Ускорение сборки проектов на C++

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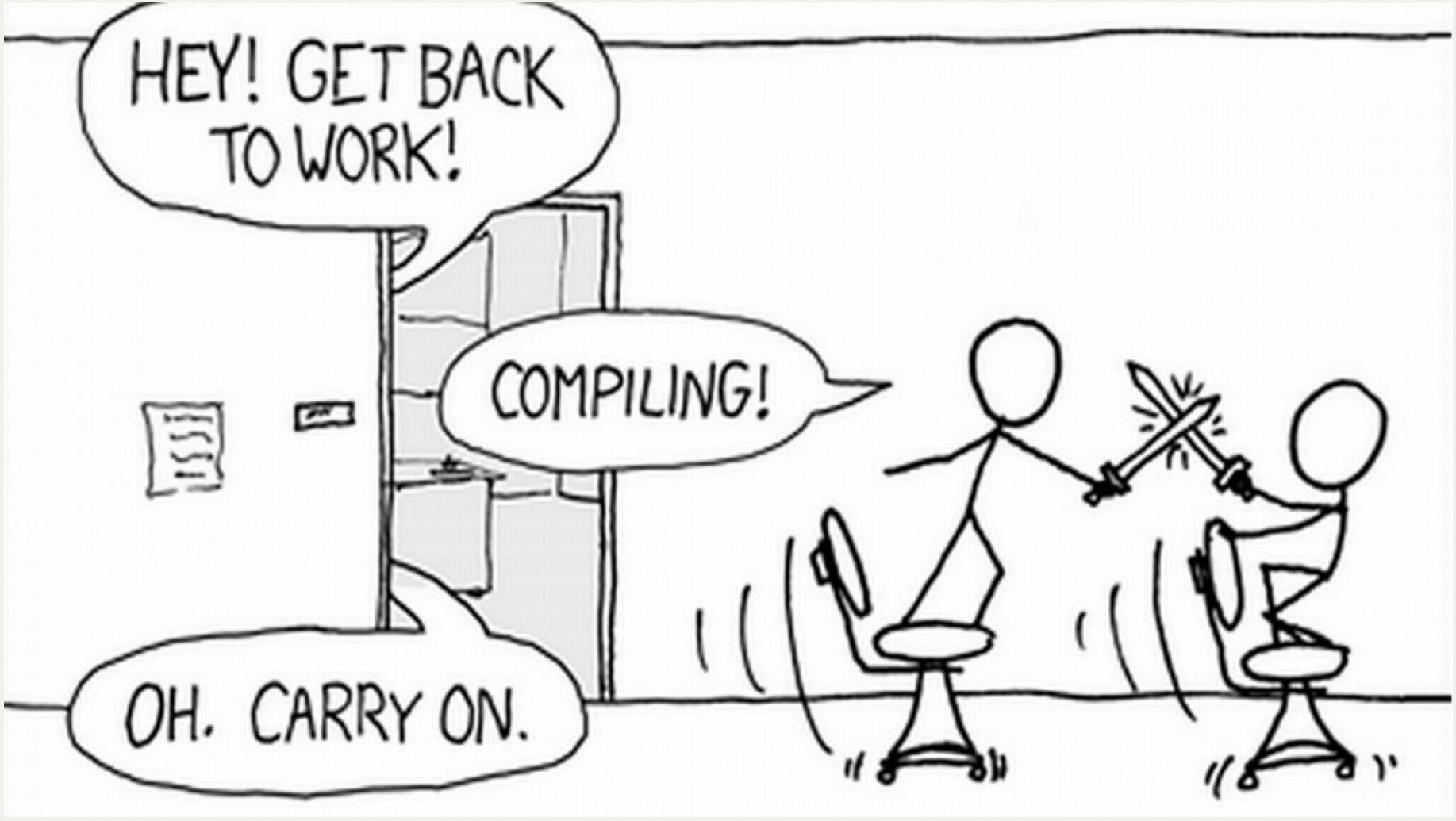
Проблема



