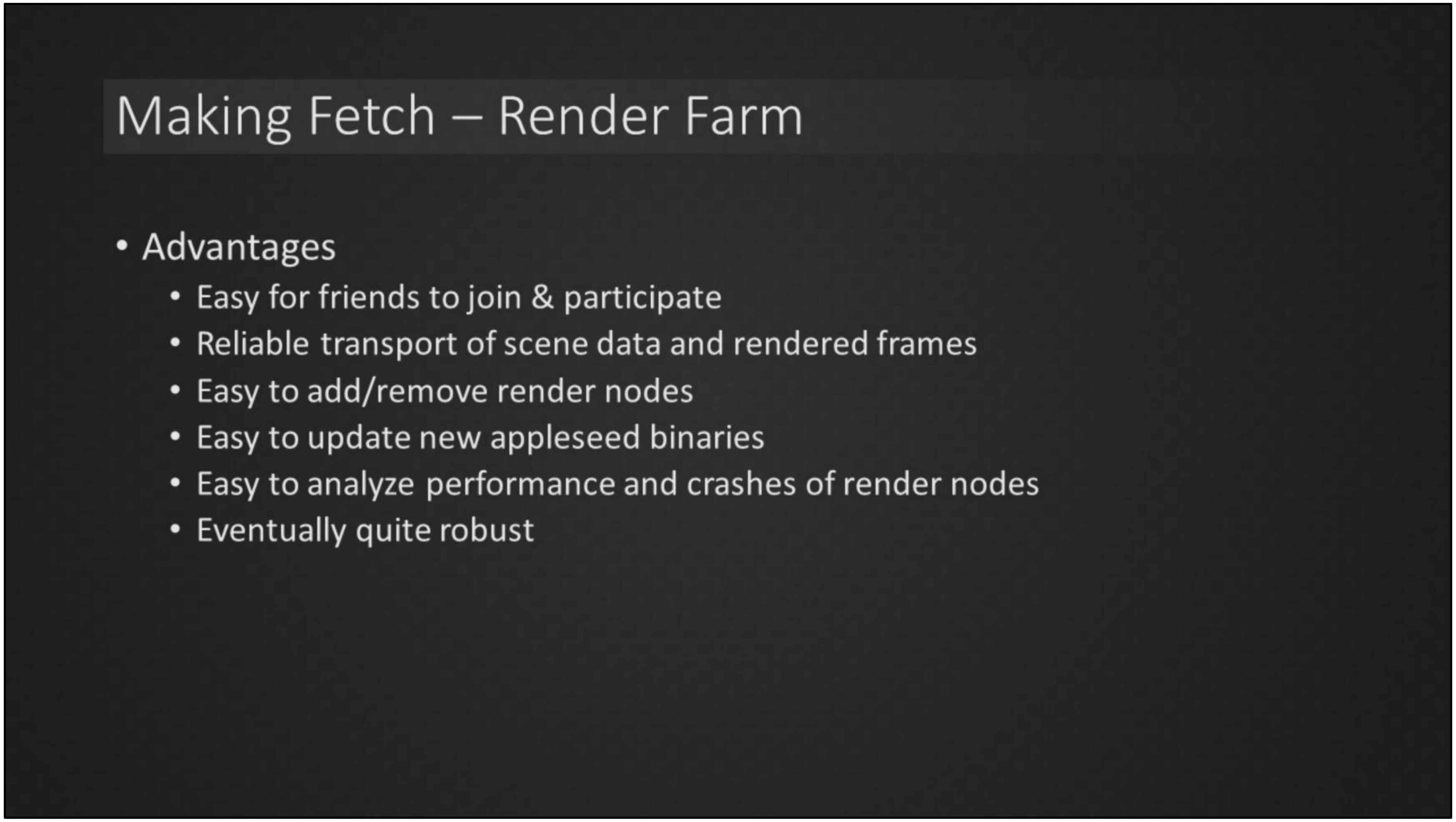
- Render Nodes Robustness
  - Not all geometry files or textures available to render given scene
  - On Windows: appleseed crash = Windows Error Reporting Message Box


appleseed.cli.exe

appleseed.cli.exe has stopped working

Windows is checking for a solution to the problem...

