

Microsoft XNA Game Studio 4.0

Compiled (XNB) Content Format

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XNB Container Format

Byte	Format identifier	'X'
Byte	Format identifier	'N'
Byte	Format identifier	'B'
Byte	Target platform	'w' = Microsoft Windows 'm' = Windows Phone 7 'x' = Xbox 360
Byte	XNB format version	5 = XNA Game Studio 4.0
Byte	Flag bits	Bit 0x01 = content is for HiDef profile (otherwise Reach) Bit 0x80 = asset data is compressed
UInt32	Compressed file size	Total size of the (optionally compressed) .xnb file as stored on disk (including this header block)
UInt32	Decompressed data size	Only included for compressed .xnb files, where it indicates the expanded size of the compressed data which starts immediately after this field (unlike the compressed file size, this does not include the uncompressed portion of the header)
<i>If the file is compressed (flag bit 0x80 is set), data from this point on is packed using the Xbox XMemCompress API</i>		
7BitEncodedInt	Type reader count	
Repeat <type reader count> {		
String	Type reader name	.NET assembly qualified name of a ContentTypeReader<T> subclass, which can be used to read one of the types contained in this file
Int32	Reader version number	Type specific version number (typically zero)
}		
7BitEncodedInt	Shared resource count	
Object	Primary asset data	The primary object which will be returned when the .xnb file is loaded
Repeat <shared resource count> {		
Object	Shared resource data	Used to break cyclic data structures (see below)
}		

Object Format

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Individual objects can be serialized in one of three ways:

Raw Values

Indicated in this document by a raw type name such as “Byte”, “String”, or “VertexBuffer”.

This is simply a dump of whatever data is expected by the type reader for the specified type.

Because it does not include any type metadata, the type must be statically specified. It is not possible to serialize polymorphic instances this way, and the value cannot be null.

Polymorphic Objects

Indicated in this document by the type name “Object”, or constrained to a specific subtype, eg. “Object: String” or “Object: VertexBuffer”.

This format starts with a 7BitEncodedInt typeId, which indicates the type of the object:

- If typeId is zero, the object is null.
- If greater than zero, (typeId - 1) is an index into the type reader table from the XNB header. Nonzero ids are followed by the object data, in the same format as a raw value for the selected type reader.

The presence of type metadata enables serialization of polymorphic class hierarchies. For instance where the format specifies a field of type “Object: Effect”, any individual .xnb file could choose to substitute an instance of type BasicEffect or SkinnedEffect.

As shorthand, this document uses the notation “Object? T” to refer to fields that will be serialized as raw values if T is a value type, or as polymorphic objects if T is a reference type.

Shared Resources

Indicated in this document by a type name such as “Shared Resource: VertexBuffer”.

These values are serialized as a 7BitEncodedInt resourceId:

- If resourceId is zero, the object is null.

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- If resourceId is greater than zero, (resourceId - 1) is an index into the list of shared resource instances, which are serialized at the end of the .xnb file (after the primary asset data).

Because the instance data is referred to by index rather than directly by value, this mechanism allows cyclic data structures and arbitrary graphs to be serialized, breaking the infinite recursion that would otherwise occur. Shared resource instances may be referenced from the primary asset data, and also from the body of any shared resource (including the resource itself). Resolving these references requires a fixup pass at the end of the main load operation.

7BitEncodedInt

This format matches the .NET BinaryReader.Read7BitEncodedInt method. It is a variable size encoding of a 32 bit integer value. C implementation:

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```

int Read7BitEncodedInt()
{
    int result = 0;
    int bitsRead = 0;
    int value;

    do
    {
        value = ReadByte();
        result |= (value & 0x7f) << bitsRead;
        bitsRead += 7;
    }
    while (value & 0x80);