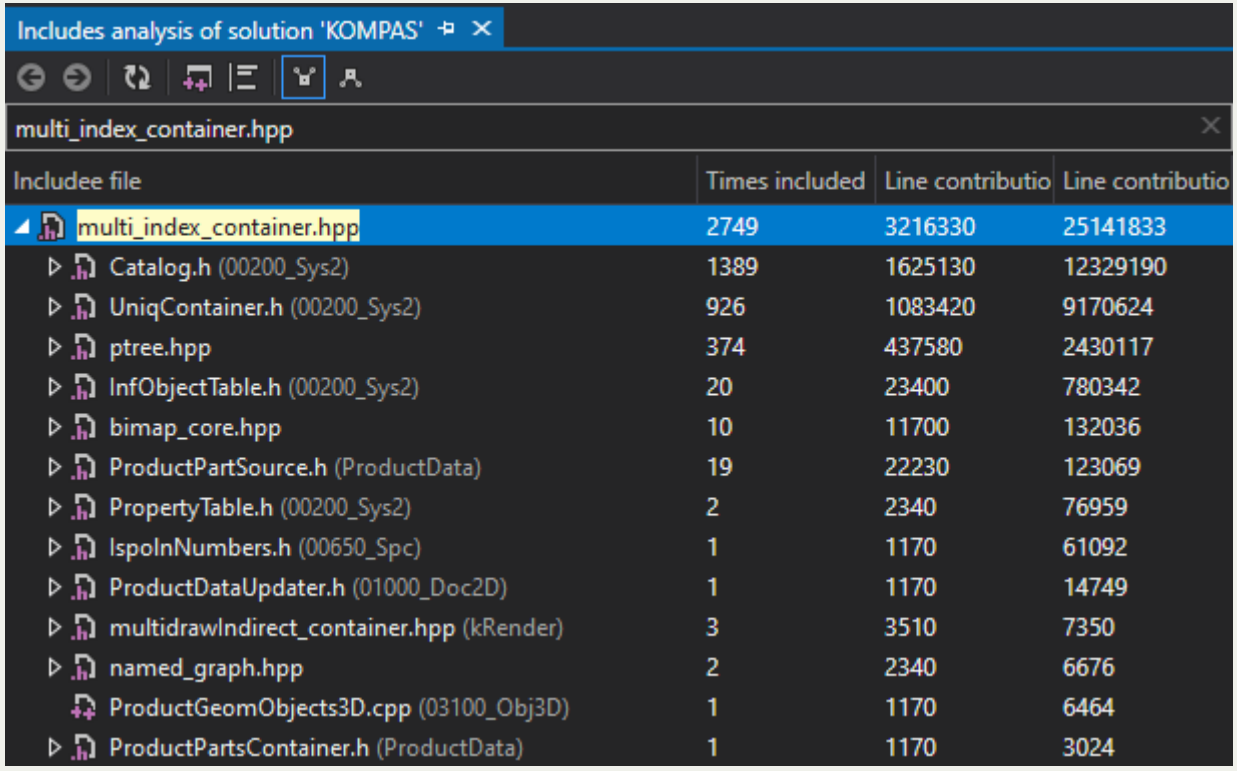
Что есть ?

- ~3 миллиона строк
- ~4500 .cpp & ~4000 .h
- 55 проектов
- boost, stl, winapi

Поиск узких мест

- Resharper C++ Analyze Includes
- C++ Build Insights

Resharper C++ Analyze Includes



Includee file	Times included	Line contributio	Line contributio
multi_index_container.hpp	2749	3216330	25141833
Catalog.h (00200_Sys2)	1389	1625130	12329190
UniqContainer.h (00200_Sys2)	926	1083420	9170624
ptree.hpp	374	437580	2430117
InfObjectTable.h (00200_Sys2)	20	23400	780342
bimap_core.hpp	10	11700	132036
ProductPartSource.h (ProductData)	19	22230	123069
PropertyTable.h (00200_Sys2)	2	2340	76959
IspolnNumbers.h (00650_Spc)	1	1170	61092
ProductDataUpdater.h (01000_Doc2D)	1	1170	14749
multidrawIndirect_container.hpp (kRender)	3	3510	7350
named_graph.hpp	2	2340	6676
ProductGeomObjects3D.cpp (03100_Obj3D)	1	1170	6464
ProductPartsContainer.h (ProductData)	1	1170	3024

C++ Build Insights

- Visual Studio 2019
- latest Windows ADK
- `perf_msvcbuildinsights.dll` -> WPA directory
- `perfcore.ini` add `perf_msvcbuildinsights.dll`

