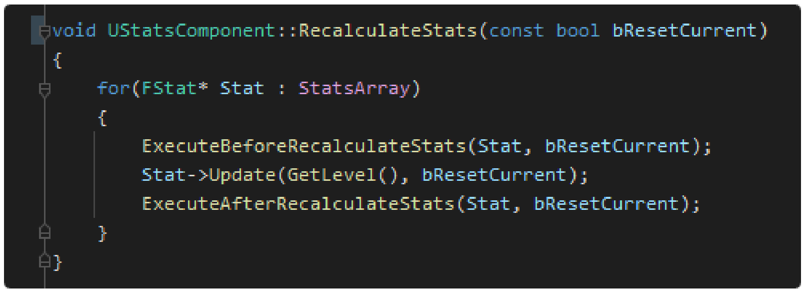
TL; DR

TODO:

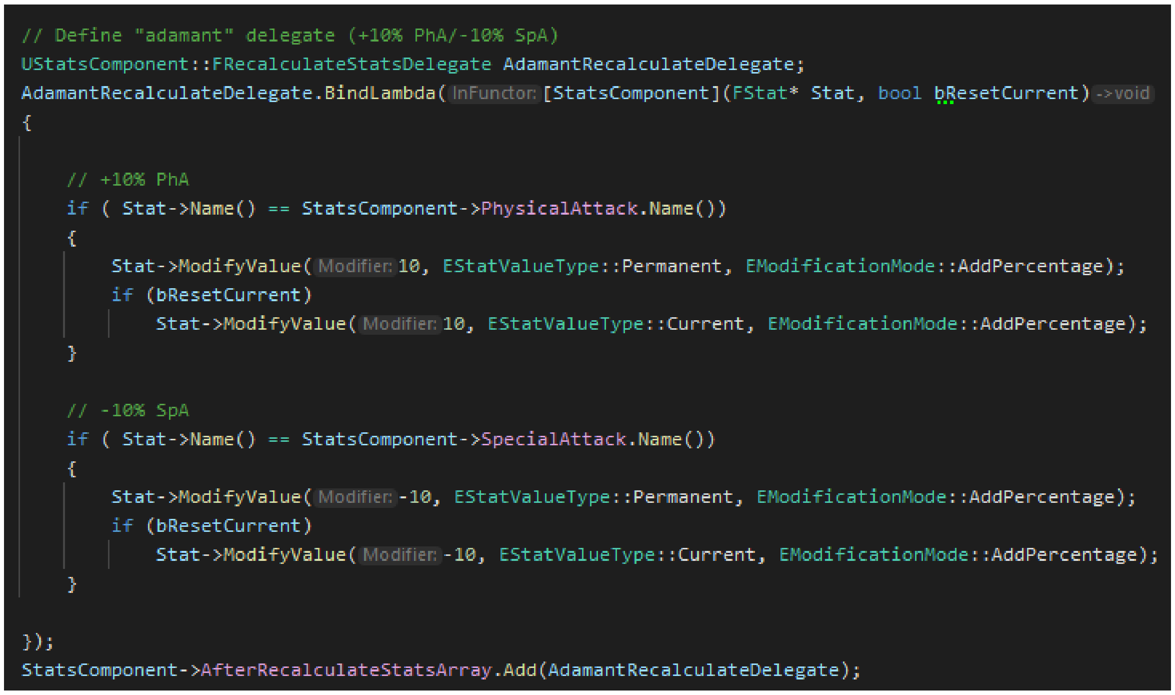
0.1 Structure

- EffectableComponents are ActorComponents that allow for delegation (effects). They have predefined places called “Outlets” that allow for code modification. Think of Outlets like electrical outlets waiting to be plugged into.
  - Let’s use StatsComponent as an example. Say we want a Pokémon-style “Adamant” nature (+10% PhA/−10%SpA). One such place for modification is in the function RecalculateStats. TODO: Update picture!



```
void UStatsComponent::RecalculateStats(const bool bResetCurrent)
{
    for(FStat* Stat : StatsArray)
    {
        ExecuteBeforeRecalculateStats(Stat, bResetCurrent);
        Stat->Update(GetLevel(), bResetCurrent);
        ExecuteAfterRecalculateStats(Stat, bResetCurrent);
    }
}
```

