
**Information technology — Common
Language Infrastructure (CLI) —
Technical Report: Common Generics**

*Technologies de l'information — Infrastructure commune de
langage (ICL) — Rapport technique: Génériques communs*

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[ISO/IEC TR 25438:2006](https://standards.iteh.ai/catalog/standards/sist/6178e448-a1d8-43c1-baaf-275234026dfâ/iso-iec-tr-25438-2006)

[https://standards.iteh.ai/catalog/standards/sist/6178e448-a1d8-43c1-baaf-
275234026dfâ/iso-iec-tr-25438-2006](https://standards.iteh.ai/catalog/standards/sist/6178e448-a1d8-43c1-baaf-275234026dfâ/iso-iec-tr-25438-2006)

PDF disclaimer

This PDF file may contain embedded typefaces. In accordance with Adobe's licensing policy, this file may be printed or viewed but shall not be edited unless the typefaces which are embedded are licensed to and installed on the computer performing the editing. In downloading this file, parties accept therein the responsibility of not infringing Adobe's licensing policy. The ISO Central Secretariat accepts no liability in this area.

Adobe is a trademark of Adobe Systems Incorporated.

Details of the software products used to create this PDF file can be found in the General Info relative to the file; the PDF-creation parameters were optimized for printing. Every care has been taken to ensure that the file is suitable for use by ISO member bodies. In the unlikely event that a problem relating to it is found, please inform the Central Secretariat at the address given below.

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[ISO/IEC TR 25438:2006](https://standards.iteh.ai/catalog/standards/sist/6178e448-a1d8-43c1-baaf-275234026dfa/iso-iec-tr-25438-2006)

<https://standards.iteh.ai/catalog/standards/sist/6178e448-a1d8-43c1-baaf-275234026dfa/iso-iec-tr-25438-2006>

© ISO/IEC 2006

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

Contents

Page

Foreword.....	v
Introduction	vi
1 Scope	1
2 Rationale	1
2.1 Reference vs. value tuples	1
2.2 Interaction with other standard types	2
3 Overview	2
3.1 Tuple types	2
3.2 Function and procedure types	2
3.3 Unit	2
3.4 Optional	3
3.5 Either	3
4 Action delegates	3
4.1 System.Action delegate	3
4.2 System.Action<A, B> delegate	4
4.3 System.Action<A, B, C> delegate	5
4.4 System.Action<A, B, C, D> delegate	6
4.5 System.Action<A, B, C, D, E> delegate	8
5 System.DelegateCast class	9
5.1 DelegateCast.ToFunction<T, Boolean>(System.Predicate<T>) method	10
5.2 DelegateCast.ToPredicate<T>(System.Function<T, System.Boolean>) method	10
5.3 DelegateCast.ToFunction<T, U>(System.Converter<T, U>) method	11
5.4 DelegateCast.ToConverter<T, U>(System.Function<T, U>) method	12
5.5 DelegateCast.ToFunction<T, T, System.Int32>(System.Comparison<T>) method	12
5.6 DelegateCast.ToComparison<T>(System.Function<T, T, System.Int32>) method	13
6 System.Either<A, B> Structure	13
6.1 Either<A, B>.Equals(System.Object) method	15
6.2 Either<A, B>.Equals(Either<A, B>) method	16
6.3 Either<A, B>.First property	17
6.4 Either<A, B>.GetHashCode() method	17
6.5 Either<A, B>.IsFirst property	18
6.6 Either<A, B>.IsSecond property	19
6.7 Either<A, B>.op_Equality(Either<A, B>, Either<A, B>) method	19
6.8 Either<A, B>.op_Inequality(Either<A, B>, Either<A, B>) method	20
6.9 Either<A, B>.Second property	21
6.10 Either<A, B>.MakeFirst(A aValue) method	22
6.11 Either<A, B>.MakeSecond(B bValue) method	22
6.12 Either<A, B>.ToString() method	23
6.13 Either<A, B>(A) constructor	23
6.14 Either<A, B>(B) constructor	24
6.15 A Either<A, B>.op_Explicit(System.Either<A, B>) method	25
6.16 B Either<A, B>.op_Explicit(System.Either<A, B>) method	26
6.17 Either<A, B>.op_Implicit(A) method	27
6.18 Either<A, B>.op_Implicit(B) method	28
7 Function Delegates	29
7.1 System.Function<A > delegate	29
7.2 System.Function<A, B> delegate	30
7.3 System.Function<A, B, C> delegate	31

