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# CV-Qualifiers and Reference Types

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## 1 Introduction

```
int a;  
int &volatile x = a;  
int &const y = a;
```

- (1) The paper X3J16/93-0135 = WG21/N0342 (section 7) proposes to ban the `volatile` qualifier on reference types, arguing that it would be difficult to make sense of the resulting semantics. Further discussion in San Jose revealed a similar sentiment for `const`-qualified reference types. I argue that both should be allowed (as per the current WP).

## 2 `volatile`-qualified references

### 2.1 The definition of `volatile`

- (1) My best argument for allowing the `volatile` qualifier on reference types is the following definition, from the WP (3.6.3 CV-qualifiers)

There are two *cv-qualifiers*, `const` and `volatile`. When applied to an object, `const` means the program may not change the object, and `volatile` has an implementation-defined meaning.

- (2) Why should we restrict the contexts in which implementations may choose to provide semantics for `volatile`?

### 2.2 When `volatile`-qualified references might make sense

- (1) Consider the following example:

```
union {  
    void *p;  
    int &volatile r;  
}
```

- (2) The `volatile` qualifier is used here to give this implementation a hint that it shouldn't cache the address of the referenced object. Why not allow an implementation to support this?

### 2.3 Orthogonality

- (1) Shouldn't `const` and `volatile` be either both allowed or both banned?

## 3 const-qualified references

### 3.1 Innocent introduction of const-qualified references

- (1) The following example shows that templates can sometimes cause const-qualified references to be introduced. Disallowing const-qualified references in the language forces the template class to be rewritten just to support the use of reference types.

```
template<class T> class C {
    const T a;
};
typedef int &intr;
C<intr> x;
```

- (2) Notice that "C<intr>::a" is of type "int & const", so this whole program would be ill-formed if const-qualified references were disallowed. Where did the poor user go wrong?
- (3) Nowhere, I claim.

### 3.2 Possible extension

- (1) Why should a user want to const-qualify a reference? After all, the reference can only be initialized once anyway; specifying const is therefore redundant.
- (2) Allowing const-qualified references certainly harms nothing. But it proves meaningful if we (or some implementation) extends the language to support re-binding references:

```
int x, y;
int &r = x;           // bind r to x
r := y;             // rebind r to y
int &const s = x;    // bind s to x
s := y;             // error: can't rebind a const reference
```

- (3) I'm certainly not proposing this extension. But the idea of this extension shows that allowing const-qualified references makes the language more orthogonal, while costing nothing.