- Outlet **arrays** are variables inside of EffectableComponents. They hold Outlets whose delegates execute when needed.
  - TODO: Update this! Let’s use StatsComponent’s AfterRecalculateStatsArray in our example. In this case, after stats are recalculated (say, on level-up), the base PhA would increase by 10% and the base SpA would decrease by 10% (additively):



```
// Define "adamant" delegate (+10% PhA/-10% SpA)
UStatsComponent::FRecalculateStatsDelegate AdamantRecalculateDelegate;
AdamantRecalculateDelegate.BindLambda( InFunctor: [StatsComponent](FStat* Stat, bool bResetCurrent) ->void
{

    // +10% PhA
    if ( Stat->Name() == StatsComponent->PhysicalAttack.Name())
    {
        Stat->ModifyValue( Modifier: 10, EStatValueType::Permanent, EModificationMode::AddPercentage);
        if (bResetCurrent)
            Stat->ModifyValue( Modifier: 10, EStatValueType::Current, EModificationMode::AddPercentage);
    }

    // -10% SpA
    if ( Stat->Name() == StatsComponent->SpecialAttack.Name())
    {
        Stat->ModifyValue( Modifier: -10, EStatValueType::Permanent, EModificationMode::AddPercentage);
        if (bResetCurrent)
            Stat->ModifyValue( Modifier: -10, EStatValueType::Current, EModificationMode::AddPercentage);
    }

});
StatsComponent->AfterRecalculateStatsArray.Add(AdamantRecalculateDelegate);
```

- `EffectComponents` are `ActorComponents` that plug into `Outlets`. These come in many forms, but an easy example is a `Buff`. `TODO: Describe how this happens with pictures!`

0.2 List of `EffectableComponents` and `Outlet` Arrays

The following tables show all implemented `EffectableComponents` and their delegate arrays. Note the "base name" indicates existence of:

1. the delegate signature `FBaseNameSignature`;

2. the private before/after arrays of `Outlets`:
   `TArray<FBaseNameOutlet> BeforeBaseName`; and

3. a function for each before/after to execute the arrays: `ExecuteBeforeBaseName (...)`.

4. `AddBeforeBaseName`, a function to add an `Outlet` to the private array `BeforeBaseName` (which also puts it in the right order based on priority).

Note that the philosophy applies to what is *probable* rather than what is *possible*. Hence the list meant to be practical rather than exhaustive.

Table 1: Delegate Arrays for `LevelComponent`

TODO: Todo

Table 2: Delegate Arrays for `LevelComponent`

GetBaseExpYield	
▶ Before	`const float OriginalYield`, `float& Yield`
▶ After	`const float OriginalYield`, `const float ReturnedYield`
GetCXP	
▶ Before	`const uint32 OriginalCXP`, `int32& ReturnedCXP`
Note:	`ReturnedCXP` is `int32&` instead of `uint32&` for Blueprint compatability.
▶ After	`const uint32 OriginalCXP` `const int32 ReturnedCXP`
Note:	`ReturnedCXP` is `const int32` instead of `const uint32` for Blueprint compatability.
GetExpYield	
▶ Before	`const float OriginalYield`, `float& ReturnedYield`, `const uint16 DefeatedLevel`, `const uint16 VictoriousLevel`

Continued on next page

Table 2: Delegate Arrays for `LevelComponent` (Continued)

Note:	"Defeated" and "Victorious" levels are provided for flexibility (e.g., in case you want to yield exp differently based on level difference, although technically you could always back-calculate the level difference based on the equation and `OriginalYield`).
▶ After	`const float OriginalYied`, `const float ReturnedYield`, `const uint16 DefeatedLevel`, `const uint16 VictoriousLevel`
Note:	"Defeated" and "Victorious" levels are provided for symmetry with respect to the "Before" delegate (since `ReturnedValue` is already calculated, I can't think of why you would need them, but you never know!).
SetBaseExpYield	
▶ Before	`const float OldYield`, `float& AttemptedYield`

▶ After	`const float OldYield`
	`const float NewYield`

SetCXP	
▶ Before	`const uint32 OldCXP`, `int32& AttemptedCXP`
Note:	`AttemptedCXP` is `int32&` instead of `uint32&` for Blueprint compatability.

▶ After	`const uint32 OldCXP`
	`const uint32 NewCXP`

Note:	`UStatsComponent` subscribes to this in order to change stats on level change.