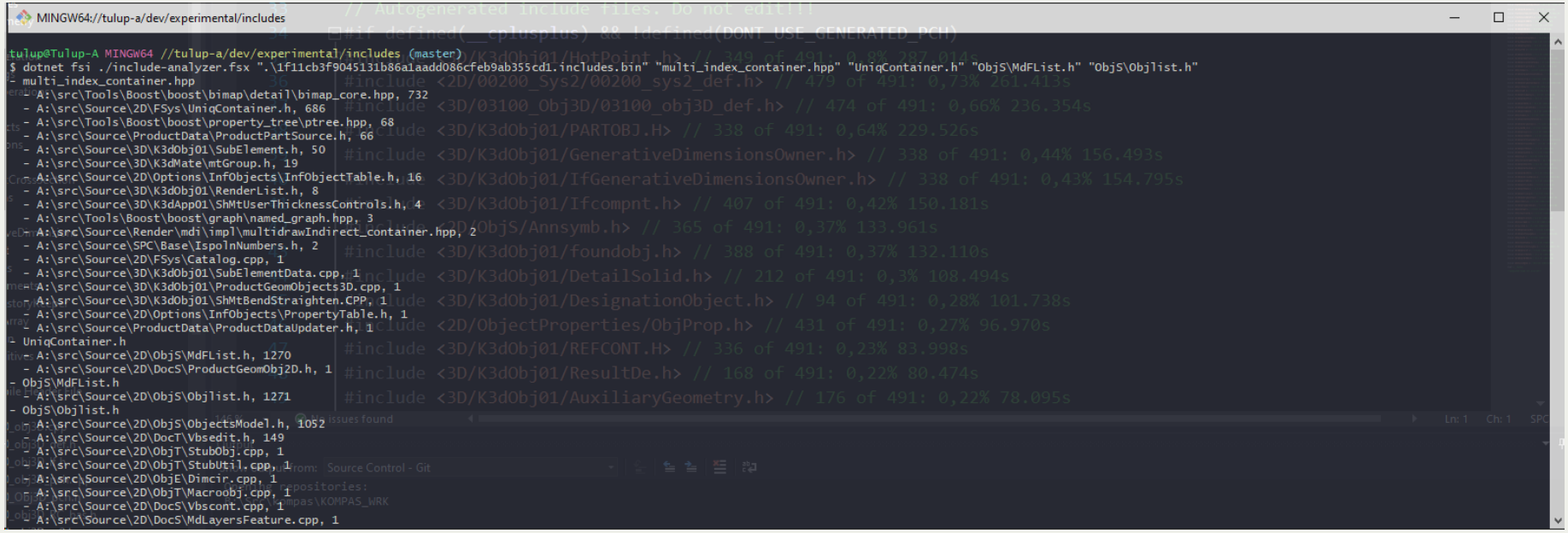
C++ Build Insights

- `vcperf /start MySessionName`
- compile your project
- `vcperf /stop MySessionName outputFile.etl`

C++ Build Insights

Line #	Activity Name	Included Path	Inclusive Duration (s) Sum	Wall Clock Time Responsibility (s) Sum	Exclusive D	Start Time (ns)	Inclusive Duration (s)	Legend
1	Parsing		291 248,166000000	794,341000000				
2		A:\src\Source\ProductData\PropertyData.h	4 084,544000000	13,616000000				
3		A:\src\Source\2D\FSys\Option.h	2 800,288000000	9,320000000				
4		A:\src\Tools\Boost\boost\variant\variant.hpp	2 689,562000000	8,409000000				
5		A:\src\Source\2D\FSys\Cfgopt.h	2 526,610000000	8,335000000				
6		A:\src\Source\2D\DocT\Dbsedit.h	2 301,613000000	8,173000000				
7		A:\src\Source\2D\ObjS\Obj.h	2 572,620000000	8,169000000				
8		A:\src\Source\2D\Options\EmbodimentsTree.h	2 518,660000000	8,049000000				
9		A:\src\Source\ProductData\PropRefsBase.h	2 409,359000000	7,561000000				
10		A:\src\Source\ProductData\MetaProductData.h	2 218,591000000	7,046000000				
11		A:\src\Source\2D\ObjS\Complobj.h	2 017,424000000	6,670000000				
12		A:\src\Source\2D\Options\Wsdef.h	2 101,165000000	6,636000000				
13		A:\src\Source\2D\ObjS\Objlist.h	1 949,444000000	6,472000000				
14		A:\src\Source\2D\TedB\Ted_base.h	1 915,549000000	6,115000000				
15		A:\src\Source\2D\DocS\Dbscont.h	1 712,567000000	5,975000000				
16		A:\src\Tools\Boost\boost\multi_index_container.hpp	1 981,786000000	5,868000000				
17		A:\src\Source\2D\Options\Komdoc.h	1 707,304000000	5,686000000				
18		A:\src\Source\2D\FSys\Prjopt.h	1 699,975000000	5,379000000				
19		A:\src\Source\2D\DocE\Dvbsedit.h	1 473,623000000	5,256000000				
20		A:\src\Source\c3d\Include\io_tape.h	1 861,150000000	5,167000000				
21		A:\src\Source\3D\K3dObj01\Ifcompnt.h	1 522,513000000	5,070000000				
22		A:\src\Source\2D\DocT\D23docedit.h	1 470,662000000	5,066000000				
23		A:\src\Source\3D\K3dObj01\HotPoint.h	1 495,312000000	4,981000000				
24		A:\src\Source\2D\FSys\Catalog.h	1 618,259000000	4,959000000				
25		A:\src\Source\2D\DocS\Drfndpt.h	1 414,098000000	4,794000000				
26		A:\src\Source\2D\Options\Wsid.h	1 365,502000000	4,658000000				
27		A:\src\Source\3D\K3dObj01\PARTOBJ.H	1 376,792000000	4,593000000				
28		A:\src\Source\2D\DocS\Ifdrfsrv.h	1 343,431000000	4,513000000				
29		A:\src\Source\3D\K3dObj01\foundobj.h	1 291,557000000	4,316000000				
30		A:\src\Source\ProductData\MetaProductSignals.h	1 268,790000000	4,297000000				
31		A:\src\Source\2D\ObjE\Leader.h	1 315,306000000	4,125000000				
32		A:\src\Tools\Boost\boost\signals2.hpp	1 218,208000000	4,122000000				
33		A:\src\Source\2D\ObjS\Tcurve.h	1 344,972000000	3,995000000				
34		A:\src\Source\2D\ObjS\AppearanceObj.h	1 265,915000000	3,968000000				
35		A:\src\Source\2D\FSys\UniqContainer.h	1 233,713000000	3,602000000				
36		A:\src\Source\2D\ObjS\Annsymb.h	1 125,564000000	3,564000000				
37		A:\src\Source\API\API5_2D\IAPIViewsAndLayers.h	947,529000000	3,538000000				
38		A:\src\Source\3D\K3dObj01\OBJECT3D.H	1 055,877000000	3,500000000				
39		A:\src\Source\3D\K3dObj01\OBJ3DTYP.H	1 057,743000000	3,494000000				
40		A:\src\Source\3D\K3dObj01\IfGenerativeDimensionsOwner.h	998,825000000	3,284000000				