    return result;
}

```

Built-In Type Readers

Primitive Types

<i>Target type</i>	<i>Type reader name</i>	<i>Format</i>
System.Byte	Microsoft.Xna.Framework.Content.ByteReader	Unsigned byte
System.SByte	Microsoft.Xna.Framework.Content.SByteReader	Signed byte
System.Int16	Microsoft.Xna.Framework.Content.Int16Reader	Little endian signed 16 bit int
System.UInt16	Microsoft.Xna.Framework.Content.UInt16Reader	Little endian unsigned 16 bit int
System.Int32	Microsoft.Xna.Framework.Content.Int32Reader	Little endian signed 32 bit int
System.UInt32	Microsoft.Xna.Framework.Content.UInt32Reader	Little endian unsigned 32 bit int
System.Int64	Microsoft.Xna.Framework.Content.Int64Reader	Little endian signed 64 bit int
System.UInt64	Microsoft.Xna.Framework.Content.UInt64Reader	Little endian unsigned 64 bit int
System.Single	Microsoft.Xna.Framework.Content.SingleReader	Little endian 32 bit IEEE float
System.Double	Microsoft.Xna.Framework.Content.DoubleReader	Little endian 64 bit IEEE double
System.Boolean	Microsoft.Xna.Framework.Content.BooleanReader	One byte, 0 = false, 1 = true
System.Char	Microsoft.Xna.Framework.Content.CharReader	Single UTF8 encoded character
System.String	Microsoft.Xna.Framework.Content.StringReader	7BitEncodedInt byte count, followed by UTF8 encoded string
System.Object	Microsoft.Xna.Framework.Content.ObjectReader	Never directly invoked, but sometimes referenced in .xnb

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		headers as a base reader for polymorphic values
--	--	---

System Types

Enum

Target type: T
Type reader name: Microsoft.Xna.Framework.Content.EnumReader`1[[T]]
T is any enum type

T	Enum value	Usually 32 bit, but can be other sizes if T is not integer
---	------------	--

Nullable

Target type: System.Nullable<T>
Type reader name: Microsoft.Xna.Framework.Content.NullableReader`1[[T]]
T is any value type

Boolean	Has value	
T	Value	Only included when has value == true

Array

Target type: T[]
Type reader name: Microsoft.Xna.Framework.Content.ArrayReader`1[[T]]

UInt32	Count
Repeat <count> {	
Object? T	Element value
}	

List

Target type: System.Collections.Generic.List<T>
Type reader name: Microsoft.Xna.Framework.Content.ListReader`1[[T]]

UInt32	Count
--------	-------

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Repeat <count>	
{	
Object? T	Element value
}	

Dictionary

Target type: System.Collections.Generic.Dictionary<K,V>

Type reader name: Microsoft.Xna.Framework.Content.DictionaryReader`2[[K],[V]]

UInt32	Count
Repeat <count>	
{	
Object? K	Item key
Object? V	Item value
}	

TimeSpan

Target type: System.TimeSpan

Type reader name: Microsoft.Xna.Framework.Content.TimeSpanReader

Int64	Tick count	10000000 ticks per second
-------	------------	---------------------------

DateTime

Target type: System.DateTime

Type reader name: Microsoft.Xna.Framework.Content.DateTimeReader

UInt64	Packed value	Low 62 bits hold a .NET DateTime tick count High 2 bits hold a .NET DateTimeKind enum value
--------	--------------	--

Decimal

Target type: System.Decimal

Type reader name: Microsoft.Xna.Framework.Content.DecimalReader

UInt32	Packed value 1	.NET System.Decimal bit pattern
UInt32	Packed value 2	
UInt32	Packed value 3	
UInt32	Packed value 4	

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ExternalReference

Target type: T

Type reader name: Microsoft.Xna.Framework.Content.ExternalReferenceReader

String	Asset name	Filename (relative to the current .xnb file, and not including the .xnb file extension) pointing to a separate .xnb file which contains an object of type T, the contents of which should be inserted at the current location into the file currently being read. If the string is empty, the resulting object is null.
--------	------------	---

Math Types

Vector2

Target type: Microsoft.Xna.Framework.Vector2

Type reader name: Microsoft.Xna.Framework.Content.Vector2Reader

Single	X
Single	Y

Vector3

Target type: Microsoft.Xna.Framework.Vector3

Type reader name: Microsoft.Xna.Framework.Content.Vector3Reader

Single	X
Single	Y
Single	Z

Vector4

Target type: Microsoft.Xna.Framework.Vector4

Type reader name: Microsoft.Xna.Framework.Content.Vector4Reader

Single	X
Single	Y
Single	Z
Single	W

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Matrix

Target type: Microsoft.Xna.Framework.Matrix