Table 3: Delegate Arrays for LevelComponent

TODO: Todo

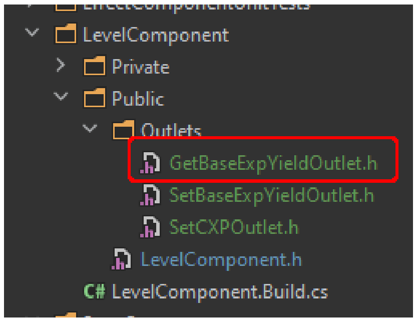
0.3 Making Your Own Outlet

As an example, let's use `BeforeGetBaseExpYield`. (You can imagine that this is an important Outlet for tweaking levelling curves.) Here's what to do:

1. **Plan ahead.** I would sincerely recommend you writing down what parameters your Outlet delegate takes on paper. We go to a few files and it's easy to be inconsistent.

2. **Go to the right directory.** We want to place the Outlet inside of `ULevelComponent`, so we'll start with that directory. If it doesn't contain an "Outlets" directory, create one and place your Outlet(s) there.

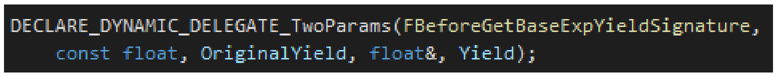
3. **Copy + paste file.** The easiest way is to copy + paste pre-existing Outlets. In this example, we'll copy + paste `SetCXPOutlet.h` and name the new file `GetBaseExpYield.h`.

   Note: this includes both `BeforeGetBaseExpYield` and `AfterGetBaseExpYield` functionality, but we'll only talk about the "Before" variant.

4. **Replace old name.** Open the new file and you'll still see the base name "SetCXP" everywhere. The easiest way is to do a find+replace "SetCXP" → "GetBaseExpYield". This replaces everything from the `.generated` include to the delegate signature. If you're curious, you can look more in-depth and replace instances one-by-one.

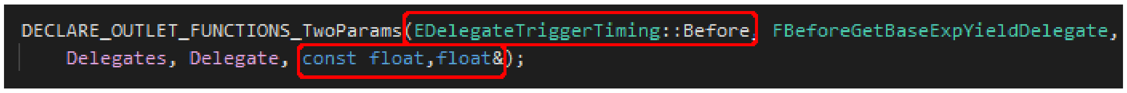
5. **Declare delegate signature.** In this case, we want the “Before” delegate signature to take two arguments: the original, unmodified yield and the one that will be returned from the `GetBaseExpYield` function.



```
DECLARE_DYNAMIC_DELEGATE_TwoParams(FBeforeGetBaseExpYieldSignature,
    const float, OriginalYield, float&, Yield);
```

You can also set the “After” signature in the same manner. *Note: yours might use more than two parameters or different parameter types. Modify accordingly.*

6. **Declare Outlet functions.** In order to be able to call `Execute` on your Outlet, you need to tell it a few things. The figure below displays a few things in red you should look at:



```
DECLARE_OUTLET_FUNCTIONS_TwoParams(EDelegateTriggerTiming::Before, FBeforeGetBaseExpYieldDelegate,
    Delegates, Delegate, const float,float&);
```

- Whether it’s a `Before` or `After` type Outlet. This affects execution based on priority:

Priorities

The lower the priority, the farther away it is from execution. If two priorities are tied, the older effect is executed first. Order is set externally by EffectsComponent. Order:

- Intrinsic “before” delegates (no Effect attached)
- “Before” delegates:
    - Priority 1
    - Priority 2.a (older)
    - Priority 2.b (newer)
    - ...
- [Function executes]
- “After” delegates:
    - ...
    - Priority 2.b (newer)
    - Priority 2.a (older)
    - Priority 1
- Intrinsic “after” delegates (have the final say)

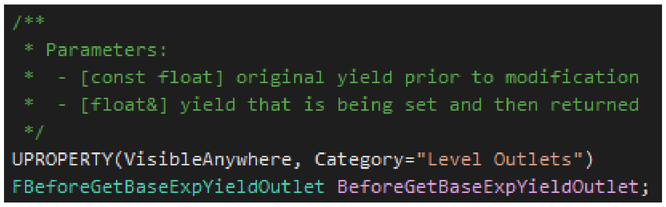
As an example, consider two delegates: one that says you can’t take damage no matter what (call the `UBuff` “Invincible”) and another that says damage against you can’t be avoided no matter what (call the `UDebuff` “Weakened”). What happens when the target takes damage? Well, it depends on priority:

- They’re probably subscribed to the Outlet in `UStatsComponent` called `BeforeModifyStat` with the target `FStat` being `Health`.
- Note that they’re both “Before” delegates.
- Let’s say Invincible has higher Priority. The result is the target takes damage because:
    1) Invincible first sets the damage to zero.
    2) Weakened then sets the damage to its original value.
- If Weakened has higher Priority, the result is flipped and the target takes no damage.