C++ Build Insights



Include What You Use (iwyu)

- удаляет лишние include
- добавляет forward declaration

Include What You Use (iwyu)

- `llvm`
- `-DLLVM_ENABLE_PROJECTS="clang;clang-tools-extra"`

Include What You Use (iwyu)

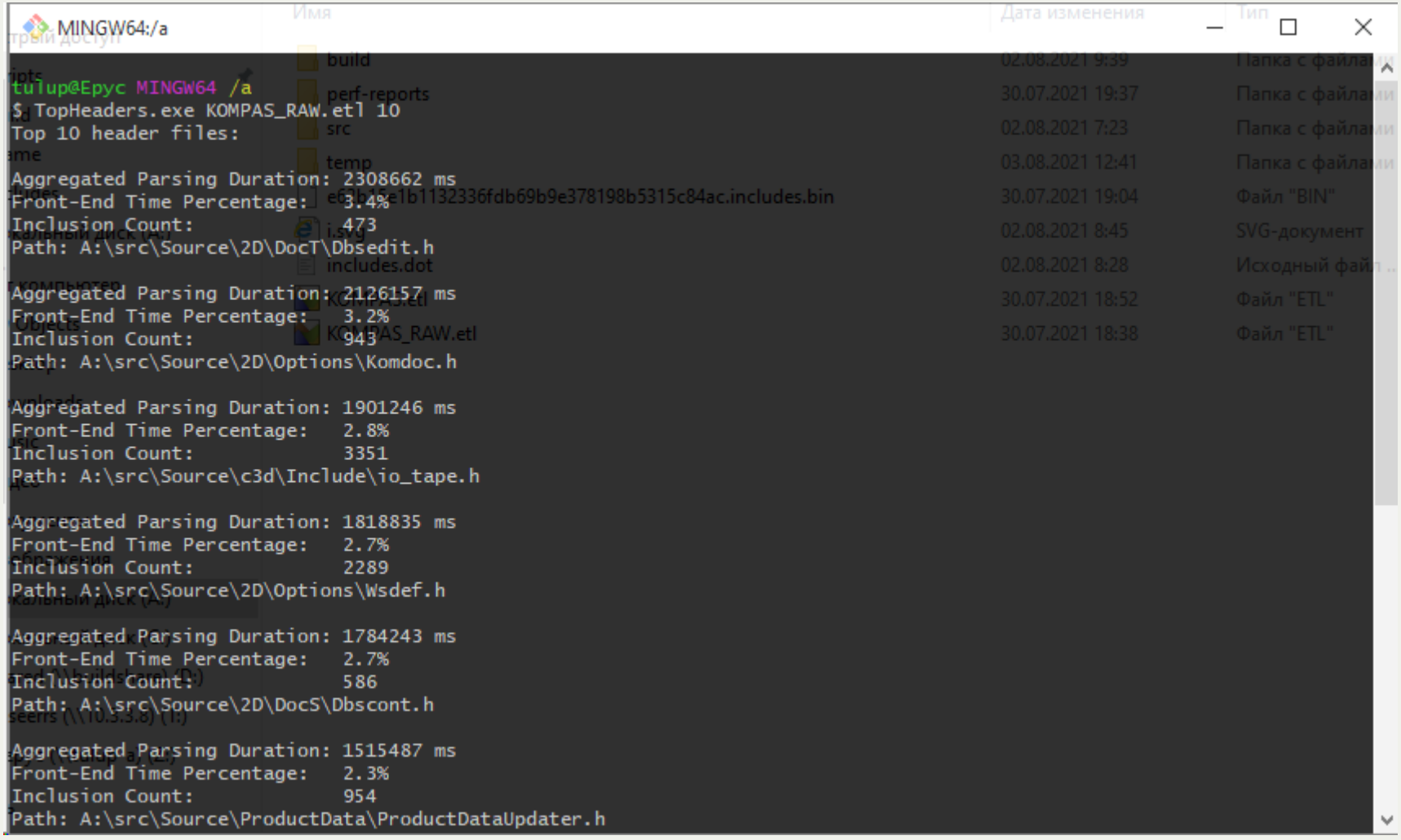
```
// найти лишние include
iwyu_tool -j 256 -p compile_commands.json -- -w > iwyu_res.cpp
```

```
// применить исправления
fix_includes.py < iwyu_res.cpp
```

