The eventB package[*]

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Abstract

This class provides a template for typesetting Event-B models. It was developed at the Swiss Federal Institute of Technology Zurich (ETH-Zurich).

Contents

1 Introduction

This package was developed in order to ease the typesetting of Event-B models in LaTeX.

2 Usage

See `sample-eventB.tex` for an example of how to use the package.

2.1 Package Options

The package offers the following options:

- `nobox`: to disable to bounding boxes for the Event-B modelling elements,
- `small`, `compact`, `tiny`: options for font size,
- `colour` (or `color`): to colour several modelling elements.

[*] This document corresponds to eventB v1.1.1, dated 2012/02/21.

3 Implementation

3.1 Package Loading

We begin by loading the required package xspace, xcolor, and etoolbox.

```
\RequirePackage{xspace}
\RequirePackage{xcolor}
\RequirePackage{etoolbox}
```

3.2 Helper Macros

We define same basic helper macros that will be used to defined other macros.

\B@keywordbase Basic macro for Event-B keywords.

```
\newcommand{\B@keywordbase}[1]{\mathbf{#1}}
```

\B@identifierbase Basic macro for Event-B identifiers.

```
\newcommand{\B@identifierbase}[1]{\mathit{#1}}
```

\B@declarationbase Basic macro for Event-B declarations (e.g., variables, constants, etc.).

```
\newcommand{\B@declarationbase}[2]{
  \begin{array}{l@{\B@tab}l}
    \B@keyword{#1:} &  #2
  \end{array}
}
```

\B@sectionbase Basic macro for Event-B sections (e.g., invariants, axioms, etc.).

```
\newcommand{\B@sectionbase}[3][]{
  \ifstrequal{#1}{}{
    \begin{array}{l}
      \B@keyword{#2:} \\
      \begin{array}{l@{\B@tab}l}
        #3
      \end{array}
    \end{array}
  }{
    \begin{array}{l@{\B@tab}l}
      #3
    \end{array}
  }
}
```

\B@ifstrequal A wrapper for ake sure that the first argument is properly expanded.

```
\newcommand{\B@ifstrequal}{\expandafter\ifstrequal\expandafter}
```

\B@eventbase Basic macro for pretty-print Event-B events.

```
\newcommand{\B@eventbase}[7][]{%
  { % BEGIN group
```

We first save the arguments to local variables.

```
    \newcommand\evt@sts{#1}% Event status
    \newcommand\evt@label{#2}% Event label
    \newcommand\evt@absevts{#3}% Abstract event
```

```
  \newcommand\evt@pars{#4}% Event parameters
  \newcommand\evt@grds{#5}% Event guards
  \newcommand\evt@wits{#6}% Event witnesses
  \newcommand\evt@acts{#7}% Event actions
```

The convergence status is skipped if empty.

```
  \B@ifstrequal{\evt@sts}{}{
    \newcommand\pretty@sts{}
  }{
    \newcommand\pretty@sts{\B@tab\Bstatus \B@tab \evt@sts \\}
  }
```

The refines clause is skipped if there are no abstract events.

```
  \B@ifstrequal{\evt@absevts}{}{
    \newcommand\pretty@absevts{}
  }{
    \newcommand\pretty@absevts{\B@tab\Brefines \B@tab \evt@absevts{} \\}
  }
```

The parameters is skipped if there are none.

```
  \B@ifstrequal{\evt@pars}{}{
    \newcommand\pretty@pars{}
  }{
    \newcommand\pretty@pars{\B@tab\Bany \B@tab \evt@pars \B@tab \Bwhere \\}
  }
```

The keywords for guards also depends on if there are parameters or not.

```
  \B@ifstrequal{\evt@grds}{}{
    \newcommand\pretty@grds{}
  }{
    \newcommand\pretty@grds@tmp{
      \begin{array}{@{\B@tab\B@tab}l@{\B@tab}l}
        \evt@grds
      \end{array}\\
    }
    \B@ifstrequal{\evt@pars}{}{
      \newcommand\pretty@grds{
        \B@tab \Bwhen \\
        \pretty@grds@tmp
      }
    }{
      \newcommand\pretty@grds{\pretty@grds@tmp}
    }
  }
```