Type reader name: Microsoft.Xna.Framework.Content.MatrixReader

Single	M11	16 floats make up a 4x4 row major matrix
Single	M12	
Single	M13	
Single	M14	
Single	M21	
Single	M22	
Single	M23	
Single	M24	
Single	M31	
Single	M32	
Single	M33	
Single	M34	
Single	M41	
Single	M42	
Single	M43	
Single	M44	

Quaternion

Target type: Microsoft.Xna.Framework.Quaternion

Type reader name: Microsoft.Xna.Framework.Content.QuaternionReader

Single	X
Single	Y
Single	Z
Single	W

Color

Target type: Microsoft.Xna.Framework.Color

Type reader name: Microsoft.Xna.Framework.Content.ColorReader

Byte	Red
Byte	Green
Byte	Blue

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Byte	Alpha
------	-------

Plane

Target type: Microsoft.Xna.Framework.Plane

Type reader name: Microsoft.Xna.Framework.Content.PlaneReader

Vector3	Normal
Single	D

Point

Target type: Microsoft.Xna.Framework.Point

Type reader name: Microsoft.Xna.Framework.Content.PointReader

Int32	X
Int32	Y

Rectangle

Target type: Microsoft.Xna.Framework.Rectangle

Type reader name: Microsoft.Xna.Framework.Content.RectangleReader

Int32	X
Int32	Y
Int32	Width
Int32	Height

BoundingBox

Target type: Microsoft.Xna.Framework.BoundingBox

Type reader name: Microsoft.Xna.Framework.Content.BoundingBoxReader

Vector3	Min
Vector3	Max

BoundingSphere

Target type: Microsoft.Xna.Framework.BoundingSphere

Type reader name: Microsoft.Xna.Framework.Content.BoundingSphereReader

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Vector3	Center
Single	Radius

BoundingFrustum

Target type: Microsoft.Xna.Framework.BoundingFrustum

Type reader name: Microsoft.Xna.Framework.Content.BoundingFrustumReader

Matrix	Frustum matrix
--------	----------------

Ray

Target type: Microsoft.Xna.Framework.Ray

Type reader name: Microsoft.Xna.Framework.Content.RayReader

Vector3	Position
Vector3	Direction

Curve

Target type: Microsoft.Xna.Framework.Curve

Type reader name: Microsoft.Xna.Framework.Content.CurveReader

Int32	Pre loop	0 = constant 1 = cycle 2 = cycle offset 3 = oscillate 4 = linear
Int32	Post loop	Same values as pre loop
UInt32	Key count	
Repeat <key count> {		
Single	Position	
Single	Value	
Single	Tangent in	
Single	Tangent out	
Int32	Continuity	0 = smooth 1 = step
}		

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Graphics Types

Texture

Target type: Microsoft.Xna.Framework.Graphics.Texture

Type reader name: Microsoft.Xna.Framework.Content.TextureReader

Never directly invoked (as Texture is an abstract base type), but sometimes referenced in .xnb headers as a base reader for polymorphic values.

Texture2D

Target type: Microsoft.Xna.Framework.Graphics.Texture2D

Type reader name: Microsoft.Xna.Framework.Content.Texture2DReader

Int32	Surface format	0 = Color 1 = Bgr565 2 = Bgra5551 3 = Bgra4444 4 = Dxt1 5 = Dxt3 6 = Dxt5 7 = NormalizedByte2 8 = NormalizedByte4 9 = Rgba1010102 10 = Rg32 11 = Rgba64 12 = Alpha8 13 = Single 14 = Vector2 15 = Vector4 16 = HalfSingle 17 = HalfVector2 18 = HalfVector4 19 = HdrBlendable
UInt32	Width	
UInt32	Height	
UInt32	Mip count	
Repeat <mip count>		

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{		
UInt32	Data size	
Byte [data size]	Image data	
}		

Texture3D

Target type: Microsoft.Xna.Framework.Graphics.Texture3D

Type reader name: Microsoft.Xna.Framework.Content.Texture3DReader

Int32	Surface format	See Texture2D for list of enum values
UInt32	Width	
UInt32	Height	
UInt32	Depth	
UInt32	Mip count	
Repeat <mip count>		
{		
UInt32	Data size	
Byte [data size]	Image data	
}		

TextureCube

Target type: Microsoft.Xna.Framework.Graphics.TextureCube

Type reader name: Microsoft.Xna.Framework.Content.TextureCubeReader

Int32	Surface format	See Texture2D for list of enum values
UInt32	Size	
UInt32	Mip count	
Repeat <6x, for each cube face: +x, -x, +y, -y, +z, -z>		
{		
Repeat <mip count>		
{		
UInt32	Data size	
Byte [data size]	Image data	
}		
}		

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IndexBuffer

Target type: Microsoft.Xna.Framework.Graphics.IndexBuffer

Type reader name: Microsoft.Xna.Framework.Content.IndexBufferReader

Boolean	Is 16 bit	If false, index values are 32 bits in size
UInt32	Data size	
Byte [data size]	Index data	

VertexBuffer

Target type: Microsoft.Xna.Framework.Graphics.VertexBuffer

Type reader name: Microsoft.Xna.Framework.Content.VertexBufferReader

