

## LinksPlatform's Platform.Unsafe Class Library

### 1.1 ./Platform.Unsafe/ByteArrayExtensions.cs

```
1 using Platform.Exceptions;
2 using Platform.Collections;
3 using System.Runtime.CompilerServices;
4
5 #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
6
7 namespace Platform.Unsafe
8 {
9     public unsafe static class ByteArrayExtensions
10     {
11         [MethodImpl(MethodImplOptions.AggressiveInlining)]
12         public static TStruct ToStructure<TStruct>(this byte[] bytes)
13             where TStruct : struct
14         {
15             Ensure.OnDebug.ArgumentNotEmpty(bytes, nameof(bytes));
16             var structureSize = System.Runtime.CompilerServices.Unsafe.SizeOf<TStruct>();
17             Ensure.OnDebug.ArgumentMeetsCriteria(bytes, array => array.Length == structureSize,
18                 ↳ nameof(bytes), "Bytes array should be the same length as struct size.");
19             TStruct structure = default;
20             fixed (byte* pointer = bytes)
21             {
22                 System.Runtime.CompilerServices.Unsafe.Copy(ref structure, pointer);
23             }
24             return structure;
25         }
26     }
27 }
```

### 1.2 ./Platform.Unsafe/IntPtr.cs

```
1 using System;
2 using System.Reflection;
3 using System.Runtime.InteropServices;
4 using Platform.Reflection;
5
6 #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
7
8 namespace Platform.Unsafe
9 {
10     /// <remarks>
11     /// Please use System.Runtime.CompilerServices.Unsafe instead.
12     /// </remarks>
13     [Obsolete("Please use System.Runtime.CompilerServices.Unsafe instead.")]
14     public static class IntPtr<T>
15     {
16         public static readonly Func<IntPtr, T> GetValue = CompileGetValueDelegate();
17         public static readonly Action<IntPtr, T> SetValue = CompileSetValueDelegate();
18
19         static private Func<IntPtr, T> CompileGetValueDelegate()
20         {
21             return DelegateHelpers.Compile<Func<IntPtr, T>>(emitter =>
22             {
23                 if (NumericType<T>.IsNumeric)
24                 {
25                     emitter.LoadArgument(0);
26                     emitter.LoadIndirect<T>();
27                     emitter.Return();
28                 }
29                 else
30                 {
31                     emitter.LoadArguments(0);
32                     emitter.Call(typeof(Marshal).GetGenericMethod(nameof(Marshal.PtrToStructure),
33                         ↳ Types<T>.Array, Types<IntPtr, Type, bool>.Array));
34                     emitter.Return();
35                 }
36             });
37         }
38
39         static private Action<IntPtr, T> CompileSetValueDelegate()
40         {
41             return DelegateHelpers.Compile<Action<IntPtr, T>>(emitter =>
42             {
43                 if (NumericType<T>.IsNumeric)
44                 {
45                     emitter.LoadArguments(0, 1);
46                     emitter.StoreIndirect<T>();
47                     emitter.Return();
48                 }
49             });
50         }
51     }
52 }
```

```

48         else
49         {
50             emitter.LoadArguments(0, 1);
51             emitter.LoadConstant(true);
52             emitter.Call(typeof(Marshal).GetTypeInfo().GetMethod(nameof(Marshal.Structure_
                    ↳ IntPtr), Types<object, IntPtr,
                    ↳ bool>.Array));
53             emitter.Return();
54         }
55     });
56 }
57 }
58 }

