Native AOT application diagnostics experience

This document explores the current state of the diagnostics experience with Native AOT applications with the goal of planning improvements in the .NET 8.0 timeline. The exploration is focused on the following way:

1. Make diagnostic tools to be native AOT.
2. Diagnostic experience with Native AOT applications

# Create Native AOT versions of diagnostic tools

There are significant wins with having managed diagnostic tools in native AOT. As a starting experiment, native AOT dotnet-trace tool was created with some minimal changes ([Appendix](#_Dotnet-Trace) has more details). A working tool could be created that was around 20 MB (compared to 76 MB without native AOT).

# Diagnostic Experience with native AOT applications

A good description of the diagnostic experience for managed applications can be found on the main [docs](https://docs.microsoft.com/en-us/dotnet/core/diagnostics/). Following is a brief look at the current status for some diagnostic components

## Debugging

A brown bag talk on the debugging experience can be found [here](https://microsoft-my.sharepoint.com/:v:/p/tommcdon/EWkCCZSJ7KhMqKDTh8wcBZcBzsVFfxm2V8pwuCv_Glat-Q?e=hqfhP9).

### Live Debugging

It is expected that developer debugging experience will first go through the build phase, which is completely managed (as in .NET Core App Runtime package is used to create the managed application and not the NativeAOT runtime nor its libraries) and resolve most issues related to their application.

The native AOT debug experience (post build and when publish is used to create the application) can be summarized as follows

* Break points, Step through, step out, Local Views, Virtual calls work reasonably well
* Disassembly code has debug symbols
* Stack names are somewhat mangled but can still get useful information
* Interface calls are not working
* Stepping through compiler generated code is not working well
* Debugging exceptions are not great

Dump Debugging

* Poor currently and need to be on parity with .NET

## Logging

* In-Proc logging of rich data payloads using DiagnosticSource and DiagnosticListener works without problems
* EventSource works well with external tools like ETW tools like PerfView
* Tracing tools based on EventPipe like dotnet-trace, dotnet-counters, dotnet-gcdump do not work in native AOT due to EventPipe not being supported

# Appendix

## Dotnet-Trace

### Steps

* Add dotnet7 feed to nuget.config
* src\Tools\dotnet-trace\dotnet-trace.csproj
  + <TargetFramework>net7.0</TargetFramework>
  + <PublishAot>true</PublishAot>
* src\Tools\dotnet-trace\CommandLine\PrintReportHelper.cs
  + Change Count() of a string to length
* C:\work\core\main\diagnostics\.dotnet\sdk\7.0.100-preview.7.22377.5\Sdks\Microsoft.NET.Sdk\targets\Microsoft.NET.PackTool.targets
  + Comment out
* <!--    <NETSdkError Condition=" '$(SelfContained)' == 'true' "
* ResourceName="PackAsToolCannotSupportSelfContained" />-->
* dotnet.cmd publish src\Tools\dotnet-trace\dotnet-trace.csproj -r win-x64 -c Release -bl
* Warnings

C:\Users\lakshanf\.nuget\packages\microsoft.diagnostics.tracing.traceevent\3.0.3\lib\netstandard2.0\Microsoft.Diagnosti

cs.Tracing.TraceEvent.dll : warning IL2104: Assembly 'Microsoft.Diagnostics.Tracing.TraceEvent' produced trim warnings.

For more information see https://aka.ms/dotnet-illink/libraries [C:\work\core\main\diagnostics\src\Tools\dotnet-trace\

dotnet-trace.csproj]

C:\Users\lakshanf\.nuget\packages\system.commandline\2.0.0-beta1.20468.1\lib\netstandard2.0\System.CommandLine.dll : wa

rning IL2104: Assembly 'System.CommandLine' produced trim warnings. For more information see https://aka.ms/dotnet-illi

nk/libraries [C:\work\core\main\diagnostics\src\Tools\dotnet-trace\dotnet-trace.csproj]

C:\Users\lakshanf\.nuget\packages\microsoft.diagnostics.tracing.traceevent\3.0.3\lib\netstandard2.0\Microsoft.Diagnosti

cs.Tracing.TraceEvent.dll : warning IL3053: Assembly 'Microsoft.Diagnostics.Tracing.TraceEvent' produced AOT analysis w

arnings. [C:\work\core\main\diagnostics\src\Tools\dotnet-trace\dotnet-trace.csproj]

C:\Users\lakshanf\.nuget\packages\system.commandline\2.0.0-beta1.20468.1\lib\netstandard2.0\System.CommandLine.dll : wa

rning IL3053: Assembly 'System.CommandLine' produced AOT analysis warnings. [C:\work\core\main\diagnostics\src\Tools\do

tnet-trace\dotnet-trace.csproj]

C:\Users\lakshanf\.nuget\packages\microsoft.diagnostics.tracing.traceevent\3.0.3\lib\netstandard2.0\Microsoft.Diagnosti

cs.FastSerialization.dll : warning IL2104: Assembly 'Microsoft.Diagnostics.FastSerialization' produced trim warnings. F

or more information see https://aka.ms/dotnet-illink/libraries [C:\work\core\main\diagnostics\src\Tools\dotnet-trace\do

tnet-trace.csproj]

C:\Users\lakshanf\.nuget\packages\runtime.win-x64.microsoft.dotnet.ilcompiler\7.0.0-preview.7.22375.6\framework\System.