VertexDeclaration	Vertex declaration
UInt32	Vertex count
Byte [vertex count * declaration.VertexStride]	Vertex data

VertexDeclaration

Target type: Microsoft.Xna.Framework.Graphics.VertexDeclaration

Type reader name: Microsoft.Xna.Framework.Content.VertexDeclarationReader

UInt32	Vertex stride	
UInt32	Element count	
Repeat <element count> {		
UInt32	Offset	
Int32	Element format	0 = Single 1 = Vector2 2 = Vector3 3 = Vector4 4 = Color 5 = Byte4 6 = Short2 7 = Short4 8 = NormalizedShort2 9 = NormalizedShort4 10 = HalfVector2 11 = HalfVector4
Int32	Element usage	0 = Position

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		1 = Color 2 = TextureCoordinate 3 = Normal 4 = Binormal 5 = Tangent 6 = BlendIndices 7 = BlendWeight 8 = Depth 9 = Fog 10 = PointSize 11 = Sample 12 = TessellateFactor
UInt32	Usage index	
}		

Effect

Target type: Microsoft.Xna.Framework.Graphics.Effect

Type reader name: Microsoft.Xna.Framework.Content.EffectReader

UInt32	Size	
Byte [size]	Effect bytecode	A compiled XNA effect

EffectMaterial

Target type: Microsoft.Xna.Framework.Graphics.EffectMaterial

Type reader name: Microsoft.Xna.Framework.Content.EffectMaterialReader

ExternalReference	Effect	Pointer to a separate .xnb file which contains an object of type Effect
Object: Dictionary<String, Object>	Parameters	Named parameter values. Supported types: <ul style="list-style-type: none"> Int32 Boolean Single Vector2 Vector3 Vector4 Matrix Arrays of any of the above

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		<ul style="list-style-type: none"> Texture (commonly stored as an ExternalReference which points to a separate .xnb file) String
--	--	--

BasicEffect

Target type: Microsoft.Xna.Framework.Graphics.BasicEffect

Type reader name: Microsoft.Xna.Framework.Content.BasicEffectReader

ExternalReference	Texture	Pointer to a separate .xnb file which contains an object of type Texture2D
Vector3	Diffuse color	
Vector3	Emissive color	
Vector3	Specular color	
Single	Specular power	
Single	Alpha	
Boolean	Vertex color enabled	

AlphaTestEffect

Target type: Microsoft.Xna.Framework.Graphics.AlphaTestEffect

Type reader name: Microsoft.Xna.Framework.Content.AlphaTestEffectReader

ExternalReference	Texture	Pointer to a separate .xnb file which contains an object of type Texture2D
Int32	Compare function	0 = Always 1 = Never 2 = Less 3 = LessEqual 4 = Equal 5 = GreaterEqual 6 = Greater 7 = NotEqual
UInt32	Reference alpha	
Vector3	Diffuse color	
Single	Alpha	
Boolean	Vertex color enabled	

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DualTextureEffect

Target type: Microsoft.Xna.Framework.Graphics.DualTextureEffect

Type reader name: Microsoft.Xna.Framework.Content.DualTextureEffectReader

ExternalReference	Texture 1	Pointer to a separate .xnb file which contains an object of type Texture2D
ExternalReference	Texture 2	Pointer to a separate .xnb file which contains an object of type Texture2D
Vector3	Diffuse color	
Single	Alpha	
Boolean	Vertex color enabled	

EnvironmentMapEffect

Target type: Microsoft.Xna.Framework.Graphics.EnvironmentMapEffect

Type reader name: Microsoft.Xna.Framework.Content.EnvironmentMapEffectReader

ExternalReference	Texture	Pointer to a separate .xnb file which contains an object of type Texture2D
ExternalReference	Environment map	Pointer to a separate .xnb file which contains an object of type TextureCube
Single	Env map amount	
Vector3	Env map specular	
Single	Fresnel factor	
Vector3	Diffuse color	
Vector3	Emissive color	
Single	Alpha	

SkinnedEffect

Target type: Microsoft.Xna.Framework.Graphics.SkinnedEffect

Type reader name: Microsoft.Xna.Framework.Content.SkinnedEffectReader

ExternalReference	Texture	Pointer to a separate .xnb file which contains an object of type Texture2D
UInt32	Weights per vertex	1, 2, or 4
Vector3	Diffuse color	
Vector3	Emissive color	
Vector3	Specular color	

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Single	Specular power	
Single	Alpha	

SpriteFont

Target type: Microsoft.Xna.Framework.Graphics.SpriteFont

Type reader name: Microsoft.Xna.Framework.Content.SpriteFontReader

Object: Texture2D	Texture	Texture containing multiple packed glyph images
Object: List<Rectangle>	Glyphs	Location of each glyph image within the texture