The witnesses are skipped if there are none.

```
  \B@ifstrequal{\evt@wits}{}{
    \newcommand\pretty@wits{}
  }{
    \newcommand\pretty@wits{
      \B@tab\Bwith\\
      \begin{array}{@{\B@tab\B@tab}ll}
        \evt@wits
      \end{array}\\
    }
  }
```

When there are no actions, SKIP is used. The keyword is changed depending on whether the event has parameters or not.

```
    \B@ifstrequal{\evt@acts}{}{
      \renewcommand\evt@acts{\SKIP}
    }{}
    \newcommand\pretty@acts@tmp{
      \begin{array}{@{\B@tab\B@tab}l@{\B@tab}l}
        \evt@acts
      \end{array}\\
    }
    \newcommand\pretty@acts@keyword{\B@tab\Bthen \\}
    \B@ifstrequal{\evt@pars}{}{
      \B@ifstrequal{\evt@grds}{}{
        \renewcommand\pretty@acts@keyword{\B@tab\Bbegin \\}
      }{}
    }{}
    \newcommand\pretty@acts{
      \pretty@acts@keyword
      \pretty@acts@tmp
    }
```

Finally we put all the pretty-print pieces together.

```
    \begin{array}{l}
      \Bevt{\evt@label} \\
      \pretty@sts
      \pretty@absevts
      \pretty@pars
      \pretty@grds
      \pretty@wits
      \pretty@acts
      \B@tab\Bend
    \end{array}
  } % END group
}
```

\B@inlineeventbase

Basic macro for pretty-print Event-B events inline.

```
\newcommand{\B@inlineeventbase}[7][]{
  { % BEGIN group
```

We first save the arguments to local variables.

```
    \newcommand\evt@sts{#1}% Event status
    \newcommand\evt@label{#2}% Event label
    \newcommand\evt@absevts{#3}% Abstract event
    \newcommand\evt@pars{#4}% Event parameters
    \newcommand\evt@grds{#5}% Event guards
    \newcommand\evt@wits{#6}% Event witnesses
    \newcommand\evt@acts{#7}% Event actions
```

The convergence status is skipped if empty.

```
    \B@ifstrequal{\evt@sts}{}{
      \newcommand\pretty@sts{}
    }{
      \newcommand\pretty@sts{(\evt@sts)}
    }
```

The refines clause is skipped if there are no abstract events.

```
    \B@ifstrequal{\evt@absevts}{}{
      \newcommand\pretty@absevts{}
    }{
      \newcommand\pretty@absevts{~\Brefines~\evt@absevts}
    }
```

The parameters is skipped if there are none.

```
    \B@ifstrequal{\evt@pars}{}{
      \newcommand\pretty@pars{}
    }{
      \newcommand\pretty@pars{\Bany~\evt@pars~\Bwhere~}
    }
```

The keywords for guards also depends on if there are parameters or not.

```
    \B@ifstrequal{\evt@grds}{}{
      \newcommand\pretty@grds{}
    }{
      \newcommand\pretty@grds@tmp{
        \evt@grds~
      }
      \B@ifstrequal{\evt@pars}{}{
        \Bwhen~\pretty@grds@tmp
      }{
        \newcommand\pretty@grds{\pretty@grds@tmp}
      }
    }
```

The witnesses are skipped if there are none.

```
    \B@ifstrequal{\evt@wits}{}{
      \newcommand\pretty@wits{}
    }{
      \newcommand\pretty@wits{
        \Bwith~
        \evt@wits~
      }
    }
```

When there are no actions, SKIP is used. The keyword is changed depending on whether the event has parameters or not.

```
    \B@ifstrequal{\evt@acts}{}{
      \renewcommand\evt@acts{\SKIP}
    }{}
    \newcommand\pretty@acts@tmp{
      \evt@acts
    }
    \newcommand\pretty@acts@keyword{\Bthen}
    \B@ifstrequal{\evt@pars}{}{
      \B@ifstrequal{\evt@grds}{}{
        \renewcommand\pretty@acts@keyword{\Bbegin}
      }{}
    }{}
    \newcommand\pretty@acts{
      \pretty@acts@keyword~
      \pretty@acts@tmp~
    }
```

Finally we put all the pretty-print pieces together.

```
    \begin{array}{l}
      \Bevt{\evt@label}\pretty@sts\pretty@absevts~\widehat{=}~
      \pretty@pars
      \pretty@grds
      \pretty@wits
      \pretty@acts
      \Bend
    \end{array}
  } % END group
}
```

`\B@makebox` A wrapper macro to make a `fbox` with the boundary adjusted.

```
\newlength{\B@tmplength}
\newcommand{\B@makebox}[1]{
  {
    \setlength{\B@tmplength}{\fboxsep}
    \setlength{\fboxsep}{2ex}
    \fbox{#1}
    \setlength{\fboxsep}{\B@tmplength}
  }
}
```

3.3 Declaration of Options for the Package

In this part various options for the package are defined.