```

### 1.3 ./Platform.Unsafe/IntPtrExtensions.cs

```

1  using System;
2  using System.Runtime.CompilerServices;
3  using Platform.Numbers;
4
5  #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
6
7  namespace Platform.Unsafe
8  {
9      /// <remarks>
10     /// Please use System.Runtime.CompilerServices.Unsafe instead.
11     /// </remarks>
12     public unsafe static class IntPtrExtensions
13     {
14         [Obsolete("GetValue method is deprecated, please use
↳ System.Runtime.CompilerServices.Unsafe.Read method instead.")]
15         [MethodImpl(MethodImplOptions.AggressiveInlining)]
16         public static TElement GetValue<TElement>(this IntPtr pointer) =>
            ↳ IntPtr<TElement>.GetValue(pointer);
17
18         [Obsolete("SetValue method is deprecated, please use
↳ System.Runtime.CompilerServices.Unsafe.Write method instead.")]
19         [MethodImpl(MethodImplOptions.AggressiveInlining)]
20         public static void SetValue<TElement>(this IntPtr pointer, TElement value) =>
            ↳ IntPtr<TElement>.SetValue(pointer, value);
21
22         [Obsolete("GetElement method is deprecated, please use
↳ System.Runtime.CompilerServices.Unsafe.Add method instead.")]
23         [MethodImpl(MethodImplOptions.AggressiveInlining)]
24         public static IntPtr GetElement(this IntPtr pointer, int elementSize, int index) =>
            ↳ pointer + (elementSize * index);
25
26         [Obsolete("GetElement method is deprecated, please use
↳ System.Runtime.CompilerServices.Unsafe.Add method instead.")]
27         [MethodImpl(MethodImplOptions.AggressiveInlining)]
28         public static IntPtr GetElement(this IntPtr pointer, long elementSize, long index) =>
            ↳ new IntPtr((byte*)pointer.ToPointer() + (elementSize * index));
29
30         [Obsolete("GetElement method is deprecated, please use
↳ System.Runtime.CompilerServices.Unsafe.Add method instead.")]
31         [MethodImpl(MethodImplOptions.AggressiveInlining)]
32         public static IntPtr GetElement<TIndex>(this IntPtr pointer, int elementSize, TIndex
            ↳ index) => pointer.GetElement((long)elementSize, (Integer)(Integer<TIndex>)index);
33
34         [MethodImpl(MethodImplOptions.AggressiveInlining)]
35         public static void WriteElementValue<TValue>(this IntPtr pointer, long index, TValue
            ↳ value) => System.Runtime.CompilerServices.Unsafe.Write((byte*)pointer +
            ↳ (System.Runtime.CompilerServices.Unsafe.SizeOf<TValue>() * index), value);
36
37         [MethodImpl(MethodImplOptions.AggressiveInlining)]
38         public static TValue ReadElementValue<TValue>(this IntPtr pointer, long index) =>
            ↳ System.Runtime.CompilerServices.Unsafe.Read<TValue>((byte*)pointer +
            ↳ (System.Runtime.CompilerServices.Unsafe.SizeOf<TValue>() * index));
39     }
40 }

```

### 1.4 ./Platform.Unsafe/MemoryBlock.cs

```

1  using System.Collections.Concurrent;
2  using System.Threading.Tasks;
3
4  #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
5
6  namespace Platform.Unsafe

```

```

7 {
8     public static unsafe class MemoryBlock
9     {
10         public static void Zero(void* pointer, long capacity)
11         {
12             Parallel.ForEach(Partitioner.Create(0, capacity), range =>
13             {
14                 var from = range.Item1;
15                 var offset = (void*)((byte*)pointer + from);
16                 var length = (uint)(range.Item2 - from);
17                 System.Runtime.CompilerServices.Unsafe.InitBlock(offset, 0, length);
18             });
19         }
20     }
21 }

```

## 1.5 ./Platform.Unsafe/Structure.cs

```

1 using System;
2 using System.Runtime.InteropServices;
3
4 #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
5
6 namespace Platform.Unsafe
7 {
8     public static class Structure<TStruct>
9         where TStruct : struct
10     {
11         /// <summary>
12         /// <para>
13         /// Returns the size of an unmanaged type in bytes.
14         /// This property do this without throwing exceptions for generic types as <see
15         ↪ cref="Marshal.SizeOf{T}()" /> and <see cref="Marshal.SizeOf(Type)" /> do.
16         /// </para>
17         /// <para>
18         /// Возвращает размер неуправляемого типа в байтах.
19         /// Этот свойство делает это без выбрасывания исключений для универсальных типов, как
20         ↪ это делают <see cref="Marshal.SizeOf{T}()" /> и <see cref="Marshal.SizeOf(Type)" />.
21         /// </para>
22         /// </summary>
23         public static int Size { get; } =
24             ↪ System.Runtime.CompilerServices.Unsafe.SizeOf<TStruct>();
25     }
26 }

```

## 1.6 ./Platform.Unsafe/StructureExtensions.cs

```

1 using System.Runtime.CompilerServices;
2 using Platform.Hardware.Cpu;
3
4 #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
5
6 namespace Platform.Unsafe
7 {
8     public unsafe static class StructureExtensions
9     {
10         [MethodImpl(MethodImplOptions.AggressiveInlining)]
11         public static byte[] ToBytes<TStruct>(this ref TStruct obj)
12             where TStruct : struct
13         {
14             var structureSize = System.Runtime.CompilerServices.Unsafe.SizeOf<TStruct>();
15             var bytes = new byte[structureSize];
16             fixed (byte* pointer = bytes)
17             {
18                 obj.CopyTo(pointer, structureSize);
19             }
20             return bytes;
21         }
22
23         [MethodImpl(MethodImplOptions.AggressiveInlining)]
24         public static void CopyTo<TStruct>(this ref TStruct source, void* destination)
25             where TStruct : struct
26         {
27             var size = System.Runtime.CompilerServices.Unsafe.SizeOf<TStruct>();
28             CopyTo(ref source, destination, size);
29         }
30
31         [MethodImpl(MethodImplOptions.AggressiveInlining)]
32         public static void CopyTo<TStruct>(this ref TStruct source, void* destination, int size)
33             where TStruct : struct
34         {