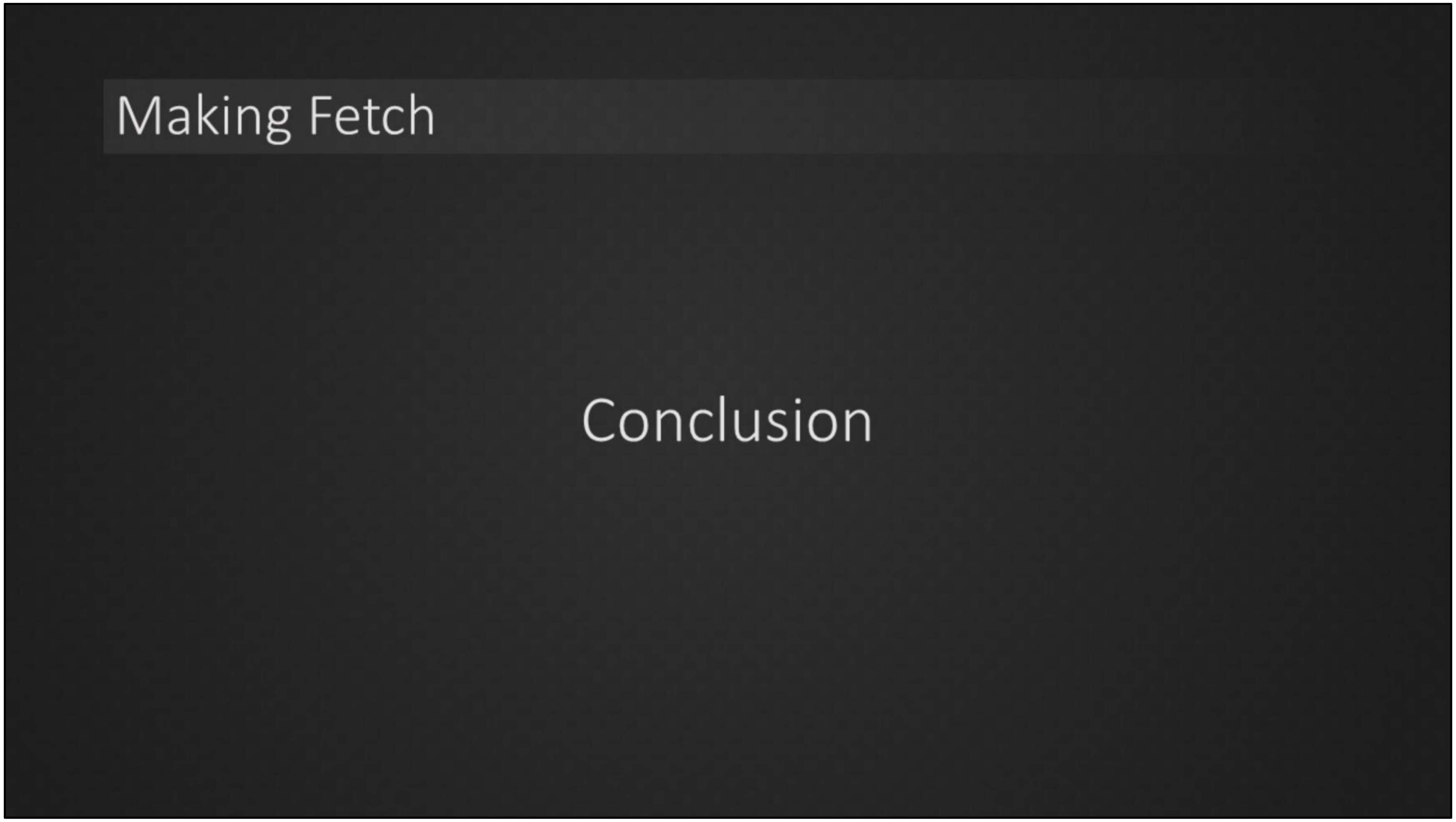
- Geometry files or textures could be missing to render a given frame
  - So the render node scripts has to check if all dependencies are present before rendering
    - Parse scene file (XML) and extract file names
- On Windows, if appleseed crashes, by default a message box opens
  - That stalls the render node until someone gets in front of the computer to manually close the message box
  - So the render node script disables Windows Error Reporting on startup (and restores it on exit)



Making Fetch – Render Farm

- Advantages
  - Easy for friends to join & participate
  - Reliable transport of scene data and rendered frames
  - Easy to add/remove render nodes
  - Easy to update new appleseed binaries
  - Easy to analyze performance and crashes of render nodes
  - Eventually quite robust