7.4	System.Function<A, B, C, D> delegate	32
7.5	System.Function<A, B, C, D, E> delegate	33
7.6	System.Function<A, B, C, D, E, F> delegate	35
8	System.Optional<T> structure	36
8.1	Optional<T>(T) constructor	38
8.2	Optional<T>.CompareTo(System.Object) method	38
8.3	Optional<T>.CompareTo(Optional<T>) method	40
8.4	Optional<T>.Equals(System.Object) method	41
8.5	Optional<T>.Equals(Optional<T>) method	42
8.6	Optional<T>.FromNullable<U>(Nullable<U>) method	43
8.7	Optional<T>.FromOptional(System.Optional<T>) method	44
8.8	Optional<T>.GetHashCode() method	45
8.9	Optional<T>.GetValueOrDefault() method	45
8.10	Optional<T>.GetValueOrDefault(T) method	46
8.11	Optional<T>.HasValue property	46
8.12	Optional<T>.op_Equality(Optional<T>, Optional<T>) method	47
8.13	Optional<T>.op_Explicit(System.Optional<T>) method	48
8.14	Optional<T>.op_Implicit(T) method	49
8.15	Optional<T>.op_Inequality(Optional<T>, Optional<T>) method	50
8.16	Optional<T>.ToNullable<U>(Optional<U>) method	51
8.17	Optional<T>.ToOptional(T) method	51
8.18	Optional<T>.ToString() method	52
8.19	Optional<T>.Value property	53
8.20	Optional<T>.INullableValue.Value property	53
9	Tuple structures System.Tuple<A, B> ... System.Tuple<A, B, ..., I, J>	54
9.1	Tuple<A, ...>() constructors	56
9.2	Tuple<A, ...>.Equals(System.Object) method	56
9.3	Tuple<A, ...>.Equals(Tuple<A, ...>) method	57
9.4	Tuple<A, ...>.ItemA, Tuple<A, B, ...>.ItemB, ... Tuple<A, B, ..., I, J>.ItemJ field	58
9.5	Tuple<A, ...>.GetHashCode() method	58
9.6	Tuple<A, ...>.op_Equality(Tuple<A, ...>, Tuple<A, ...>) method	59
9.7	Tuple<A, B>.op_Implicit(KeyValuePair<A, B>) method	60
9.8	Tuple<A, B>.op_Implicit(Tuple<A, B>) method	60
9.9	Tuple<A, ...>.op_Inequality(Tuple<A, ...>, Tuple<A, ...>) method	61
9.10	Tuple<A, ...>.ToString() method	62
10	System.Unit enum	62
10.1	Unit.Unit field	63

IT IS STANDARD PREVIEW
 (standards.itech.ai)
 ISO/IEC TR 25438:2006
<http://www.iso.org/standards/stds/si/6178/418/ald8-43cl-baaf-254382006.html>
 25438:2006 System.Tr 25438-2006

Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work. In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of the joint technical committee is to prepare International Standards. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

In exceptional circumstances, the joint technical committee may propose the publication of a Technical Report of one of the following types:

- type 1, when the required support cannot be obtained for the publication of an International Standard, despite repeated efforts;
- type 2, when the subject is still under technical development or where for any other reason there is the future but not immediate possibility of an agreement on an International Standard;
- type 3, when the joint technical committee has collected data of a different kind from that which is normally published as an International Standard ("state of the art", for example).

Technical Reports of types 1 and 2 are subject to review within three years of publication, to decide whether they can be transformed into International Standards. Technical Reports of type 3 do not necessarily have to be reviewed until the data they provide are considered to be no longer valid or useful.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights.

ISO/IEC TR 25438 was prepared by Ecma International (as Ecma TR/89) and was adopted, under a special "fast-track procedure", by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, in parallel with its approval by national bodies of ISO and IEC.

Introduction

This Technical Report defines a collection of types that are intended to enhance the common language nature of the CLI, by facilitating language inter-operation. The collection includes generic tuples, functions, actions, optional value representation, a type that can contain a value of one of two different types, and a utility filler type.

These types are experimental and will be considered for inclusion in a future version of the CLI International Standard. A reference implementation, written in C#, is included (see the accompanying file `CommonGenericsLibrary.cs`). This implementation source is also available from <http://kahu.zoot.net.nz/ecma>. A binary version is also available from that site, along with any updates to the proposal.

