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Nitro versus FreeType

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Comparison of Nitro to FreeType

- To keep things simple, I will refer to both Saffron and Nitro as simply Nitro unless otherwise noted
 - Many ways to compare these two systems
 - Performance
 - Quality
 - Code size
 - Font size
 - Ease of use
 - Ability to enhance, modify, and maintain
 - Code and API complexity
 - Hardware and GPU support
 - Intellectual property issues
 - Etc...
 - The list is long and requires domain knowledge and expertise to even evaluate
 - This presentation contains some brief notes and comments on the topic
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Performance: Raw Rendering Speed

PPEM	Saffron	FreeType	Nitro: Float	Nitro: C Fixed	Nitro: ASM Fixed	Nitro: C Fixed x64
20	166000	231000	606000	603000	669000 (4.03x)	843000 (5.08x)
28	126000	179000	490000	498000	544000 (4.32x)	684000 (5.43x)
40	87000	143000	387000	394000	430000 (4.94x)	514000 (5.91x)
60	52000	108000	282000	289000	309000 (5.94x)	359000 (6.90x)
80	34000	86000	215000	224000	235000 (6.91x)	266000 (7.82x)
100	24000	68000	175000	180000	188000 (7.83x)	208000 (8.66x)
200	7800	37000	71000	75000	75000 (9.62x)	79000 (10.13x)

Glyphs per second on an Intel Core i7 Q840 CPU, Font: Verdana, Quality Setting: Highest, Symmetric CSM, ASM is x86 assembly language for a very small number of functions (7 functions, only 80 lines of code, function line lengths: 4, 6, 2, 6, 6, 28, 28), C Fixed x64 is pure C code with compiler settings permitting single instruction 32 bit x 32 bit = 64 bit multiples to be generated

Distance fields are faster



Quality – A Complex Topic

- FreeType quality with hinting enabled is very good
- But the same is true for Nitro (we can now demonstrate this with the new FY14 Font Manager code)
- FreeType is tuned for getting very good results for hinted "body type" (i.e., reading at typical sizes)
- However, there are NO options for different rendering settings in FreeType (you get only one choice)
- With CSM, you can tune the rendering to the specific use, application, font, display technology, etc...
- Nitro can match the FreeType rendering quality for body type using CSM and with some tuning effort can improve upon it
 - Monotype has demonstrated this with tuned CSM settings
- Furthermore, CSM can be used to achieve BETTER results than FreeType in many other cases
 - Nitro is better at bigger PPEMs (FreeType is too aliased)
 - This will become increasingly more important as display resolutions increase
 - Nitro is better on different display technologies such as E-ink (Monotype has proven this)
 - Distance fields are considerably better at animation (FreeType is too aliased and exhibits moire patterns)
- The single most important reason that Monotype has been successful with our technology is CSM
 - Amazon compared Saffron with tuned CSM settings to FreeType on the E-ink Kindle device
 - Saffron was the clear winner
 - Monotype has written a 34 page white paper on this topic showing how it was done (not so easy)

Distance field quality is at least equal and often better



Compressed Fonts: Present and Future

- Present
 - FreeType has NO support for compressed fonts
 - Nitro supports CTF (our font compression technology) and can be easily modified to support other compressed formats
 - Consequently, we can deliver a MUCH smaller font solution than FreeType
 - Another big additional advantage of CSM is size
 - You can represent both light and bold variations from a single regular weight font
 - Multiple weights of a single typeface is a common application requirement
 - You can't do this with FreeType
 - This saves considerable font memory
- Future
 - Because traditional hinting is VERY slow, I will be introducing some new compression methods for hinted outlines that will enable the excellent quality of hinted fonts without the performance penalty of the hinting process (let's call this "Compressed Hinted Outlines" for now)
 - Nitro will support Compressed Hinted Outlines
 - FreeType has no such concept
 - With Compressed Hinted Outlines, producing very high quality hinted results with Nitro will be at least 10X-20X faster than using FreeType to hint the font and then render

Distance fields are smaller
Compressed hinted outlines are much faster



Code and API Complexity

- The FreeType code base is very complex with almost no comments
 - 534 source files, 88 header files
- The FreeType API is vast and complex
- Does MELCO really require that level of complexity in their applications?
 - Hard to believe that we do
- Nitro with MAZ, Merge Contours, and everything else is only 8 files!
- The NUMBER ONE imperative in software engineering is managing complexity
- Nitro is MUCH simpler and extremely well documented and well structured
- Is the Nitro API sufficient for all MELCO applications?
 - Probably not, but we can easily add just what we need
 - FreeType caters to the entire world of requirements and suffers because of that
 - Code bloat
 - Major complexity
 - Difficult to understand, enhance, modify, and maintain

Distance fields are simpler



Hardware and GPU support

- The FreeType algorithms are NOT amenable to a hardware implementation
- Our distance field algorithms are very amenable to a hardware implementation
 - This has already been demonstrated with “Sesamicro”
- The FreeType algorithms are NOT amenable to a GPU implementation
 - Google has approached me personally about solving this problem
 - Google is already experimenting with distance fields on the GPU for font rendering in Chrome to replace FreeType
- Our distance field algorithms are very amenable to a GPU implementation
- The requirement for a GPU implementation will become mainstream MUCH faster than you may expect
- Qualcomm and others are pushing GPUs into embedded systems such as Car Navigation very quickly

Distance fields support HW and GPUs



Other Advantages

- Intellectual property issues
 - Nitro is well protected by our extensive patent portfolio
 - FreeType is mostly free of patent issues with some notable and relevant exceptions
 - Sub-pixel rendering (i.e., LCD optimized rendering) is likely infringing on Microsoft’s ClearType patents given the nature of their implementation
 - Our implementation is patented and based on distance fields
 - Benefits of commercial collaboration with Monotype and Adobe
 - Licensing revenue
 - Free software and fonts of significant value
 - Sophisticated and experienced Quality Assurance (QA) team
 - Access to domain experts
 - Validation of ideas in the marketplace
 - Understanding of current and future needs and trends
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Other Advantages

- Strokes fonts
 - We have demonstrated the clear size advantage of stroke fonts for certain applications
 - FreeType doesn't support stroke fonts

 - Ability to enhance, modify, and maintain
 - Nitro: very easy (small, simple, well documented, well structured)
 - FreeType: very hard (large, complex, no internal documentation)

 - High-end special effects
 - The distance field is an ideal representation for performing complex special effects such as soft body deformation, collision detection, offsets, blends, and extruding 3D glyphs from their 2D counterparts
 - FreeType can't do any of these
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