```

```

35         if (CacheLine.Size >= size)
36         {
37             System.Runtime.CompilerServices.Unsafe.Copy(destination, ref source);
38         }
39         else
40         {
41             System.Runtime.CompilerServices.Unsafe.CopyBlock(destination,
42                 ↪ System.Runtime.CompilerServices.Unsafe.AsPointer(ref source), (uint)size);
43         }
44     }
45 }

```

## 1.7 ./Platform.Unsafe.Tests/IntPtrExtensionsTests.cs

```

1  using System;
2  using System.Runtime.InteropServices;
3  using Xunit;
4  using Xunit.Abstractions;
5  using Platform.Diagnostics;
6
7  namespace Platform.Unsafe.Tests
8  {
9      public unsafe class IntPtrExtensionsTests
10     {
11         private const int N = 10000000;
12
13         private readonly ITestOutputHelper _output;
14
15         public IntPtrExtensionsTests(ITestOutputHelper output)
16         {
17             _output = output;
18         }
19
20         [Fact]
21         public void ReadAndWriteOperationsForPointerValuesDelegatesTest()
22         {
23             var pointer = Marshal.AllocHGlobal(sizeof(ulong));
24             ulong result = default;
25             for (var i = 0; i < N; i++)
26             {
27                 result = Delegates(pointer);
28             }
29             Assert.Equal(42UL, result);
30             Marshal.FreeHGlobal(pointer);
31         }
32
33         private static ulong Delegates(IntPtr pointer)
34         {
35             ulong result;
36             //IntPtr<ulong>.SetValue(pointer, 42UL);
37             System.Runtime.CompilerServices.Unsafe.Write((void*)pointer, 42UL);
38             //result = IntPtr<ulong>.GetValue(pointer);
39             result = System.Runtime.CompilerServices.Unsafe.Read<ulong>((void*)pointer);
40             return result;
41         }
42
43         [Fact]
44         public void ReadAndWriteOperationsForPointerValuesExtensionMethodsTest()
45         {
46             var pointer = Marshal.AllocHGlobal(sizeof(ulong));
47             ulong result = default;
48             for (var i = 0; i < N; i++)
49             {
50                 result = ExtensionMethods(pointer);
51             }
52             Assert.Equal(42UL, result);
53             Marshal.FreeHGlobal(pointer);
54         }
55
56         private static ulong ExtensionMethods(IntPtr pointer)
57         {
58             ulong result;
59             //pointer.SetValue(42UL);
60             System.Runtime.CompilerServices.Unsafe.Write((void*)pointer, 42UL);
61             //result = pointer.GetValue<ulong>();
62             result = System.Runtime.CompilerServices.Unsafe.Read<ulong>((void*)pointer);
63             return result;
64         }
65
66         [Fact]