Feedback on these types is encouraged. (Please send comments to ecmacli@zoot.net.nz.)

iTeh STANDARD PREVIEW (standards.iteh.ai)

[ISO/IEC TR 25438:2006](#)

<https://standards.iteh.ai/catalog/standards/sist/6178e448-a1d8-43c1-baaf-275234026dfa/iso-iec-tr-25438-2006>

Information technology — Common Language Infrastructure (CLI) — Technical Report: Common Generics

1 Scope

The CLI standard libraries (ISO/IEC 23271) provide a collection of common types that can be used by multiple languages. With the addition of generics to the CLI, the standard libraries have been extended to include a number of common generic types, in particular, collections. However, at present, these libraries do not include many simple generic types found in a number of different languages. Any language which uses these common types must implement them rather than deferring to the CLI library, thereby reducing language interoperability. This Technical Report addresses this issue by providing a number of these common types.

Generic tuples (product types) are standard in a number of languages: C++ (`template Pair`), Ada, Haskell, and Standard ML (SML). However, languages differ in the number of pre-defined tuple sizes supported by their standard libraries; e.g. C++ provides just one (`Pair`) while Haskell provides eight (sizes 2 to 9) and SML allows any size of tuple. This Technical Report provides nine (sizes 2 to 10).

Generic programming encourages “higher order” programming where generic functions (methods) take function (delegate) type arguments that have generic types. Examples include Ada’s `with` and generic constraints, and function arguments in Haskell and SML. In the CLI, function values are provided in the form of delegates, so this proposal defines standard generic delegate types for functions (which return a value) and procedures (which do not).

ISO/IEC TR 25438:2006

Another two types that occur in a number of languages are an *optional* type, which either contains a value of some other type or an indication that such a value is not present, and an *either* type, which holds a value of one of two possible types and an indication of which one is present. This proposal provides both of these.

Note The optional type is similar to, but different from, the type `System.Nullable`.

Finally, in existing generic languages, a need has been found for a *filler* type to be used when a particular generic parameter is not required for a particular use of the generic type. A standard one-value type is often provided for this purpose, often called `Unit` or `Void`. This Technical Report includes such a type.

2 Rationale

2.1 Reference vs. value tuples

In some languages (such as C++ and Ada) tuple types can be value or reference types, while in others (such as Haskell and SML) they are always reference types. This implementation provides only value type tuples (which can contain value or reference types). Boxed versions of these types can be used when reference versions are required. Named boxed types would, of course, help greatly here, but these are not currently provided by the CLI Standard.

A simple generic type, such as `Boxed<T>`, can be written to address this issue. Such a type has been made available in the reference implementation of this proposal. However it is not being considered for standardization at this time.

2.2 Interaction with other standard types

The CLI Standard contains six types related to those in this proposal. These are:

`System.Action<T>`: This type is just the first member of this collection's set of action types. As it is already standardized it is not included here.

`System.Comparison<T>`: This type is equivalent to this collection's `Function<T, T, Int32>`. Conversion methods are provided.

`System.Converter<T,U>`: This type is equivalent to this collection's `Function<T, U>`. Conversion methods are provided.

`System.Nullable<T>`: This type is a restricted version of this collection's `Optional<T>`. The difference is that `Nullable<T>` is restricted to non-nullable value types, whereas `Optional<T>` can also wrap reference types and nullable value types. Both these choices are useful in different applications, so there is no clash between these two types. This proposal includes operators on the `Optional<T>` type to convert to/from `Nullable<T>` values.

`System.Predicate<T>`: This type is equivalent to this collection's `Function<T, Boolean>`. However as the CLI does not support type synonyms, these two types are (unfortunately) not equivalent. A separate static class provides methods to convert between these two types. The methods are in a separate class as additional methods cannot be declared on delegate types.

`System.Collections.Generic.KeyValuePair<K,V>`: This is just a differently named equivalent of this collection's `Tuple<K,V>`. Conversion operators are provided on `Tuple<K,V>` to convert to/from `KeyValuePair<K,V>`.