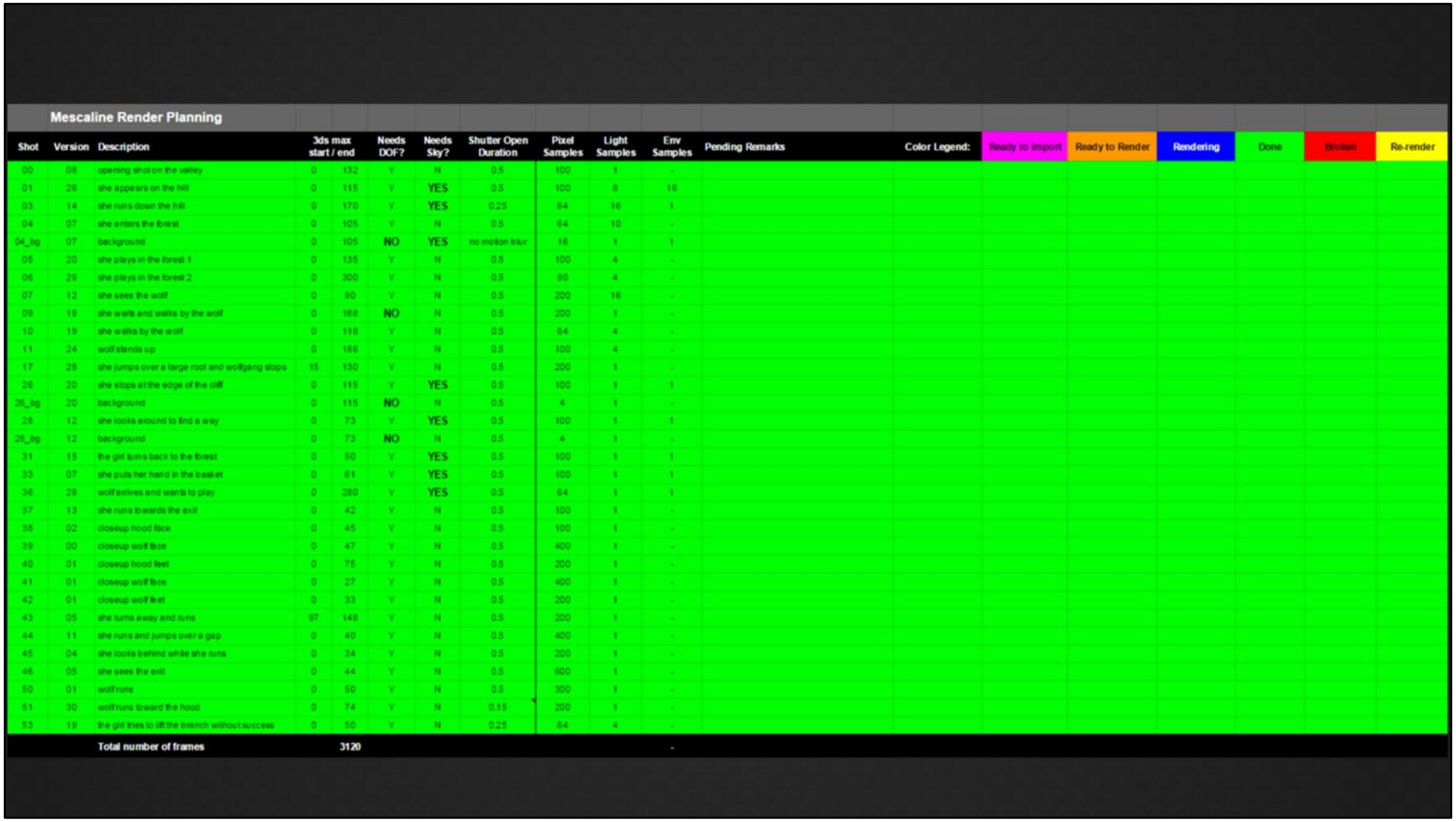
- Intermezzo: a close-up of the wolf with his curious feather-like fur...



Making Fetch

Conclusion

- Let’s conclude this section, and the talk.