```

```

67 public void ReadAndWriteOperationsForPointerValuesUnsafeClassMethodsTest()
68 {
69     void* pointer = (void*)Marshal.AllocHGlobal(sizeof(ulong));
70     ulong result = default;
71     for (var i = 0; i < N; i++)
72     {
73         result = ReadAndWriteMethods(pointer);
74     }
75     Assert.Equal(42UL, result);
76     Marshal.FreeHGlobal((IntPtr)pointer);
77 }
78
79 private static ulong ReadAndWriteMethods(void* pointer)
80 {
81     ulong result;
82     System.Runtime.CompilerServices.Unsafe.Write(pointer, 42UL);
83     result = System.Runtime.CompilerServices.Unsafe.Read<ulong>(pointer);
84     return result;
85 }
86
87 [Fact]
88 public void ReadAndWriteOperationsComparisionTest()
89 {
90     var t1 = Performance.Measure(ReadAndWriteOperationsForPointerValuesDelegatesTest);
91     var t2 =
92         ↪ Performance.Measure(ReadAndWriteOperationsForPointerValuesExtensionMethodsTest);
93     var t3 = Performance.Measure(ReadAndWriteOperationsForPointerValuesUnsafeClassMethod
94         ↪ sTest);
95     var message = $"{t1} {t2} {t3}";
96     _output.WriteLine(message);
97 }
98
99 [Fact]
100 public void ElementOffsetOperationsForPointerValuesExtensionMethods()
101 {
102     var pointer = Marshal.AllocHGlobal(sizeof(ulong) * 10);
103     ulong result = default;
104     for (var i = 0; i < N; i++)
105     {
106         result = GetElementExtensionMethods(pointer);
107     }
108     Assert.Equal(5UL * 8UL, result - (ulong)pointer);
109     Marshal.FreeHGlobal(pointer);
110 }
111
112 private static ulong GetElementExtensionMethods(IntPtr pointer)
113 {
114     ulong result;
115     //result = (ulong)pointer.GetElement(8, 5);
116     result = (ulong)System.Runtime.CompilerServices.Unsafe.Add<ulong>((void*)pointer, 5);
117     return result;
118 }
119
120 [Fact]
121 public void ElementOffsetOperationsForPointerValuesUnsafeClassMethodsTest()
122 {
123     void* pointer = (void*)Marshal.AllocHGlobal(sizeof(ulong) * 10);
124     ulong result = default;
125     for (var i = 0; i < N; i++)
126     {
127         result = GetElementMethods(pointer);
128     }
129     Assert.Equal(5UL * 8UL, result - (ulong)pointer);
130     Marshal.FreeHGlobal((IntPtr)pointer);
131 }
132
133 private static ulong GetElementMethods(void* pointer)
134 {
135     ulong result;
136     result = (ulong)System.Runtime.CompilerServices.Unsafe.Add<ulong>(pointer, 5);
137     return result;
138 }
139
140 [Fact]
141 public void GetElementOperationsComparisionTest()
142 {
143     var t1 =
144         ↪ Performance.Measure(ElementOffsetOperationsForPointerValuesExtensionMethods);

```

```

142         var t2 = Performance.Measure(ElementOffsetOperationsForPointerValuesUnsafeClassMetho
            ↪ dsTest);
143         var message = $"{t1} {t2}";
144         _output.WriteLine(message);
145     }
146 }
147 }

```

## 1.8 ./Platform.Unsafe.Tests/SizeOfTests.cs

```

1 using System.Runtime.InteropServices;
2 using Xunit;
3
4 namespace Platform.Unsafe.Tests
5 {
6     public static class SizeOfTests
7     {
8         public struct X<T>
9         {
10             public readonly T F1;
11             public readonly T F2;
12         }
13
14         [Fact]
15         public static void UnsafeClassSizeOfTest()
16         {
17             var size = System.Runtime.CompilerServices.Unsafe.SizeOf<X<int>>();
18             Assert.Equal(8, size);
19         }
20
21         [Fact]
22         public static void MarshalSizeOfTest()
23         {
24             var size = Marshal.SizeOf(default(X<int>));
25             Assert.Equal(8, size);
26         }
27
28         [Fact]
29         public static void StructurePropertyTest()
30         {
31             var size = Structure<X<int>>.Size;
32             Assert.Equal(8, size);
33         }
34     }
35 }

```

## 1.9 ./Platform.Unsafe.Tests/StructAndBytesConversionTests.cs

```

1 using Xunit;
2
3 namespace Platform.Unsafe.Tests
4 {
5     public static class StructAndBytesConversionTests
6     {
7         [Fact]
8         public static void StructToBytesTest()
9         {
10             ulong source = ulong.MaxValue;
11             var result = source.ToBytes();
12             for (int i = 0; i < result.Length; i++)
13             {
14                 Assert.Equal(byte.MaxValue, result[i]);
15             }
16         }
17
18         [Fact]
19         public static void BytesToStructTest()
20         {
21             byte[] bytes = new[] { byte.MaxValue, byte.MaxValue, byte.MaxValue, byte.MaxValue,
            ↪ byte.MaxValue, byte.MaxValue, byte.MaxValue, byte.MaxValue };
22             ulong result = bytes.ToStructure<ulong>();
23             Assert.Equal(ulong.MaxValue, result);
24         }
25     }
26 }

```

## 1.10 ./Platform.Unsafe.Tests/ZeroMemoryTests.cs

```

1 using Xunit;
2
3 namespace Platform.Unsafe.Tests

```

```
4 {
5     public static unsafe class ZeroMemoryTests
6     {
7         [Fact]
8         public static void ZeroMemoryTest()
9         {
10             var bytes = new byte[1024];
11             for (int i = 0; i < bytes.Length; i++)
12             {
13                 bytes[i] = unchecked((byte)i);
14             }
15             fixed (byte* pointer = bytes)
16             {
17                 MemoryBlock.Zero(pointer, bytes.Length);
18             }
19             for (int i = 0; i < bytes.Length; i++)
20             {
21                 Assert.Equal(0, bytes[i]);
22             }
23         }
24     }
25 }
```

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