Option for bounding boxes By default, Event-B modelling elements, e.g., invariants, events, etc., are displayed in a bounding box. This `nobox` option enables them to be displayed without the bounding box.

`\B@event` Default definition displays Event-B events in a box.

```
\newcommand{\B@event}[7][]{
  \B@makebox{
    \ensuremath{
      \B@eventbase[#1]{#2}{#3}{#4}{#5}{#6}{#7}
    }
  }
}
```

`\B@declaration` Default definition displays Event-B declarations in a box.

```
\newcommand{\B@declaration}[2]{
  \B@makebox{
    \ensuremath{
      \B@declarationbase{#1}{#2}
    }
  }
}
```

`\B@section` Default definition displays Event-B sections in a box

```
\newcommand{\B@section}[3][]{
  \B@makebox{
    \ensuremath{
      \B@sectionbase[#1]{#2}{#3}
    }
  }
}
```

The above commands are redefined accordingly when option `nobox` is enabled.

```
\DeclareOption{nobox}{
```

`\B@event` Redefine the definition without the bounding box.

```
  \renewcommand{\B@event}[7][]{
    \B@eventbase[#1]{#2}{#3}{#4}{#5}{#6}{#7}
  }
```

`\B@declaration` Redefine the definition without the bounding box.

```
  \renewcommand{\B@declaration}[2]{
    \B@declarationbase{#1}{#2}
  }
```

`\B@section` Redefine the definition without the bounding box.

```
  \renewcommand{\B@section}[3][]{
    \B@sectionbase[#1]{#2}{#3}
  }
}
```

Options for font size and spacing We define the default values for font size and some spacing commands, and how the are redefined according to options `small`, `compact`, and `tiny`. In particular, option `compact` and `tiny` implies option `nobox`.

```
\newcommand{\B@fontsize}{\normalsize} % The font size used in Bcode environment
\newcommand{\Bvspace}[1][2ex]{\\[#1]} % Vertical space
\newcommand{\Bhspace}[1][2em]{\hspace{#1}} % Horizontal space
\newcommand{\B@tab}{\quad} % A small separation space

\DeclareOption{small}{
  \renewcommand{\B@fontsize}{\small}
  \renewcommand{\Bvspace}[1][1ex]{\\[#1]}
  \renewcommand{\Bhspace}[1][1em]{\hspace{#1}}
  \renewcommand{\B@tab}{\ }
}
\DeclareOption{compact}{
  \renewcommand{\B@fontsize}{\footnotesize}
  \renewcommand{\Bvspace}[1][0ex]{\\[#1]}
  \renewcommand{\Bhspace}[1][0.5em]{\hspace{#1}}
  \renewcommand{\B@tab}{\ }
  \ExecuteOptions{nobox}
}
\DeclareOption{tiny}{
  \renewcommand{\B@fontsize}{\scriptsize}
  \renewcommand{\Bvspace}[1][-0.5ex]{\\[#1]}
  \renewcommand{\Bhspace}[1][0.5em]{\hspace{#1}}
  \renewcommand{\B@tab}{\ }
  \ExecuteOptions{nobox}
}