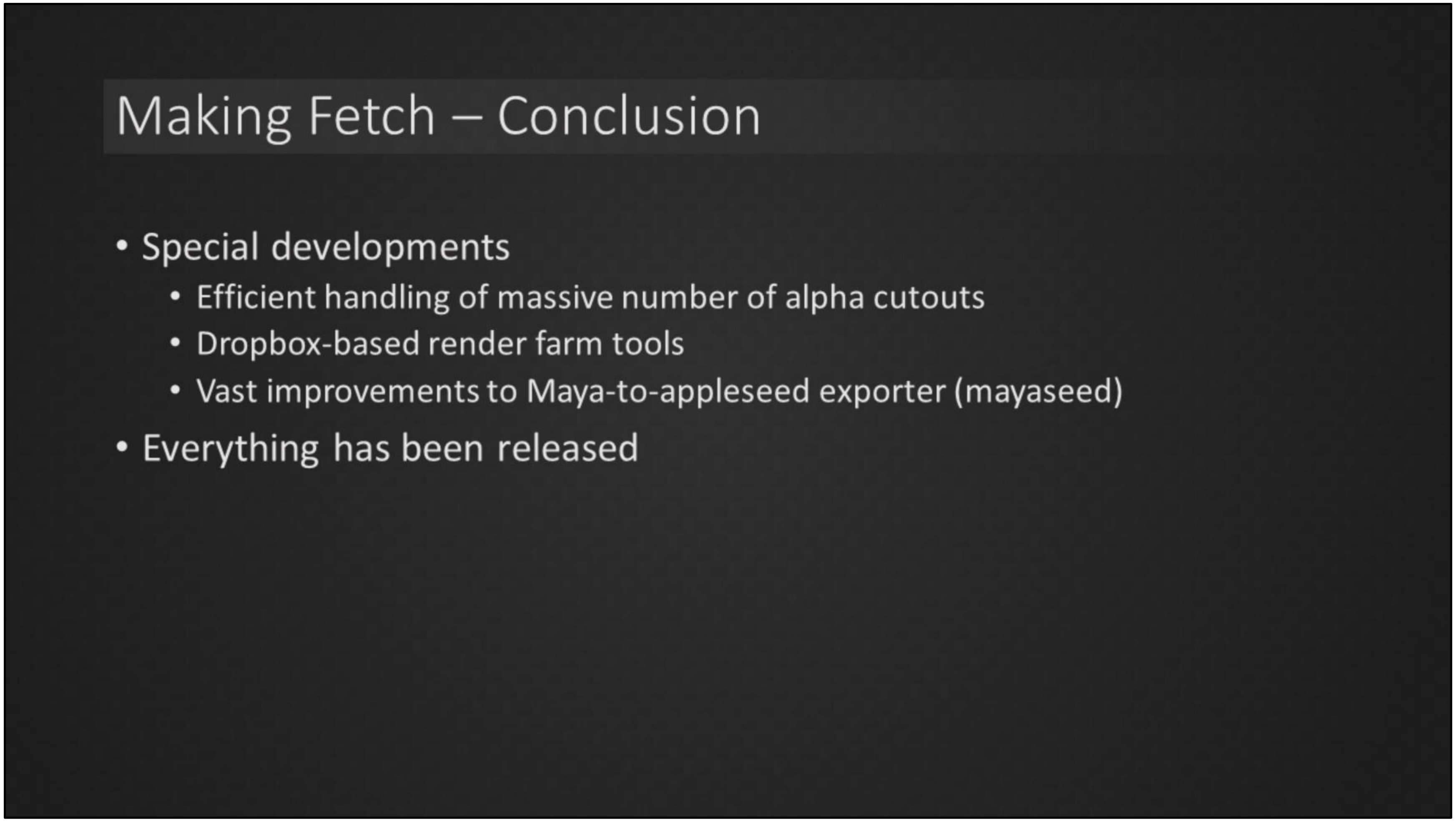


Mescaline Render Planning

Shot	Version	Description	3ds max start / end		Needs DOF?	Needs Sky?	Shutter Open Duration	Pixel Samples	Light Samples	Env Samples	Pending Remarks
00	08	opening shot on the valley	0	132	Y	N	0.5	100	1	-	
01	26	she appears on the hill	0	115	Y	YES	0.5	100	8	16	
03	14	she runs down the hill	0	170	Y	YES	0.25	64	16	1	
04	07	she enters the forest	0	105	Y	N	0.5	64	10	-	
04_bg	07	background	0	105	NO	YES	no motion blur	16	1	1	
05	20	she plays in the forest 1	0	135	Y	N	0.5	100	4	-	
06	29	she plays in the forest 2	0	300	Y	N	0.5	80	4	-	
07	12	she sees the wolf	0	90	Y	N	0.5	200	16	-	
09	18	she waits and walks by the wolf	0	168	NO	N	0.5	200	1	-	
10	19	she walks by the wolf	0	118	Y	N	0.5	64	4	-	
11	24	wolf stands up	0	188	Y	N	0.5	100	4	-	
17	28	she jumps over a large root and wolfgang stops	15	130	Y	N	0.5	200	1	-	
26	20	she stops at the edge of the cliff	0	115	Y	YES	0.5	100	1	1	
26_bg	20	background	0	115	NO	N	0.5	4	1	-	
28	12	she looks around to find a way	0	73	Y	YES	0.5	100	1	1	
28_bg	12	background	0	73	NO	N	0.5	4	1	-	
31	15	the girl turns back to the forest	0	50	Y	YES	0.5	100	1	1	
33	07	she puts her hand in the basket	0	61	Y	YES	0.5	100	1	1	
36	28	wolf arrives and wants to play	0	280	Y	YES	0.5	64	1	1	
37	13	she runs towards the exit	0	42	Y	N	0.5	100	1	-	
38	02	closeup hood face	0	45	Y	N	0.5	100	1	-	
39	00	closeup wolf face	0	47	Y	N	0.5	400	1	-	
40	01	closeup hood feet	0	75	Y	N	0.5	200	1	-	
41	01	closeup wolf face	0	27	Y	N	0.5	400	1	-	
42	01	closeup wolf feet	0	33	Y	N	0.5	200	1	-	
43	05	she turns away and runs	97	148	Y	N	0.5	200	1	-	
44	11	she runs and jumps over a gap	0	40	Y	N	0.5	400	1	-	
45	04	she looks behind while she runs	0	34	Y	N	0.5	200	1	-	
46	05	she sees the exit	0	44	Y	N	0.5	600	1	-	
50	01	wolf runs	0	50	Y	N	0.5	300	1	-	
51	30	wolf runs toward the hood	0	74	Y	N	0.15	200	1	-	
53	19	the girl tries to lift the branch without success	0	50	Y	N	0.25	64	4	-	
		Total number of frames		**3120**						-	