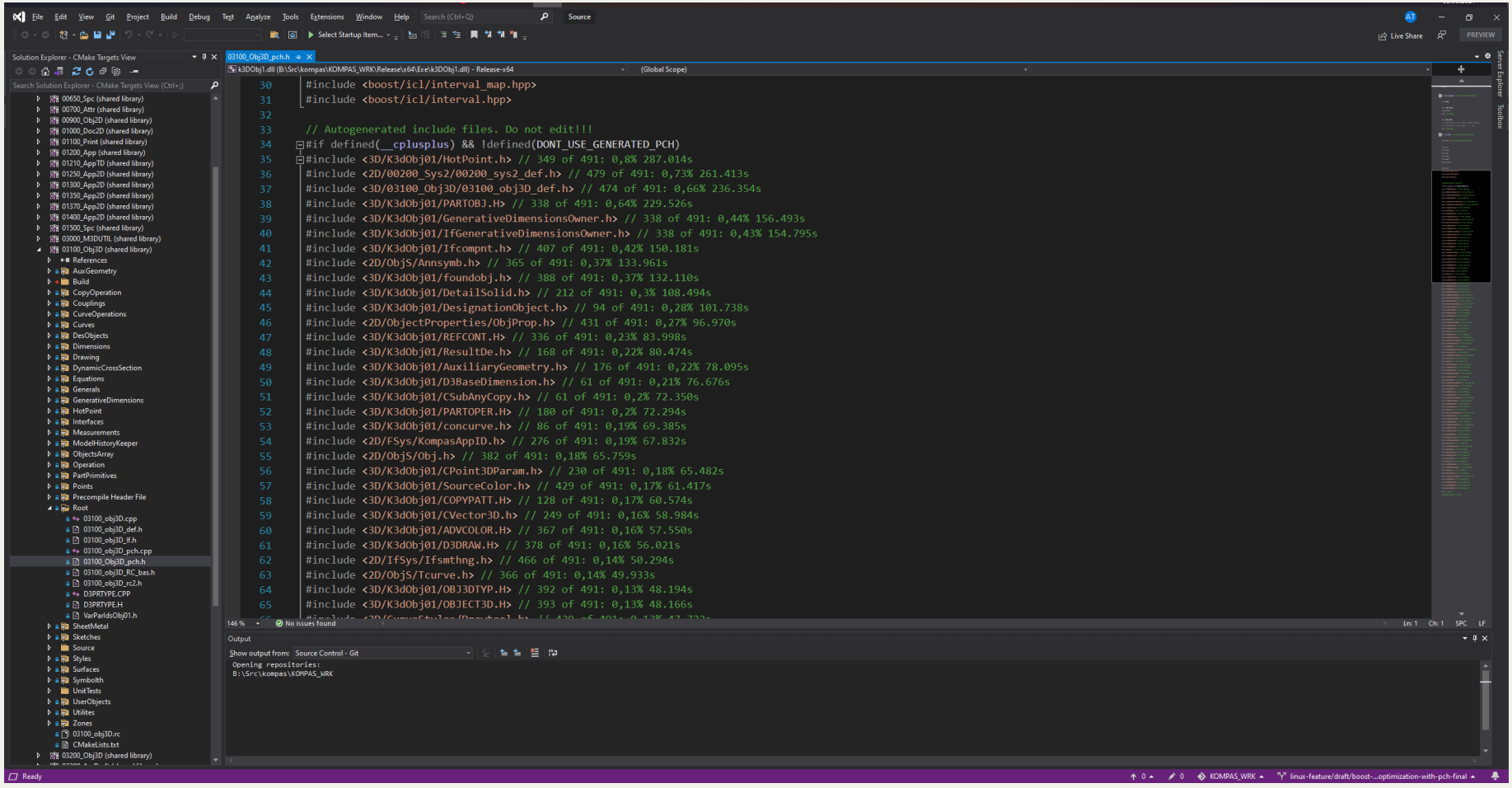
PCH

- `vcperf /start MySessionName`
- compile your project
- `vcperf /stopnoanalyze MySessionName outputFile.etl`

