



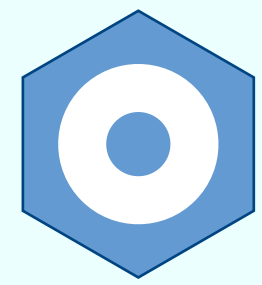


- `send` is a “marker interface”
- Similar to a C++ “type trait”

- Inferred if:
  - A copy can be made (value semantics)
  - A borrow can be shared (**const**  $T^{\wedge}$ )
  - **NOT** mutable borrow ( $T^{\wedge}$ )

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# Sync & Send in Circle

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an owned place is a local variable or subobject of a local variable

g is a non-local variable declared at rel1.cxx:8:6

```
Pair g { 10, 20 };
      ^
```

```
sean@red:~/projects/circle4/talk$ circle match1.cxx
```

```
match: match1.cxx:21:10
```

```
    return match(obj) {
          ^
```

match-expression is not exhaustive

```
.i8, .u8, .i16, .u16, .u32, .i64, .s
```

```
sean@red:~/projects/circle4/talk$ circle thread1.cxx
```

```
error: thread1.cxx:22:32
```

```
    threads^.push_back(thread(&entry_point, ^s, i));
                          ^
```

error during overload resolution for std2::thread::thread

```
instantiation: std2.h:1225:9
```

```
    thread/(where F:static, Args...:static)(F f, Args... args) safe
fe
      ^
```

during constraints checking of template parameter Args

template arguments: [

```
    F = void(&)(std2::basic_string<char, std2::allocator<char>>^/
SCC-0, int) safe
```

```
    Args#0 = std2::basic_string<char, std2::allocator<char>>^/_
```

```
    Args#1 = int
  ]
```

```
constraint: std2.h:1224:26
```

```
    template<std2::send F, std2::send... Args>
```

constraint std2::send not satisfied over std2::basic\_string<char, std2::allocator<char>>^

```
sean@red:~/projects/circle4/talk$
```

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```
match1.cxx x match2.cxx x match3.cxx x std2.h x
```

```
1 #feature on safety
```

```
2 #include "std2.h"
```

```
3
```

```
4 using namespace std2;
```

```
5
```

```
6 // Can we pass mutable borrows into thread entry
```

```
7 void entry_point(string^ s, int tid) safe {
```

```
8     s^->append("More text");
```

```
9     // println(*s);
```

```
10 }
```

```
11
```

```
12 int main() safe {
```

```
13     vector<thread> threads { };
```

```
14
```

```
15     {
```

```
16         // s dies before the threads join, so possible
```

```
17         string s = "Hello threads";
```

```
18
```

```
19         // Launch all threads.
```

```
20         const int num_threads = 15;
```

```
21         for(int i : num_threads)
```

```
22             threads^.push_back(thread(&entry_point, ^s
```

```
23         }
```

```
24
```

```
25         // Join all threads.
```

```
26         for(thread^ t : ^threads)
```

```
27             t^->join();
```

```
28     }
```

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