Color Legend:	Ready to import	Ready to Render	Rendering	Done	Broken	Re-render

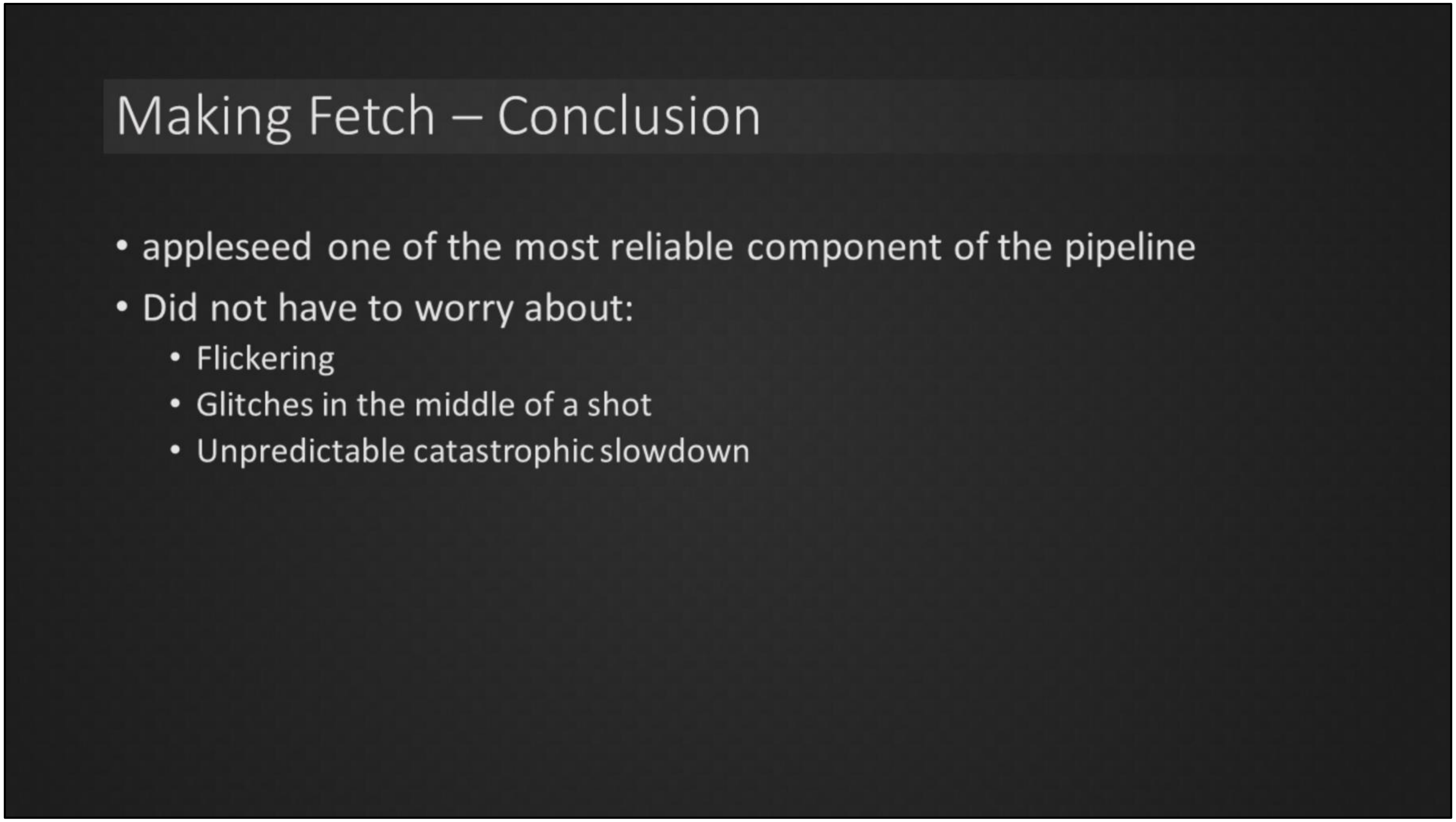
- It’s hard to say how long rendering eventually took
  - Since it was mixed up with lots of activities such as preparing shots, exporting them, etc.
- A couple weeks seems like a reasonable estimate



Making Fetch – Conclusion

- Special developments
  - Efficient handling of massive number of alpha cutouts
  - Dropbox-based render farm tools
  - Vast improvements to Maya-to-appleseed exporter (mayaseed)
- Everything has been released