PCH


MINGW64:/a
tulup@Epyc MINGW64 /a
$ TopHeaders.exe KOMPAS_RAW.etl 10
Top 10 header files:
Aggregated Parsing Duration: 2308662 ms
Front-End Time Percentage: 3.4%
Inclusion Count: 473
Path: A:\src\Source\2D\DocT\Dbsedit.h
Aggregated Parsing Duration: 2126157 ms
Front-End Time Percentage: 3.2%
Inclusion Count: 943
Path: A:\src\Source\2D\Options\Komdoc.h
Aggregated Parsing Duration: 1901246 ms
Front-End Time Percentage: 2.8%
Inclusion Count: 3351
Path: A:\src\Source\c3d\Include\io_tape.h
Aggregated Parsing Duration: 1818835 ms
Front-End Time Percentage: 2.7%
Inclusion Count: 2289
Path: A:\src\Source\2D\Options\Wsdef.h
Aggregated Parsing Duration: 1784243 ms
Front-End Time Percentage: 2.7%
Inclusion Count: 586
Path: A:\src\Source\2D\DocS\Dbscont.h
Aggregated Parsing Duration: 1515487 ms
Front-End Time Percentage: 2.3%
Inclusion Count: 954
Path: A:\src\Source\ProductData\ProductDataUpdater.h

PCH


#include <boost/icl/interval_map.hpp>
#include <boost/icl/interval.hpp>
// Autogenerated include files. Do not edit!!!
#if defined(__cplusplus) && !defined(DONT_USE_GENERATED_PCH)
#include <3D/K3dObj01/HotPoint.h> // 349 of 491: 0,8% 287.014s
#include <2D/00200_Sys2/00200_sys2_def.h> // 479 of 491: 0,73% 261.413s
#include <3D/03100_Obj3D/03100_obj3D_def.h> // 474 of 491: 0,66% 236.354s
#include <3D/K3dObj01/PARTOBJ.H> // 338 of 491: 0,64% 229.526s
#include <3D/K3dObj01/GenerativeDimensionsOwner.h> // 338 of 491: 0,44% 156.493s
#include <3D/K3dObj01/IfGenerativeDimensionsOwner.h> // 338 of 491: 0,43% 154.795s
#include <3D/K3dObj01/Ifcompnt.h> // 407 of 491: 0,42% 150.181s
#include <2D/ObjS/Annsymb.h> // 365 of 491: 0,37% 133.961s
#include <3D/K3dObj01/foundobj.h> // 388 of 491: 0,37% 132.110s
#include <3D/K3dObj01/Detail5olid.h> // 212 of 491: 0,3% 108.494s
#include <3D/K3dObj01/DesignationObject.h> // 94 of 491: 0,28% 101.738s
#include <2D/ObjectProperties/ObjProp.h> // 431 of 491: 0,27% 96.970s
#include <3D/K3dObj01/REFCONT.H> // 336 of 491: 0,23% 83.998s
#include <3D/K3dObj01/ResultDe.h> // 168 of 491: 0,22% 80.474s
#include <3D/K3dObj01/AuxiliaryGeometry.h> // 176 of 491: 0,22% 78.095s
#include <3D/K3dObj01/D3BaseDimension.h> // 61 of 491: 0,21% 76.676s
#include <3D/K3dObj01/CSubAnyCopy.h> // 61 of 491: 0,2% 72.350s
#include <3D/K3dObj01/PARTOPER.H> // 180 of 491: 0,2% 72.294s
#include <3D/K3dObj01/concurve.h> // 86 of 491: 0,19% 69.385s
#include <2D/FSys/KompasAppID.h> // 276 of 491: 0,19% 67.832s
#include <2D/ObjS/Obj.h> // 382 of 491: 0,18% 65.759s
#include <3D/K3dObj01/CPoint3DParam.h> // 230 of 491: 0,18% 65.482s
#include <3D/K3dObj01/SourceColor.h> // 429 of 491: 0,17% 61.417s
#include <3D/K3dObj01/COPYPATT.H> // 128 of 491: 0,17% 60.574s
#include <3D/K3dObj01/CVector3D.h> // 249 of 491: 0,16% 58.984s
#include <3D/K3dObj01/ADVCOLOR.H> // 367 of 491: 0,16% 57.550s
#include <3D/K3dObj01/D3DRAW.H> // 378 of 491: 0,16% 56.021s
#include <2D/IfSys/Ifsmthng.h> // 466 of 491: 0,14% 50.294s
#include <2D/ObjS/Tcurve.h> // 366 of 491: 0,14% 49.933s
#include <3D/K3dObj01/OBJ3DTYP.H> // 392 of 491: 0,13% 48.194s
#include <3D/K3dObj01/OBJECT3D.H> // 393 of 491: 0,13% 48.166s