```

Options for colouring Keywords, labels and identifiers in Event-B can be coloured. We define several commands and redefine them accordingly for colouring. When `colour` (or `color`) option is enabled, one can customise the colours for Event-B keywords, labels or identifier or proof obligation labels.

```
⟨*eventB⟩
% Default definition for Event-B keywords
⟨/eventB⟩
\newcommand{\B@keyword}[1]{\ensuremath{\B@keywordbase{#1}}\xspace}
\newcommand{\Bidentifier}[1]{\ensuremath{\B@identifierbase{#1}}\xspace}
% Default definition for Event-B identifiers

\newcommand{\Blabel}[2][]{\ensuremath{\B@label[#1]{#2}}\xspace}
\newcommand{\Bpo}[1]{\ensuremath{\B@po{#1}}\xspace}
\DeclareOption{colour}{
  \newcommand{\setBKeywordColour}[1]{\colorlet{B@keywordcolor}{#1}}
  \setBKeywordColour{blue}
  \newcommand{\setBIdentifierColour}[1]{\colorlet{B@identifiercolor}{#1}}
  \setBIdentifierColour{blue!50!red}
  \newcommand{\setBLabelColour}[1]{\colorlet{B@labelcolor}{#1}}
  \setBLabelColour{green!50!black}
  \newcommand{\setBPOColour}[1]{\colorlet{B@pocolor}{#1}}
  \setBPOColour{red}
  \renewcommand{\B@keyword}[1]{
    \ensuremath{\textcolor{B@keywordcolor}{\B@keywordbase{#1}}}\xspace
  }
  \renewcommand{\Bidentifier}[1]{
    \ensuremath{\textcolor{B@identifiercolor}{\B@identifierbase{#1}}}\xspace
  }
  \renewcommand{\Blabel}[2][]{
    \ensuremath{\textcolor{B@labelcolor}{\B@label[#1]{#2}}}\xspace
  }
  \renewcommand{\Bpo}[1]{
    \ensuremath{\textcolor{B@pocolor}{\B@po{#1}}}\xspace
  }
}
\DeclareOption{color}{
  \ExecuteOptions{colour}
}

```

After declaration of options, we execute them accordingly.

```
\ProcessOptions
```

3.4 Commands for Pretty-Print Event-B Models

We start with the definition of the `\eventB` macro.

```
\newcommand{\eventB}{Event-B\xspace}
```

The `Bcode` environment for displaying Event-B models. The environment has an optional argument for specifying the font size. By default, it is the same as the `\B@fontsize` controlled by the package option.

```
\newenvironment{Bcode}[1][\B@fontsize]{\begin{center}#1}{\end{center}}
```

Declarations and Collections Event-B modelling elements are organised into declarations (e.g., variables, constants, etc.) or collections (e.g., invariants, axioms). For each declaration, the input is a comma-separated list of elements. For each collection, the input is a newly(\\)-separated list of elements.

```
\newcommand{\carriersets}[1]{
  \B@declaration{sets}{#1}
}
```

```
\newcommand{\constants}[1]{
  \B@declaration{constants}{#1}
}
```

```
\newcommand{\axioms}[2][]{
  \B@section[#1]{axioms}{#2}
}
```

```
\newcommand{\variables}[1]{
  \B@declaration{variables}{#1}
}
```

```
\newcommand{\invariants}[2][]{
  \B@section[#1]{invariants}{#2}
}
```

```
\newcommand{\variant}[1]{
  \B@declaration{variant}{#1}
}
```

Event-B keywords We define the keywords for pretty-print Event-B models.

```
\newcommand{\Bany}{\B@keyword{any}}
\newcommand{\Bbegin}{\B@keyword{begin}}
\newcommand{\Bend}{\B@keyword{end}}
\newcommand{\Brefines}{\B@keyword{refines}}
\newcommand{\Bstatus}{\B@keyword{status}}
\newcommand{\Bthen}{\B@keyword{then}}
\newcommand{\Bwhen}{\B@keyword{when}}
\newcommand{\Bwhere}{\B@keyword{where}}
\newcommand{\Bwith}{\B@keyword{with}}
```

Event-B modelling elements We define several macros for pretty-print Event-B modelling elements.

```
\newcommand{\Bctx}[1]{\ensuremath{\mathbf{#1}}\xspace}
\newcommand{\Bset}[1]{\Bidentifier{#1}}
\newcommand{\Bcst}[1]{\Bidentifier{#1}}
\newcommand{\Baxm}[1]{\Blabel{#1}}
\newcommand{\Bthm}[1]{\Blabel[thm]{#1}}

\newcommand{\Bmch}[1]{\ensuremath{\mathbf{#1}}\xspace}
\newcommand{\Bvrb}[1]{\Bidentifier{#1}}
\newcommand{\Binv}[1]{\Blabel{#1}}
\newcommand{\Bevt}[1]{\Blabel{#1}}
\newcommand{\Bpar}[1]{\Bidentifier{#1}}
\newcommand{\Bact}[1]{\Blabel{#1}}
\newcommand{\Bgrd}[1]{\Blabel{#1}}
\newcommand{\Bbap}[1]{\hbox{\sl\bfseries #1}}
```