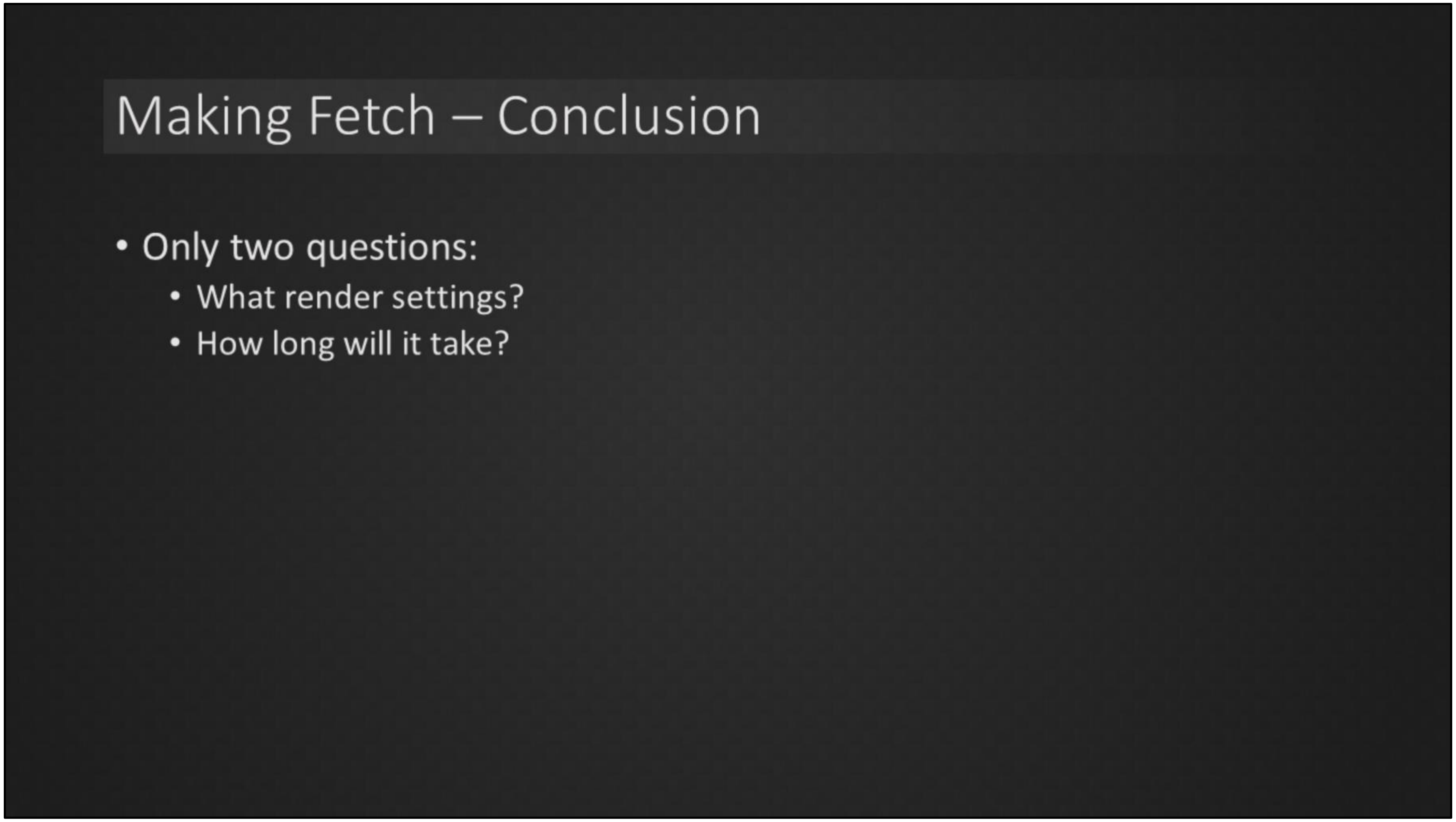
- Making Fetch led to a few interesting developments:
  - Very efficient handling of large number of alpha cutouts
  - The Dropbox-based render farm system we just talked about
  - And vast improvements to mayaseed, our Maya-to-appleseed translator
- Everything that we did for Fetch founds it way into official releases.



Making Fetch – Conclusion

- appleseed one of the most reliable component of the pipeline
- Did not have to worry about:
  - Flickering
  - Glitches in the middle of a shot
  - Unpredictable catastrophic slowdown

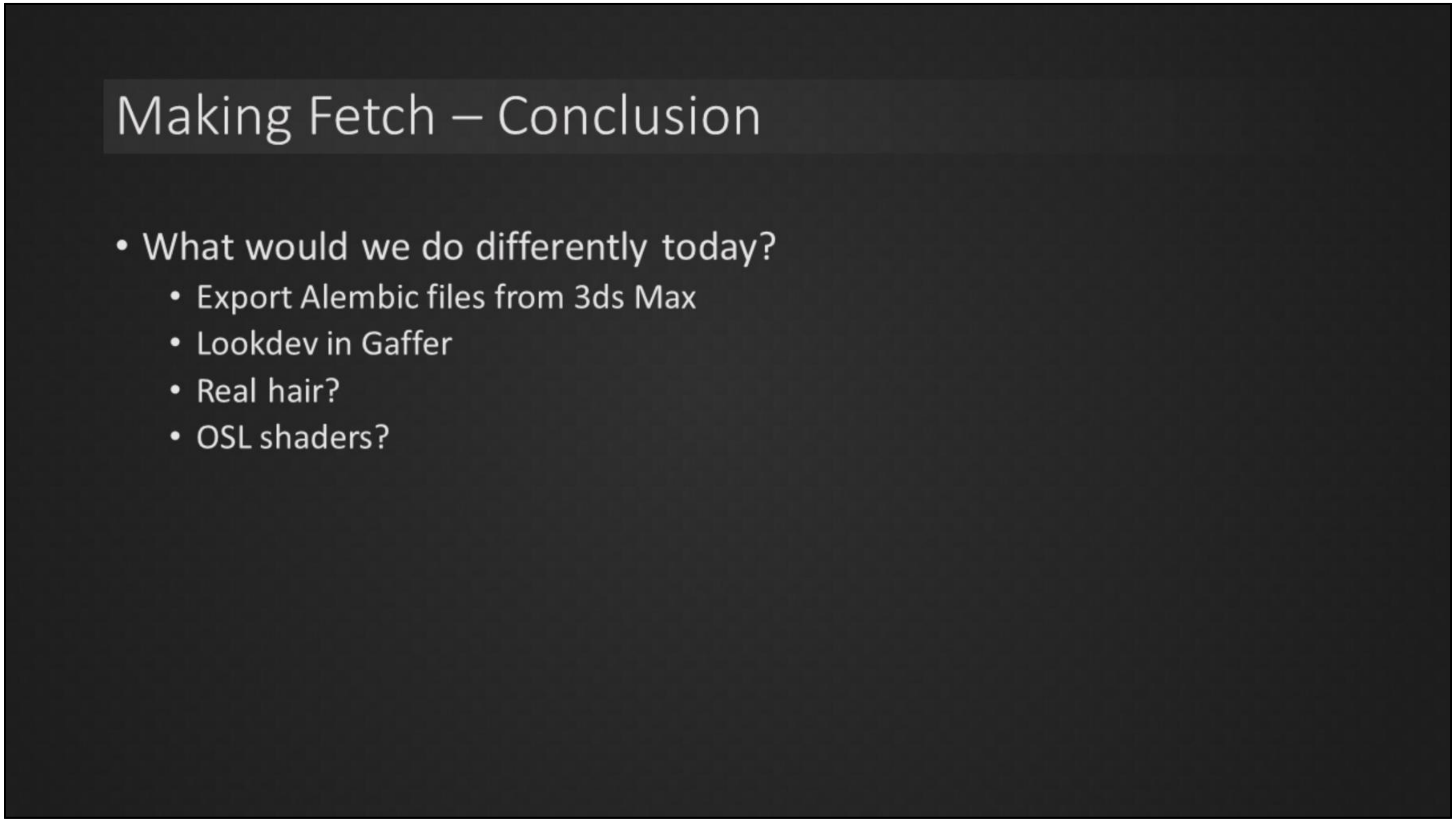
- Retrospectively, appleseed was certainly one of the most (if not the most) reliable component of the pipeline
- We did fix a few important bugs at the very beginning of the project, but after that it was very reliable
- Flickering has never been a concern, and we didn’t get any
- Similarly, when we did encounter render glitches in the middle of the shot, they were due to a bad scene setup, not due to appleseed
- We didn’t suffer from unpredictable performance problems such as catastrophic slowdown...