PRE-STANDARD PREVIEW
(standards.iteh.ai)

3 Overview

[ISO/IEC TR 25438:2006](#)

3.1 Tuple types

<https://standards.iteh.ai/catalog/standards/sist/6178e448-a1d8-43c1-baaf-275234026dfa/iso-iec-tr-25438-2006>

Tuples are provided as value types with public fields, which mirrors their typical usage in current languages. Overloading on arity is leveraged to provide eight standard tuple types.

The fields are named `ItemA`, `ItemB`, ..., `ItemI`. A single n-ary constructor is provided to easily define all fields.

An `Equals()` method is provided and defined as the component fields being equal according to their `Equals()` methods.

The corresponding `GetHashCode()` method and `op_Equality` and `op_Inequality` methods are provided.

`ToString()` is overridden to provide the typical tuple parenthesized notation.

For tuples of size 2, methods are provided to convert to/from values of type `System.Collections.Generic.KeyValuePair<K, V>`.

3.2 Function and procedure types

Standard delegates are provided for function types (`System.Function<>`) and procedures (`System.Action<>`). Delegates are defined for 0 to 5 argument functions and 0 and 2 to 5 argument procedures. (The single argument procedure is already included in the CLI Standard.)

3.3 Unit

The `Unit` type is a filler type. This is useful, for example, when an existing generic type is used, but one of its type arguments is not required for the particular application.

3.4 Optional

The `Optional<A>` type represents either a value of type A, or the lack of a value. A value of this type is immutable and provides two constructors, one providing a value, the other for providing no value. Properties are provided to test for validity and to obtain the value. An exception is thrown if an attempt to access a non-existent value.

3.5 Either

The `Either<A, B>` type represents either a value of type A, or a value of type B. A value of this type is immutable. Properties are provided to test which type of value is present and to obtain the value. An exception is thrown if an attempt to access the value of one type is made when a value of the other type is present.

4 Action delegates

4.1 System.Action delegate

```
[ILAsm]
.class public auto ansi sealed System.Action
    extends System.Delegate
{
    .method public hidebysig newslot virtual
        instance void Invoke()
}

[C#]
public delegate void Action();
```

iTech STANDARD PREVIEW
(standards.iteh.ai)

ISO/IEC TR 25438:2006
<https://standards.iteh.ai/catalog/standards/sist/6178e448-a1d8-43c1-baaf-275234026dfa/iso-iec-tr-25438-2006>

Assembly Info:

- *Name:*
- *Public Key:*
- *Version:*
- *Attributes:*
 - `CLSCompliantAttribute(true)`

Implements:

- `System.ICloneable`

Summary:

Represents a method that performs an action.

Parameters:

Inherits From: `System.Delegate`

Library: BCL

Description

A generic delegate type for zero-argument, methods which perform an action (return void).

4.2 System.Action<A, B> delegate

```
[ILAsm]
.class public auto ansi sealed System.Action`2<A, B>
    extends System.Delegate
{
    .method public hidebysig newslot virtual
        instance void Invoke(!0 argA,
                             !1 argB)
}

[C#]
public delegate void Action<A, B>
    (A argA,
     B argB
    );
```

ITeH STANDARD PREVIEW
(standards.iteh.ai)

ISO/IEC TR 25438:2006
<https://standards.iteh.ai/catalog/standards/sist/6178e448-a1d8-43c1-baaf-275234026dfa/iso-iec-tr-25438-2006>

Assembly Info:

- *Name:*
- *Public Key:*
- *Version:*
- *Attributes:*
 - `CLSCompliantAttribute(true)`

Implements:

- `System.ICloneable`

Summary:

Represents a method that performs an action using the supplied arguments.

Parameters:

Parameter	Description
<i>argA</i>	The first argument to the action.
<i>argB</i>	The second argument to the action.

Inherits From: `System.Delegate`

Library: BCL

Description

A generic delegate type for two-argument methods, which perform an action (return void).

4.3 System.Action<A, B, C> delegate

iTech STANDARD PREVIEW
(standards.itech.ai)

```

[ILAsm]
.class public auto ansi sealed System.Action`3<A, B, C>
  extends System.Delegate
{
  .method public hidebysig newslot virtual
    instance void Invoke(!0 argA,
                        !1 argB,
                        !2 argC)
}

[C#]
public delegate void Action<A, B, C>
    (A argA,
     B argB,
     C argC
    );

```

Assembly Info:

- *Name:*

- *Public Key:*

- *Version:*

- *Attributes:*
 - CLSCompliantAttribute(true)

Implements:

- System.ICloneable

Summary:

Represents a method that performs an action using the supplied arguments.