Meta-macros for creating macros for modelling elements We define meta-marcos to create macros for different modelling elements.

```
\newcommand{\B@newmacro}[3][]{
  \ifstrequal{#1}{}{
    \expandafter\def\csname #2\endcsname{#3{#2}}
  }{
    \expandafter\def\csname #1\endcsname{#3{#2}}
  }
}
```

```
\newcommand{\newBctx}[2][]{\B@newmacro[#1]{#2}{\Bctx}}
```

```
\newcommand{\newBset}[2][]{\B@newmacro[#1]{#2}{\Bset}}
```

```
\newcommand{\newBcst}[2][]{\B@newmacro[#1]{#2}{\Bcst}}
```

```
\newcommand{\newBaxm}[2][]{\B@newmacro[#1]{#2}{\Baxm}}
```

```
\newcommand{\newBthm}[2][]{\B@newmacro[#1]{#2}{\Bthm}}
```

```
\newcommand{\newBmch}[2][]{\B@newmacro[#1]{#2}{\Bmch}}
```

```
\newcommand{\newBvrb}[2][]{\B@newmacro[#1]{#2}{\Bvrb}}
```

```
\newcommand{\newBinv}[2][]{\B@newmacro[#1]{#2}{\Binv}}
```

```
\newcommand{\newBevt}[2][]{\B@newmacro[#1]{#2}{\Bevt}}
```

```
\newcommand{\newBpar}[2][]{\B@newmacro[#1]{#2}{\Bpar}}
```

```
\newcommand{\newBgrd}[2][]{\B@newmacro[#1]{#2}{\Bgrd}}
```

```
\newcommand{\newBact}[2][]{\B@newmacro[#1]{#2}{\Bact}}

%%%%% Theorem Proof Obligation
%%%%% Print the theorem proof obligation, given the theorem label.
%%%%% Arguments:
%%%%% 1. Theorem label
%%%%%
%%%%% Usage:
%%%%% - \thmpo{thm} will produce "thm/THM"
\newcommand{\thmpo}[1]{\Bthm{#1}/\Bpo{THM}}

%%%%% Axiom Well-definedness Proof Obligation
%%%%% Print the axiom well-definedness proof obligation, given the
%%%%% axiom label.
%%%%% Arguments:
%%%%% 1. Axiom label
%%%%%
%%%%% Usage:
%%%%% - \axmwdpo{axm} will produce "axm/WD"
\newcommand{\axmwdpo}[1]{\Baxm{#1}/\Bpo{WD}}

%%%%% Invariant Proof Obligation
%%%%% Print the invariant proof obligation, given the event name and
%%%%% invariant label
%%%%% Arguments:
%%%%% 1. Event name
%%%%% 2. Invariant label
```

```
%%%%%
%%%%% Usage:
%%%%% - \invpo{evt}{inv} will produce "evt/inv/INV"
\newcommand{\invpo}[2]{\Bevt{#1}/\Binv{#2}/\Bpo{INV}}

%%%%% Theorem (in guard) Proof Obligation
%%%%% Print the simulation proof obligation, given the event name and
%%%%% the theorem (in guard) label.
%%%%% Arguments:
%%%%% 1. Event name
%%%%% 2. Theorem (in guard) label
%%%%%
%%%%% Usage:
%%%%% - \grdthmpo{evt}{thm} will produce "evt/thm/THM"
\newcommand{\grdthmpo}[2]{\Bevt{#1}/\Bthm{#2}/\Bpo{THM}}

%%%%% Feasibility Proof Obligation
%%%%% Print the feasibility proof obligation, given the event name and
%%%%% the action label
%%%%% Arguments:
%%%%% 1. Event name
%%%%% 2. Action label
%%%%%
%%%%% Usage:
%%%%% - \fispo{evt}{act} will produce "evt/act/FIS"
\newcommand{\fispo}[2]{\Bevt{#1}/\Bact{#2}/\Bpo{FIS}}

%%%%% Variant finiteness Proof Obligation
%%%%% Print the Variant finiteness proof obligation
%%%%% Arguments: No arguments
%%%%%
%%%%% Usage:
%%%%% - \finpo will produce "FIN"
\newcommand{\finpo}{\Bpo{FIN}}

%%%%% Variant Proof Obligation
%%%%% Print the guard strengthen proof obligation, given the event name
%%%%% Arguments:
%%%%% 1. Event name
%%%%%
%%%%% Usage:
%%%%% - \grdpo{evt} will produce "evt/VAR"
\newcommand{\varpo}[1]{\Bevt{#1}/\Bpo{VAR}}

%%%%% Simulation Proof Obligation
%%%%% Print the simulation proof obligation, given the event name and
%%%%% the action label.
%%%%% Arguments:
%%%%% 1. Event name
%%%%% 2. Action label
%%%%%
%%%%% Usage:
```

```
%%%%% - \simpo{evt}{act} will produce "evt/act/SIM"
\newcommand{\simpo}[2]{\Bevt{#1}/\Bact{#2}/\Bpo{SIM}}

%%%%% Guard Strengthen Proof Obligation
%%%%% Print the guard strengthen proof obligation, given the event
%%%%% name and the guard label
%%%%% Arguments:
%%%%% 1. (Abstract) Event name
%%%%% 2. (Abstract) Guard label
%%%%%
%%%%% Usage:
%%%%% - \grdpo{evt}{grd} will produce "evt/grd/GRD"
\newcommand{\grdpo}[2]{\Bevt{#1}/\Bgrd{#2}/\Bpo{GRD}}

%%%%% Variant Natural Number Proof Obligation
%%%%% Print the Variant Natural Number proof obligation, given the event name
%%%%% Arguments:
%%%%% 1. Event name
%%%%%
%%%%% Usage:
%%%%% - \natpo{evt} will produce "evt/NAT"
\newcommand{\natpo}[1]{\Bevt{#1}/\Bpo{NAT}}