Making Fetch – Conclusion

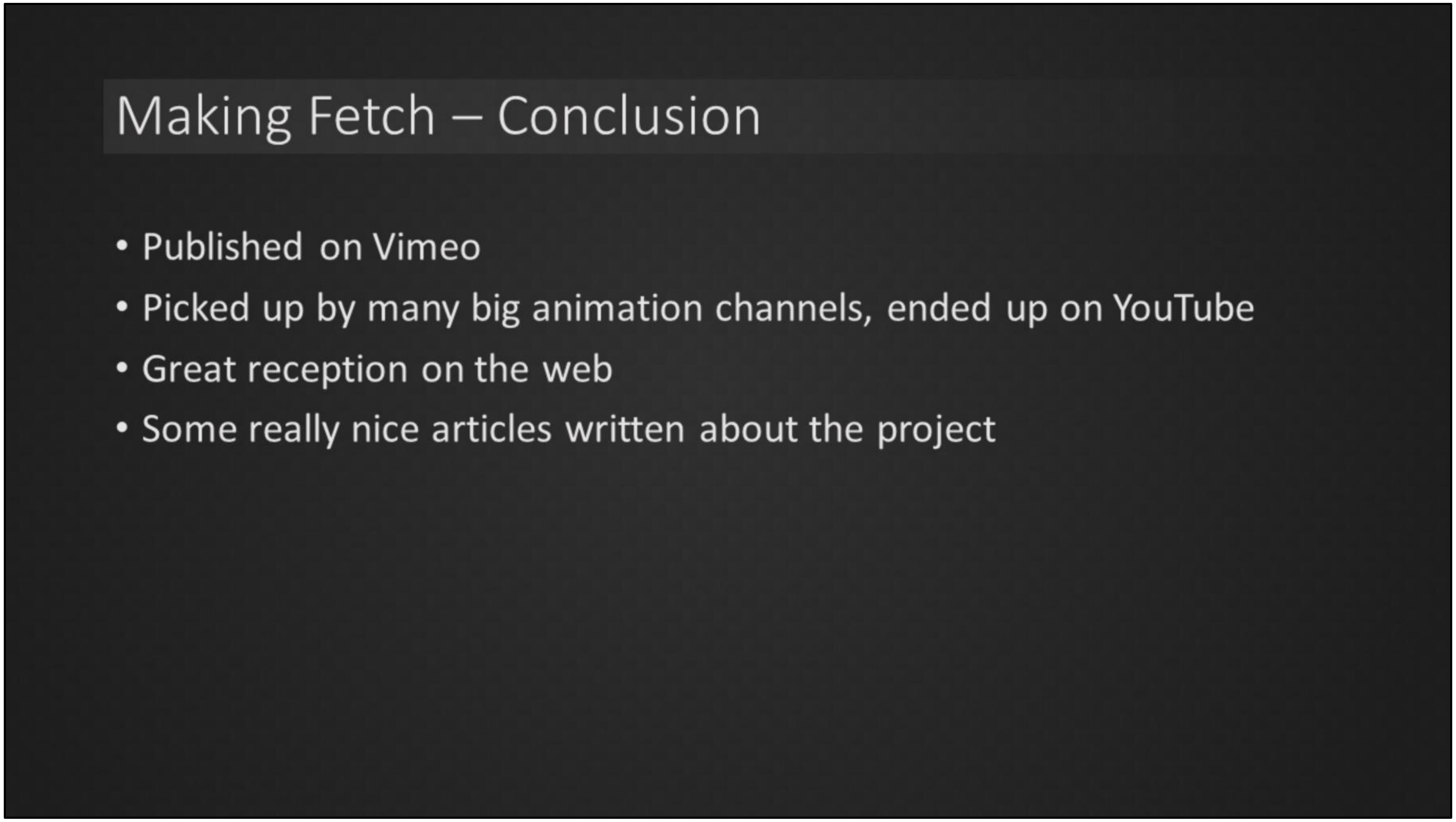
- Only two questions:
  - What render settings?
  - How long will it take?