Linq.Expressions.dll : warning IL3053: Assembly 'System.Linq.Expressions' produced AOT analysis warnings. [C:\work\core

\main\diagnostics\src\Tools\dotnet-trace\dotnet-trace.csproj]

C:\Users\lakshanf\.nuget\packages\runtime.win-x64.microsoft.dotnet.ilcompiler\7.0.0-preview.7.22375.6\framework\Microso

ft.CSharp.dll : warning IL3053: Assembly 'Microsoft.CSharp' produced AOT analysis warnings. [C:\work\core\main\diagnost

ics\src\Tools\dotnet-trace\dotnet-trace.csproj]

C:\Users\lakshanf\.nuget\packages\runtime.win-x64.microsoft.dotnet.ilcompiler\7.0.0-preview.7.22375.6\framework\System.

Private.Xml.dll : warning IL3053: Assembly 'System.Private.Xml' produced AOT analysis warnings. [C:\work\core\main\diag

nostics\src\Tools\dotnet-trace\dotnet-trace.csproj]

C:\Users\lakshanf\.nuget\packages\runtime.win-x64.microsoft.dotnet.ilcompiler\7.0.0-preview.7.22375.6\framework\System.

ComponentModel.TypeConverter.dll : warning IL3053: Assembly 'System.ComponentModel.TypeConverter' produced AOT analysis

warnings. [C:\work\core\main\diagnostics\src\Tools\dotnet-trace\dotnet-trace.csproj]

C:\Users\lakshanf\.nuget\packages\runtime.win-x64.microsoft.dotnet.ilcompiler\7.0.0-preview.7.22375.6\framework\System.

Diagnostics.DiagnosticSource.dll : warning IL3053: Assembly 'System.Diagnostics.DiagnosticSource' produced AOT analysis

warnings. [C:\work\core\main\diagnostics\src\Tools\dotnet-trace\dotnet-trace.csproj]

* Assets

Directory of artifacts\bin\dotnet-trace\Release\net7.0\win-x64\publish

08/31/2022 12:04 PM <DIR> .

08/31/2022 12:04 PM <DIR> ..

08/31/2022 12:04 PM <DIR> amd64

08/31/2022 12:04 PM <DIR> arm64

02/22/2018 10:52 PM 59,024 Dia2Lib.dll

08/31/2022 12:04 PM 20,334,080 dotnet-trace.exe

08/31/2022 12:04 PM 73,576,448 dotnet-trace.pdb

08/31/2022 12:03 PM 44,196 Microsoft.Diagnostics.NETCore.Client.pdb

08/31/2022 12:03 PM 34,502 Microsoft.Diagnostics.NETCore.Client.xml

01/04/2019 09:24 AM 32,000 OSExtensions.dll

08/31/2022 12:04 PM <DIR> shims

02/22/2018 10:52 PM 23,216 TraceReloggerLib.dll

08/31/2022 12:04 PM <DIR> x86

7 File(s) 94,103,466 bytes

6 Dir(s) 633,114,943,488 bytes free

* Usage

artifacts\bin\dotnet-trace\Release\net7.0\win-x64\publish\dotnet-trace.exe collect --providers Demo -- DotNetTest.exe

Provider Name Keywords Level Enabled By

Demo 0xFFFFFFFFFFFFFFFF Verbose(5) --providers

Launching: DotNetTest.exe

Process : DotNetTest.exe

Output File : C:\work\core\LakshanF\CSharp\src\aot\experiments\Diagnostics\Logging\EventSource\DotNet\bin\Debug\net7.0\win-x64\publish\DotNetTest.exe\_20220831\_120920.nettrace

[00:00:00:00] Recording trace 0.00 (B)

Press <Enter> or <Ctrl+C> to exit...

Trace completed.

Process exited with code '0'.

PS C:\work\core\LakshanF\CSharp\src\aot\experiments\Diagnostics\Logging\EventSource\DotNet\bin\Debug\net7.0\win-x64\publish> dir dotnet\*

Directory: C:\work\core\LakshanF\CSharp\src\aot\experiments\Diagnostics\Logging\EventSource\DotNet\bin\Debug\net7.0\win-x64\publish