```

\inlineevent

```
\newcommand{\inlineevent}[7][]{
  \B@inlineeventbase[#1]{#2}{#3}{#4}{#5}{#6}{#7}
}
\newcommand{\B@label}[2][]{
  \ifstrequal{#1}{}{
    \mathsf{#2}
  }{
    \mathit{#2}
  }
}






\newcommand{\B@po}[1]{\ensuremath{\mathsf{#1}}\xspace}

%%%%% (BEGIN) Macros for Pretty-Print Event-B Components %%%
\newcommand{\SKIP}{\textsc{skip}\xspace}
%
```

\INITIALISATION

```
%%%%% INITIALISATION label
\newBevt{INITIALISATION}

```

```
%%%%% Pretty print the initialisation: no ``refines'' clause. no parameters, no
%%%%% guards
%%%%% Arguments:
%%%%% 1. (Newline(\\)-separated) list of assignments.
%%%%%
%%%%% Usage: \initialisation{S1(v,x,y)\\S2(w,x,y)}
%%%%%       will produce the following
%%%%%
%%%%%       init
%%%%%       begin
%%%%%         S1(v, x, y)
%%%%%         S2(w, x, y)
%%%%%       end
%%%%%
\newcommand{\initialisation}[1]{
  \event{\INITIALISATION}{}{}{}{}{#1}
}

\newcommand{\event}[7][]{
  \B@event[#1]{#2}{#3}{#4}{#5}{#6}{#7}
}

```

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Numbers written in italic refer to the page where the corresponding entry is described; numbers underlined refer to the code line of the definition; numbers in roman refer to the code lines where the entry is used.

Change History

v1.0

General: Initial version 1

v1.0.1

\B@declaration: Ensure math-mode 6

\B@event: Ensure math-mode 6

\B@section: Ensure math-mode . . 6

v1.1

General: Re-implement how options are defined, added options 'nobox' 1

v1.1.1

General: Updated documentation . 1

v2.0

General: Major re-implementation, use **etoolbox** instead of **ifthen** 1

Updated documentation, added **DoNotIndex** 1

\B@makebox: Added 6

\INITIALISATION: Renamed from **init** 12

\inlineevent: Renamed from **eventinline** 12