- We were basically left with only two questions:
  - What render settings to use for acceptable noise levels & render times?
  - How long will the render take for any given shot?



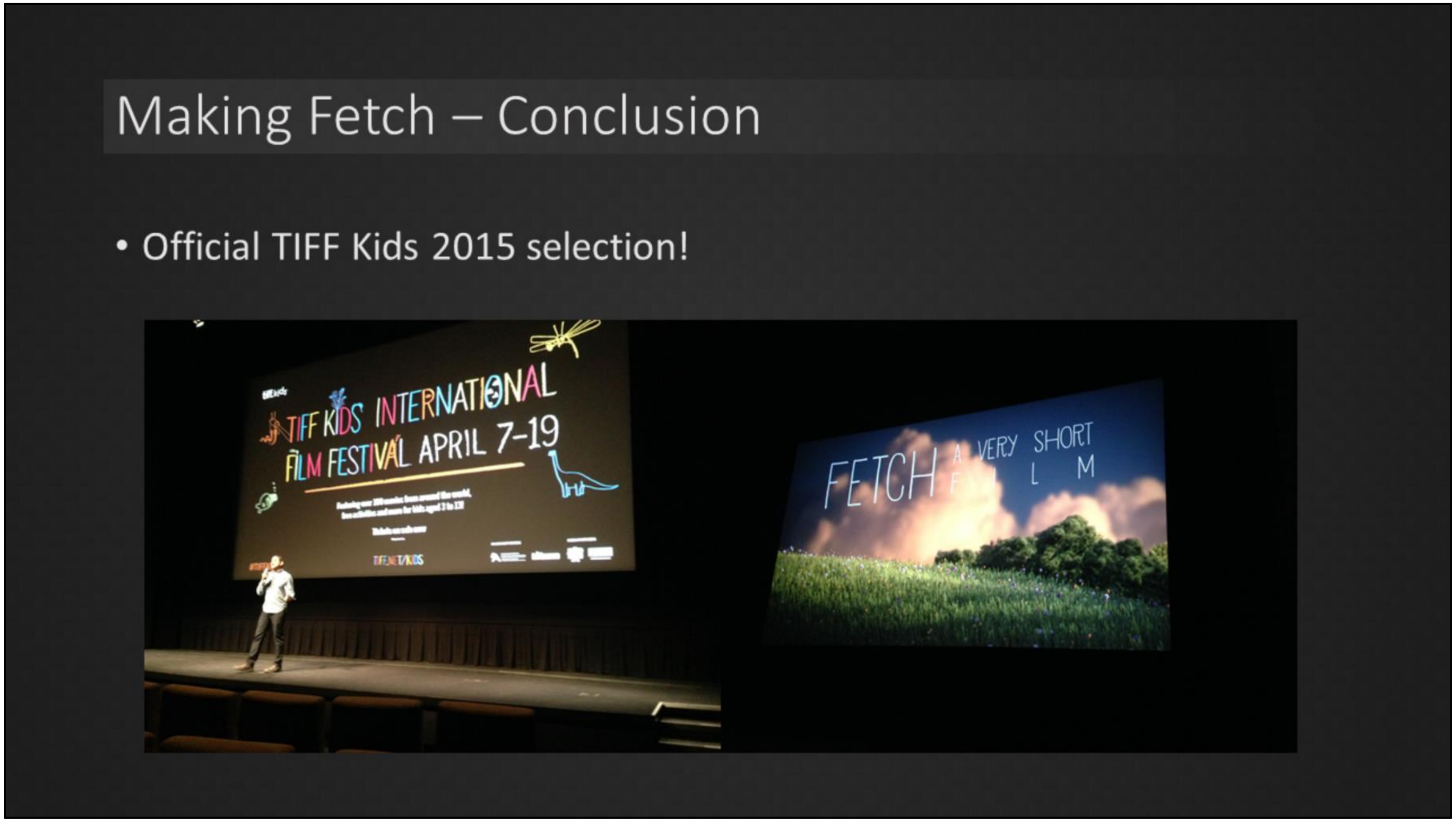
Making Fetch – Conclusion

- What would we do differently today?
  - Export Alembic files from 3ds Max
  - Lookdev in Gaffer
  - Real hair?
  - OSL shaders?



Making Fetch – Conclusion

- Published on Vimeo
- Picked up by many big animation channels, ended up on YouTube
- Great reception on the web
- Some really nice articles written about the project



Making Fetch – Conclusion

- Official TIFF Kids 2015 selection!

- We were actually invited to Toronto last month to present the film!

Thank you!

Questions?

- We’ve got a few minutes, I’ll be happy to answer any question!