Object: List<Rectangle>	Cropping	Blank border space that was cropped from glyph images prior to packing (to save space), but which should still be respected when laying out text for rendering
Object: List<Char>	Character map	Unicode character code points corresponding to each rectangle in the glyph and cropping list (guaranteed sorted into ascending order)
Int32	Vertical line spacing	
Single	Horizontal spacing	
Object: List<Vector3>	Kerning	ABC character layout data for each glyph
Nullable<Char>	Default character	

Model

Target type: Microsoft.Xna.Framework.Graphics.Model

Type reader name: Microsoft.Xna.Framework.Content.ModelReader

UInt32	Bone count
Repeat <bone count> {	
Object: String	Bone name
Matrix	Bone transform
}	
Repeat <bone count> {	
<i>BoneReference</i> (see below)	Parent bone
UInt32	Child bone count
Repeat <child bone count> {	

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<i>BoneReference</i>	Child bone
}	
}	
UInt32	Mesh count
Repeat <mesh count> {	
Object: String	Mesh name
<i>BoneReference</i>	Mesh parent bone
BoundingSphere	Mesh bounds
Object	Mesh tag
UInt32	Mesh part count
Repeat <mesh part count> {	
UInt32	Vertex offset
UInt32	Num vertices
UInt32	Start index
UInt32	Primitive count
Object	Mesh part tag
Shared resource: VertexBuffer	Vertex buffer
Shared resource: IndexBuffer	Index buffer
Shared resource: Effect	Effect
}	
}	
<i>BoneReference</i>	Model root bone
Object	Model tag

The *BoneReference* type varies in size depending on the number of bones in the model. If bone count is less than 255 this value is serialized as a Byte, otherwise it is UInt32. If the reference value is zero the bone is null, otherwise (bone reference - 1) is an index into the model bone list.

Media Types

SoundEffect

Target type: Microsoft.Xna.Framework.Audio.SoundEffect

Type reader name: Microsoft.Xna.Framework.Content.SoundEffectReader

UInt32	Format size	
--------	-------------	--

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Byte [format size]	Format	WAVEFORMATEX structure
UInt32	Data size	
Byte [data size]	Data	Audio waveform data
Int32	Loop start	In bytes (start must be format block aligned)
Int32	Loop length	In bytes (length must be format block aligned)
Int32	Duration	In milliseconds

Song

Target type: Microsoft.Xna.Framework.Media.Song

Type reader name: Microsoft.Xna.Framework.Content.SongReader

String	Streaming filename	Relative path to a .wma file
Object: Int32	Duration	In milliseconds

Video

Target type: Microsoft.Xna.Framework.Media.Video

Type reader name: Microsoft.Xna.Framework.Content.VideoReader

Object: String	Streaming filename	Relative path to a .wmv file
Object: Int32	Duration	In milliseconds
Object: Int32	Width	
Object: Int32	Height	
Object: Single	Frames per second	
Object: Int32	Soundtrack type	0 = Music 1 = Dialog 2 = Music and dialog

ReflectiveReader

Target type: T

Type reader name: Microsoft.Xna.Framework.Content.ReflectiveReader`1[[T]]

This reader is selected as a default fallback for types that do not provide their own custom `ContentTypeWriter` and `ContentTypeReader` implementations. It uses .NET reflection to examine the type T, and recursively calls into other type readers to load its fields and properties.

The deserialization process is:

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- If T has a base class other than System.Object or System.ValueType, first call the type reader for that base class
- Load all valid properties
- Load all valid fields

Fields and properties are valid for automatic serialization if:

- They are declared directly by the type T (not inherited from a base class)
- They are instance members (not static)
- They are not decorated with ContentSerializerIgnoreAttribute
- They are either public, or decorated with ContentSerializerAttribute
- They are gettable
- They are either settable, or the type reader for the type of that member specifies CanDeserializeIntoExistingObject = true
- They are either not marked as shared resources, or the declaring type T is not a value type
- They are not indexer properties

To deserialize a field or property:

- Load as a shared resource if the member is decorated with ContentSerializerAttribute.SharedResource = true
- Otherwise, If the member is a value type, load as a raw value
- Otherwise, load as a polymorphic object

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