- The parameters you defined in the delegate's signature. I know, I know—anytime you repeat code, you're probably doing something wrong. The biggest issue here is the UHT. The main (but not only) issue is that you can't have `UPROPERTY`s inside macros or the property won't register. If you have a better way of automating this, *tell me!*
- Repeat for the "After" variant.

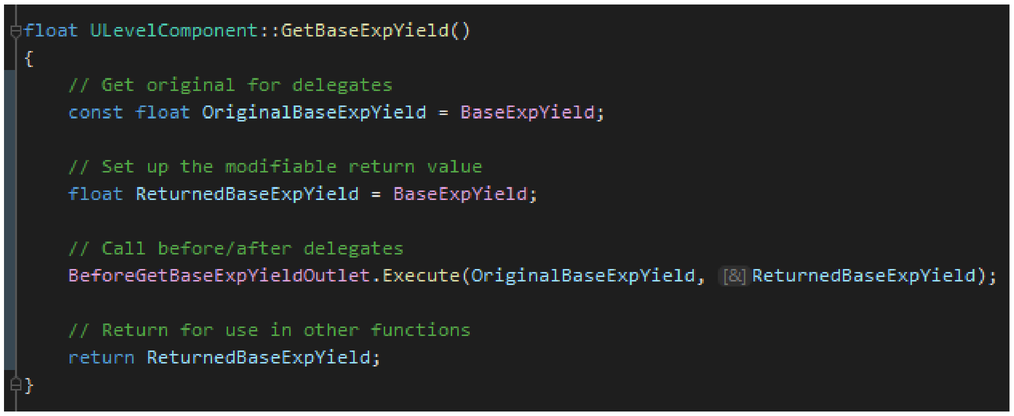
7. **Check number of parameters.** I make a point of this because I find it's my most common error. Make sure your declared signature *and* declared Outlet function macros have the correct number of params (two in our case). Explicitly, you might need to use `DECLARE_DYNAMIC_DELEGATE_FourParams(...)`.

8. **Declare `UPROPERTY`.** Inside the `UEffectableComponent` (in this example, `ULevelComponent`), declare the Outlet as a variable. Note that it's custom to have this `UPROPERTY` as public and in the "Outlets" category. It's also a good idea to comment the `UPROPERTY` with the parameters.



```
/**
 * Parameters:
 *  - [const float] original yield prior to modification
 *  - [float&] yield that is being set and then returned
 */
UPROPERTY(VisibleAnywhere, Category="Level Outlets")
FBeforeGetBaseExpYieldOutlet BeforeGetBaseExpYieldOutlet;
```

9. **Implement.** Now it's time to place your Outlet in the appropriate place(s). For our example, it's pretty simple: place it inside of `GetBaseExpYield` in `ULevelComponent`'s `.cpp` file.



```
float ULevelComponent::GetBaseExpYield()
{
    // Get original for delegates
    const float OriginalBaseExpYield = BaseExpYield;

    // Set up the modifiable return value
    float ReturnedBaseExpYield = BaseExpYield;

    // Call before/after delegates
    BeforeGetBaseExpYieldOutlet.Execute(OriginalBaseExpYield, [&] ReturnedBaseExpYield);

    // Return for use in other functions
    return ReturnedBaseExpYield;
}
```

Note that you might have to do things like cache original values. Also, it may not appear necessary to have both "Before" and "After" Outlets in a function like this. However, it is still recommended to do so.

10. **A note on complementary Outlets.** If you create a “Before” Outlet, you should also create an “After” Outlet. The biggest difference might be the delegate signature (e.g., reference “`&`” to `const`).

    - An example where this would be necessary is an animation delegate. You only want to fire a “bonus exp” animation *after* the amount of exp has been determined, checked, and is now constant.

0.4 Making Your Own Effects

Suppose you want to make your own effect from scratch. `TODO: todo`