Parameters:

Parameter	Description
<i>argA</i>	The first argument to the action.
<i>argB</i>	The second argument to the action.
<i>argC</i>	The third argument to the action.

ITC STANDARD PREVIEW
 (standards.iteh.ai)

Inherits From: System.Delegate

Library: BCL

[ISO/IEC TR 25438:2006](https://standards.iteh.ai/catalog/standards/sist/6178e448-a1d8-43c1-baaf-275234026dfa/iso-iec-tr-25438-2006)
<https://standards.iteh.ai/catalog/standards/sist/6178e448-a1d8-43c1-baaf-275234026dfa/iso-iec-tr-25438-2006>

Description

A generic delegate type for three-argument methods, which perform an action (return void).

4.4 System.Action<A, B, C, D> delegate

```

[ILAsm]
.class public auto ansi sealed System.Action`4<A, B, C, D>
    extends System.Delegate
{
    .method public hidebysig newslot virtual
        instance void Invoke(!0 argA,
                            !1 argB,
                            !2 argC,
                            !3 argD)
}

[C#]
public delegate void Action<A, B, C, D>
    (A argA,
     B argB,
     C argC,
     D argD
    );
    
```

Assembly Info:

- *Name:*
- *Public Key:*
- *Version:*
- *Attributes:*
 - CLSCompliantAttribute(true)

Implements:

- `System.ICloneable`

Summary:

iTeh STANDARD PREVIEW
(standards.iteh.ai)

Represents a method that performs an action using the supplied arguments.

Parameters:

[ISO/IEC TR 25438:2006
https://standards.iteh.ai/catalog/standards/sist/6178e448-a1d8-43c1-baaf-275234026dfa/iso-iec-tr-25438-2006](https://standards.iteh.ai/catalog/standards/sist/6178e448-a1d8-43c1-baaf-275234026dfa/iso-iec-tr-25438-2006)

Parameter	Description
<i>argA</i>	The first argument to the action.
<i>argB</i>	The second argument to the action.
<i>argC</i>	The third argument to the action.
<i>argD</i>	The fourth argument to the action.

Inherits From: `System.Delegate`

Library: BCL

Description

A generic delegate type for four-argument methods, which perform an action (return void).

4.5 System.Action<A, B, C, D, E> delegate

```

[ILAsm]
.class public auto ansi sealed System.Action`5<A, B, C, D, E>
    extends System.Delegate
{
    .method public hidebysig newslot virtual
        instance void Invoke(!0 argA,
                               !1 argB,
                               !2 argC,
                               !3 argD,
                               !4 argE)
}

[C#]
public delegate void Action<A, B, C, D, E>
    (A argA,
     B argB,
     C argC,
     D argD,
     E argE
    );

```

Assembly Info:

iTeh STANDARD PREVIEW (standards.iteh.ai)

- *Name:*

[ISO/IEC TR 25438:2006](https://standards.iteh.ai/catalog/standards/sist/6178e448-a1d8-43c1-baaf-275234026dfa/iso-iec-tr-25438-2006)

<https://standards.iteh.ai/catalog/standards/sist/6178e448-a1d8-43c1-baaf-275234026dfa/iso-iec-tr-25438-2006>

- *Public Key:*

- *Version:*

- *Attributes:*

- CLSCompliantAttribute(true)

Implements:

- System.ICloneable

Summary:

Represents a method that performs an action using the supplied arguments.

Parameters:

Parameter	Description
<i>argA</i>	The first argument to the action.
<i>argB</i>	The second argument to the action.
<i>argC</i>	The third argument to the action.
<i>argD</i>	The fourth argument to the action.
<i>argE</i>	The fifth argument to the action.

Inherits From: `System.Delegate`

Library: BCL

Description

A generic delegate type for five-argument methods, which perform an action (return void).

5 `System.DelegateCast` class

ISO/IEC TR 25438:2006
<http://standards.iteh.ai/>
 http://www.iso.org/iso/iec-tr-25438-2006

```
[ILAsm]
.class public abstract sealed beforefieldinit System.DelegateCast
  extends System.Object

[C#]
public static class DelegateCast
```

Assembly Info:

- *Name:*
- *Public Key:*
- *Version:*
- *Attributes:*
 - `CLSCompliantAttribute(true)`