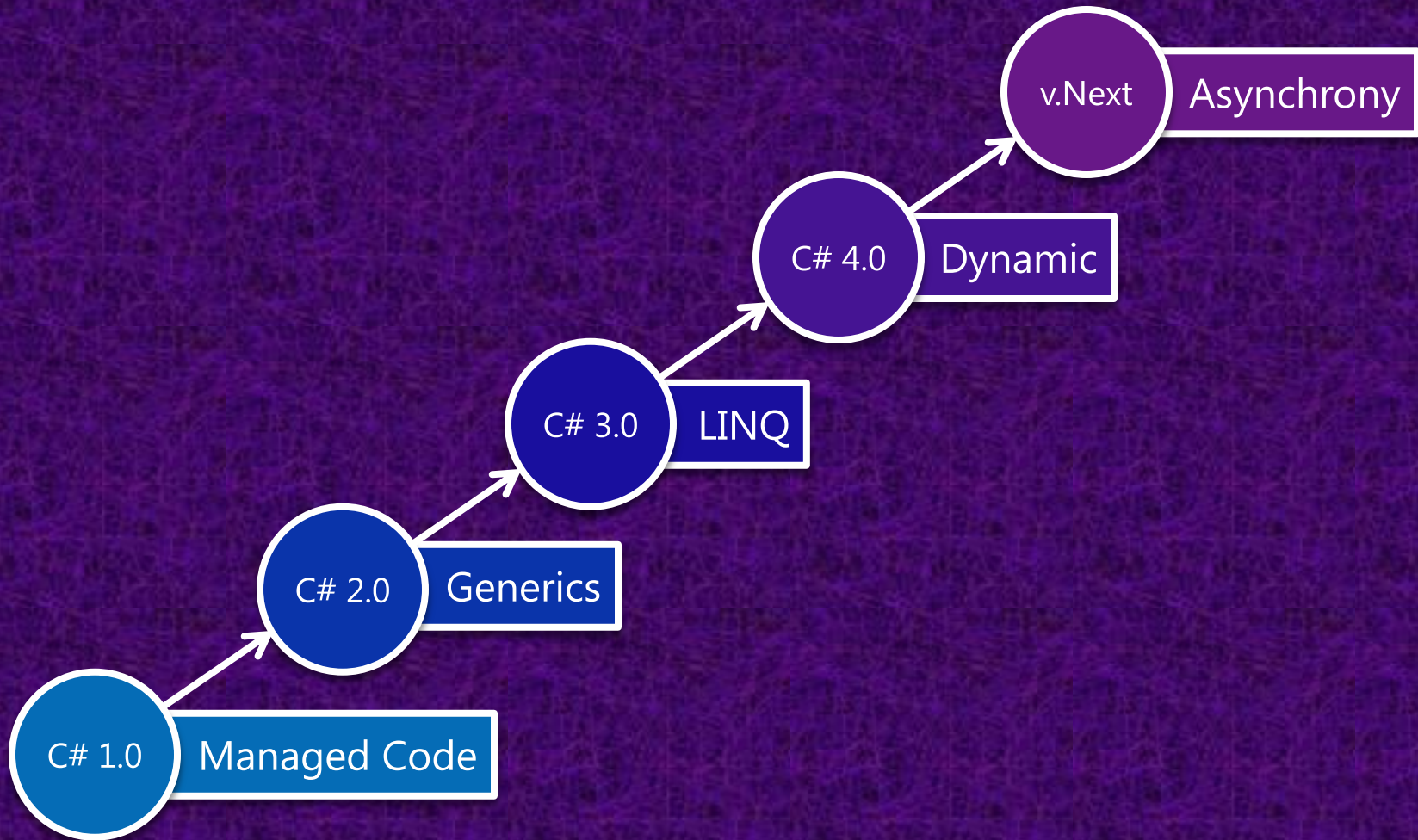


Unified Types and Reified Generics in .NET

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C# Evolution



C# 1.0: Unified Type System

- User defined value types (structs)
 - Can implement interfaces
 - Implicitly convert to object and their interfaces
- Everything can be treated as an object
- Issues:
 - Mutable structs and boxing: copy bugs
 - Performance: Allocation every time

C# 2.0: Reified Generics

- Full runtime type semantics
 - Type checks, object creation, etc
- Efficient at runtime
 - JIT compiler specializes for value types
 - Reference types share JIT'ed code
- Unifies without boxing
 - Generic types and methods apply across value and reference types

Shared Notion of Generics

- What belongs to the language vs the VM?
- Pros:
 - Great interop
 - Common libraries
- Cons:
 - One size fits all
 - Hard to fit some languages on the VM

Transition Pains

- New Collection Classes
- “Upgrading” code hard to do incrementally
- .NET Framework reveals its history

Supporting Language Features

- C# 3.0: Language Integrated Query (LINQ)
 - Func<T>
 - IEnumerable<T>
 - Expression<T>
- C# 4.0: Dynamic binding
 - Callsite<T1,...,Tn>
- C# vnext: Async methods
 - Task<T>

How Much Unification

- Code duplication a smell of lacking unification
- void vs non-void
 - Func<void>, Task<void>, Visitor<void> etc.
- Generic arity
 - Func<T>, Func<S,T>, Func<R, S, T>, ...
 - Tuple<T>, Tuple<S,T>, Tuple<R,S,T>, ...

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