Результаты

Line #	Activity Name	Included Path	Inclusive Duration (s) Sum	Exclusive Duration (s) Sum	Count Sum	Included By
1	Parsing		211 745,477000000	25 615,136000000	3 082 932	
2		A:\src\Source\2D\DocT\Dbsedit.h	2 298,329000000	9,207000000	473	
3		A:\src\Source\2D\Options\Komdoc.h	2 066,588000000	129,441000000	942	
4		A:\src\Source\c3d\Include\io_tape.h	1 989,162000000	230,592000000	3 351	
5		A:\src\Source\2D\DocS\Dbscont.h	1 777,383000000	19,406000000	586	
6		A:\src\Source\2D\Options\Wsdef.h	1 743,275000000	32,410000000	2 289	
7		A:\src\Source\2D\TedB\Ted_base.h	1 476,638000000	84,326000000	1 521	
8		A:\src\Source\ProductData\ProductDataUpdater.h	1 466,511000000	11,386000000	953	
9		A:\src\Source\2D\DocE\Dvbsedit.h	1 338,844000000	6,323000000	357	
10		A:\src\Source\c3d\Include\math_define.h	1 171,573000000	332,271000000	3 050	
11		A:\src\Source\3D\K3dObj01\HotPoint.h	1 135,875000000	32,684000000	1 085	
12		A:\src\Tools\Boost\boost\multi_index_container.hpp	1 108,068000000	11,612000000	1 226	
13		A:\src\Source\2D\Options\Komdocrw.h	1 080,165000000	50,286000000	2 341	
14		A:\src\Source\2D\DocT\D23docedit.h	1 057,922000000	9,910000000	568	
15		A:\src\Source\2D\ObjS\Obj.h	1 055,374000000	46,774000000	2 215	
16		A:\src\Source\c3d\Include\tool_cstring.h	1 015,731000000	49,004000000	3 784	
17		A:\src\Source\3D\K3dObj01\PARTOBJ.H	1 008,018000000	22,360000000	947	
18		A:\src\Source\2D\Options\Libwst.h	996,129000000	33,643000000	2 292	
19		A:\src\Source\ProductData\MetaProps.h	972,140000000	197,932000000	1 071	
20		A:\src\Source\2D\ObjS\Annsymb.h	954,504000000	17,173000000	1 870	
21		A:\src\Source\2D\DocS\Drfndpt.h	952,945000000	18,243000000	1 064	
22		A:\src\Source\ProductData\MetaProductSignals.h	943,571000000	46,240000000	586	
23		A:\src\Source\2D\FSys\Catalog.h	935,084000000	83,470000000	2 375	
24		A:\src\Tools\Boost\boost\preprocessor\iteration\detail\iter\forward1.hpp	903,690000000	15,479000000	3 316	
25		A:\src\Source\2D\ObjS\Complobj.h	901,254000000	10,017000000	776	
26		A:\src\Source\ProductData\PropertyData.h	894,718000000	440,896000000	1 118	
27		A:\src\Tools\Boost\boost\signals2.hpp	894,139000000	1,282000000	586	
28		A:\src\Source\2D\DocS\Ifdrfsrv.h	877,712000000	33,478000000	1 083	
29		A:\src\Source\2D\Options\EmbodimentsTree.h	859,698000000	51,818000000	2 623	
30		A:\src\Source\2D\00200_Sys2\00200_sys2_def.h	842,966000000	68,559000000	2 836	
31		A:\src\Source\2D\Options\Wsbank.h	825,016000000	18,367000000	2 280	
32		A:\src\Source\c3d\Include\model_item.h	811,789000000	51,772000000	2 227	
33		A:\src\Source\3D\K3dObj01\IfGenerativeDimensionsOwner.h	792,801000000	15,531000000	1 032	
34		A:\src\Source\2D\ObjS\Objlist.h	780,973000000	62,541000000	228	
35		A:\src\Source\2D\CurveStyles\Drawtool.h	778,000000000	106,660000000	2 897	

Результаты

https://docs.google.com/spreadsheets/d/1cbizmv5p2pZk-3vLuv1MqV849x4IXV85vQmua3JO_F8/edit#gid=0

AMD EPYC 7742 64 x 2 Core @ 2.25 GHz	1 TB	linux	6m31s	6m33s	5m12s	
AMD EPYC 7742 64 x 2 Core @ 2.25 GHz	1 TB	linux	5m4s	4m53s	4m2s	2dc76351284f52c6290026bf752d1ce1b0dc5efd
AMD EPYC 7742 64 x 2 Core @ 2.25 GHz	1 TB	linux	4m36s	4m35s	3m50s	0a63db91fe413b3ac222208b493b0cadd192050b
i7-5820K CPU @ 3.30GHz	32 GB	Тулуп	26m59s	22m10s		
i7-5820K CPU @ 3.30GHz	32 GB	Тулуп	23m54s	18m13s		2dc76351284f52c6290026bf752d1ce1b0dc5efd
i7-5820K CPU @ 3.30GHz	32 GB	Тулуп	21m54s	16m35s		0a63db91fe413b3ac222208b493b0cadd192050b
i7-5820K CPU @ 3.30GHz	32 GB	Тулуп		15m00s		92cb9c7e328b49ff62da04771db19e210947cd86
i7-5820K CPU @ 3.30GHz	32 GB	Тулуп		13m41s		adaf388f816fc9354054e5b8aa4c7c37c115d460
i7-5820K CPU @ 3.30GHz	32 GB	Тулуп		12m59s		d1517387eb1b23c2ed2cb78188712250006fa4b1
i7-5820K CPU @ 3.30GHz	32 GB	Тулуп		12m25s		e6222d14c44eaff476afa89faf662a488e3575c7
i7-10750H CPU @ 2.60GHz	32 GB	Тулуп		18m39s		
i7-10750H CPU @ 2.60GHz	32 GB	Тулуп		16m39s		2dc76351284f52c6290026bf752d1ce1b0dc5efd
i7-10750H CPU @ 2.60GHz	32 GB	Тулуп		14m37s		0a63db91fe413b3ac222208b493b0cadd192050b
i7-7700 CPU @ 3.60 GHz	32 GB	Виноградов		~25m		
i7-7700 CPU @ 3.60 GHz	32 GB	Виноградов		~17m		0a63db91fe413b3ac222208b493b0cadd192050b
i7-7700 CPU @ 3.60 GHz	32 GB	Виноградов		~14m		e6222d14c44eaff476afa89faf662a488e3575c7
i7-9700K CPU @ 3.60GHz	32 GB	Шапошникова	23m25s	17m49s	20m57s	
i7-9700K CPU @ 3.60GHz	32 GB	Шапошникова	20m35s	14m50s	21m11s	2dc76351284f52c6290026bf752d1ce1b0dc5efd
i7-9700K CPU @ 3.60GHz	32 GB	Шапошникова	15m43s	12m9s		0a63db91fe413b3ac222208b493b0cadd192050b
i7-4770 CPU @ 3.40GHz	16 GB	Кондриков	36m44s	30m27s	36m55s	
i9-9900kf CPU @ 3.60GHz	16 GB	Ерохин	17m28s	15m4s	17m8s	49654047d1888eb818088554a6a779479dd834fa
i7-3770 CPU @ 3.40GHz	16 GB	Кузнецов		30m17s		49654047d1888eb818088554a6a779479dd834fa
i7-7700 CPU @ 3.60 GHz	32 GB	Синюков		24m50s		
i9-9900kf CPU @ 3.60GHz	16 GB	Ерохин	18m11s	15m3s	16m59s	
i9-9900kf CPU @ 3.60GHz	16 GB	Ерохин		13m36s	17m3s	2dc76351284f52c6290026bf752d1ce1b0dc5efd
i9-9900kf CPU @ 3.60GHz	16 GB	Ерохин		10m57s	13m5s	0a63db91fe413b3ac222208b493b0cadd192050b
i7-7700K CPU @ 4.20GHz	64 Gb	Сидякин		17m42.039s		853ef5bb5f22ae8662afe1d6fc8d995df0ed9cfc

Результаты

22m10s		
18m13s		2dc76351284f52c6290026bf752d1ce1b0dc5efd
16m35s		0a63db91fe413b3ac222208b493b0cadd192050b
15m00s		92cb9c7e328b49ff62da04771db19e210947cd86
13m41s		adaf388f816fc9354054e5b8aa4c7c37c115d460
12m59s		d1517387eb1b23c2ed2cb78188712250006fa4b1
12m25s		e6222d14c44eaff476afa89faf662a488e3575c7

Спасибо!

Ссылки

- Include What You Use
- Finding build bottlenecks with C++ Build Insights